Consolidated Edison Company of
New York, Inc.
31-01 20th Avenue
Long Island City NY 11105-2048
www.conEd.com

April 27, 2026

Mr. Justin Starr
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233-7014

Re: Consolidated Edison Company of New York, Inc.
Former Woodworth Avenue Works
Yonkers, New York
Operable Unit 2 Remedial Investigation Work Plan

Dear Mr. Starr:

The Consolidated Edison Company of New York, Inc. (Con Edison) is submitting for your review and approval the following Operable Unit (OU) 2 Remedial Investigation Work Plan (RIWP) to conduct field activities related to the Former Woodworth Avenue Works (the Site) in Yonkers, New York (Figure 1). The former MGP site, hereinafter referred to as OU-1, occupies 4.3 acres of land bounded by Woodworth Avenue to the east, Alexander Street to the west, Ashburton Avenue to the south, and Babcock Place to the north located in Yonkers, Westchester County, New York. OU-1 is composed of three blocks and seven lots, with the Metro-North Commuter Railroad running north-south, bisecting OU-1 into its western and eastern portions (Figures 2 and 3). A Remedial Investigation (RI) was implemented on OU-1 in 2021 by GEI Consultants, Inc., P.C. to investigate the nature and extent of chemical compounds within the soil and groundwater that may be associated with the former MGP operations. A Site description, history and activities and results of the RI are discussed in the NYSDEC-approved Remedial Investigation Report (RIR) dated April 2022.

Three adjacent properties have been investigated by third parties associated with other sites under NYSDEC remedial programs. The three properties are identified as the following:

- Poly Chrome East Site (NYDEC Site No. C360098) located on the south side of Ashburton Avenue.
- Poly Chrome West Site (NYDEC Site No. C360099) located on the west side of Alexander Street.
- Excelsior Bag Site (NYDEC Site No. C360190) located northwest of OU-1, on the west side of Alexander Street.

The locations of the investigation borings completed on those properties and reported to the NYSDEC are included on Figures 3 and 4 for reference.

OU-2 was established for off-Site areas where the nature and extent of impacts were not delineated during the Remedial Investigation or through the investigations completed by others on the adjacent properties. OU-2 includes the following areas:

- Area north of OU-1 and Babcock Place.
- Area west of Alexander Street between OU-1 and the Poly Chrome West Site.
- Area south of Ashburton Avenue and north of the Poly Chrome East Site.
- Adjacent area of the Hudson River.

OU-3 may be established for the adjacent area of the Hudson River to determine the presence of and delineating MGP impacts within subsurface sediment. OU boundaries are shown in Figure 2.

The scope of work included in this work plan is required to collect additional soil data within OU-1 and further delineate potential MGP-related impacts migrating side- and down-gradient of OU-1, referred to hereinafter as OU-2. This OU-2 RIWP includes four elements, as requested by NYSDEC, as follows:

- Collect additional analytical data for soils contaminants within OU-1 that were not conducted under the 2021 RI.
- Delineate the limits of MGP impacts to the south of OU-1 adjacent to Ashburton and Woodworth Avenues, and north of OU-1, adjacent Babcock Place and Alexander Street.
- Evaluate the construction of the 48-inch diameter brick sewer along Ashburton Avenue to assess potential preferential migration pathway for MGP impacts as it relates to a potential preferential migration pathway from this 48-inch brick sewer to the Hudson River.
- Evaluate potential MGP impacts present within sediments within the Hudson River adjacent the existing sewer outfall.

Remedial Investigation Scope of Work

Con Edison and its contractors have completed the RI sampling activities that were proposed as part of the New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH)-approved RI Work Plan entitled Remedial Investigation Work Plan, Former Woodworth Avenue Works (Site No. 360164), Yonkers, New York dated September 2020. The additional OU-1 and OU-2 RI activities proposed below will also be conducted in accordance with this work plan. The remainder of this letter describes the proposed scope of work.

The RI activities will be conducted in accordance with the Site-specific Health and Safety Plan (HASP), the Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and Community Air Monitoring Plan (CAMP) included as Appendices A through D. The CAMP will be implemented at the Site during intrusive field activities. Table 1 includes a list of proposed samples, locations, and rationale.

Additional OU-1 Soil Boring Installation

Additional soil borings are proposed within OU-1 to collect soil data for constituents not analyzed during the RI. Three borings are proposed on each the eastern and western portions of OU-1. The proposed soil boring locations are shown in Figure 4. Actual drilling locations will be determined based upon the subsurface utility clearance activities.

- Three borings (SB-301, SB-302, and SB-303) will be advanced on the west portion of OU-1 (Greyston Bakery).
- Three borings (SB-311, SB-312, and SB-313) will be advanced on the east portion of OU-1 (Woodworth Avenue Properties).

Three soil samples per boring will be analyzed for:

- Volatile Organic Compounds (VOCs) via EPA Method 8260
- Semivolatile Organic Compounds (SVOCs) via EPA Method 8270
- Polychlorinated Biphenyls (PCBs) via EPA Method 8082
- Pesticides via EPA Method 8081B
- Herbicides via EPA Method 8151A
- Trivalent and Hexavalent Chromium via EPA Method 7196A
- NYSDEC 40-list Per- and Polyfluoroalkyl Substances (PFAS) via EPA Method 1633

Three soil samples will be collected from each boring location. A soil sample will be collected from within each the shallow (0-5 ft below original grade or clean site cover), intermediate (greatest impacts observed or at the water table interface if no impacts are observed), and deep (completion depth of boring) zones from intervals with the highest degree of impacts based on visual impacts and PID readings. If no impacts are encountered, then a sample will be collected at the bottom of each respective zone. A clean site cover is present on the western side of OU 1. The shallow sample will be collected below this cover. The cover will be repaired once the boring is complete. At boring location SB-312, the ground surface was recently raised by approximately 20 feet. An additional sample will be collected within the recent fill material at SB-213 for the following analyses:

- Volatile Organic Compounds (VOCs) via EPA Method 8260
- Semivolatile Organic Compounds (SVOCs) via EPA Method 8270
- Target Analyte List (TAL) metals via EPA Method 6000/7000 series
- Total cyanide via EPA Method 9012
- Polychlorinated Biphenyls (PCBs) via EPA Method 8082
- Pesticides via EPA Method 8081B
- Herbicides via EPA Method 8151A

- Trivalent and Hexavalent Chromium via EPA Method 7196A
- NYSDEC 40-list Per- and Polyfluoroalkyl Substances (PFAS) via EPA Method 1633

Soil borings will be advanced to 40 feet. Soil boring SB-312 will be advanced to 60 feet.

All soil borings will be installed with a sonic drill rig in accordance with drilling methods and procedures in the FSP and 2020 RI Work Plan. At a minimum, the first 5 feet of each soil boring will be excavated by non-mechanical means (e.g., vacuum truck, post-hole digger) as part of the utility clearance activities.

Soil samples will be collected and logged continuously to the bottom of the boring. Following the completion of overburden soil borings, each will be abandoned by tremie grouting the boring from the bottom to the ground surface. The clean site cover on the western side of OU 1 will be repaired once the borings are complete.

OU-2 Soil Boring Installation

One soil boring (SB-206), located south of Ashburton Avenue near Woodworth Avenue, was proposed during the RI, but not installed due to the above and below ground utilities present. The proposed location is now south of the utilities on private property. Two soil borings located to the north of Babcock Place installed during the RI (SB-217 and SB-218) and soil borings completed by others on adjacent properties to the northwest exhibited olfactory and visual impacts potentially associated with the former MGP Site operations. Four additional soil borings (SB-304 to SB-307) are proposed to delineate the impacts associated with the former MGP Site in the northern direction. Two additional soil borings (SB-308 and SB-310) are proposed to delineate the impacts associated with the former MGP Site in the southwest direction along Alexander Street. The proposed soil boring locations are shown in Figure 4. Actual drilling locations will be determined based upon the subsurface utility clearance activities and access.

Two soil samples per boring will be analyzed for:

- Volatile Organic Compounds (VOCs) via EPA Method 8260D
- Semi-volatile Organic Compounds (SVOCs) via EPA Method 8270E
- Target Analyte List (TAL) Metals via EPA Method 6000/7000 Series
- Total Cyanide via EPA Method 9012B
- Fingerprint/Forensic Analysis via EPA Method 8015 (if NAPL is observed)

The first soil sample will be collected at the depth with the highest degree of impacts based on visual impacts and PID readings. The second soil sample will be collected below observed impacts to delineate the vertical extent of contamination. If no impacts are encountered, then a sample will be collected at the water table.

Soil borings will be advanced to a depth of 10 feet below visual impacts observed at the closest previous investigation boring, or 10 feet below visual impacts, whichever is greater. If MGP-

related visual impacts are observed, an additional soil boring will be offset approximately 50 feet to the north or south, until no impacts are observed.

Installation of utilities was completed along Ashburton Avenue and Alexander Street in 2023 and 2024 relating to the City of Yonkers utility projects and adjacent sites. Opportunistic observations and sampling were completed when available during this utility work. Soil from the utility trench was logged for lithology, visually inspected for impacts, and field screened with a PID. The soil samples were analyzed for:

- VOCs via EPA Method 8260D
- SVOCs via EPA Method 8270E
- TAL Metals via EPA Method 6000/7000 Series
- Total Cyanide via EPA Method 9012B
- Fingerprint/Forensic Analysis via EPA Method 8015 (if NAPL is observed)

Soil samples were collected at the depth with the highest degree of impacts based on visual impacts and PID readings. If no impacts were encountered, then a sample was collected at the base of the excavation.

Previously completed opportunistic observations and sampling, and any additional observations and sampling completed during the course of this RI, will be reported as part of this RI report.

Sewer System Investigation

A combined sewer overflow (CSO) conduit is located adjacent to the southern property boundary of the Site. The brick lined CSO was constructed in the mid 1800's and extends from the corner of the former MGP property located at the corner of Ashburton and Woodworth Avenue to the west, along Ashburton Avenue, towards the Hudson River. At one point in time, the CSO could be observed above the level of the river as it extended from the former shoreline along the Hudson River. Over time, the Hudson River was filled in to create made land and thus the CSO was encapsulated by material and was fully contained under the ground surface. GEI, Con Edison, and the NYSDEC determined that if the CSO had a compromised integrity, or if CSO bedding material was present, that it could be a conduit for MGP source material to leave the Site and migrate towards the outfall location and ultimately the Hudson River. The 48-inch diameter brick sewer along Ashburton Avenue is a potential preferential migration pathway for MGP impacts.

During the Remedial Investigation, the sewer system in this area was unable to be completely evaluated. There was an attempt to find and assess the sewer system by excavation via soft digging method, however the field conditions and presence of potential utilities did not allow for this method. A camera inspection was utilized to gain video footage of the inside of the sewer and no product was seen, however this method was not very successful in helping to understand potential pathways to the Hudson River the sewer offers.

Sewer construction documents will be requested via Freedom of Information Law ("FOIL") Request to the City of Yonkers and reviewed to determine if any bedding materials used in the construction of the CSO have the potential to create a preferential migration pathway for MGP source material from OU-1.

We will seek access from the City of Yonkers to conduct a video inspection inside of the sewer pipe between Ashburton Avenue and the Hudson River. During the previous sewer inspection, the CSO was blocked near Ashburton Avenue. For this inspection we would seek access to enter the sewer from a manhole on private property. This would allow inspection of the sewer beyond the previous blocked area.

Two soil borings (SB-308 and 309) are proposed on the northern and southern sides of the Ashburton Avenue CSO to inspect materials on each side of the CSO. Soil boring SB-309 will be advanced to a depth of 30 feet bgs. The proposed soil boring locations are shown in Figure 4. Actual drilling locations will be determined based upon the subsurface utility clearance activities and access.

One soil sample per boring will be analyzed for:

- VOCs via EPA Method 8260C
- SVOCs via EPA Method 8270D
- TAL Metals via EPA Method 6000/7000 Series
- Total Cyanide via EPA Method 9012B
- Fingerprint/Forensic Analysis via EPA Method 8015 (if NAPL is observed)

The soil sample will be collected at the depth with the highest degree of impacts based on visual impacts and PID readings. If no impacts are encountered, then a sample will be collected at the elevation of the bottom of the CSO, which is estimated to be 10 feet bgs.

Sediment Sampling in the Hudson River

Previous site investigations have established that the groundwater flows west to southwest from the Site toward the Hudson River. The Hudson River surface water and sediment has been listed as potential exposure point due to downgradient migration of groundwater constituents of concern (COCs) and discharge to surface water.

Samples were collected using a hand auger during low tide from the Hudson River in the immediate vicinity of the sewer outfall that extends from Ashburton Avenue during the RI. Due to the difficulty collecting sediment samples in the water, only a limited number of samples were collected.

Additional sediment samples will be collected using a hand auger at low tide within the Hudson River in the immediate vicinity of the sewer outfall to further classify the COCs in the surface water sediment. To allow for the best sampling conditions sediment samples will be collected

from the river at the lowest tide events during the full moon. During the full moon, the gravitational pull of the moon is in line with the gravitational pull of the sun, producing up to a 20 percent reduction in low tides. A lower tide will aid in creating a more efficient environment to collect the surface water sediment samples.

Six sediment samples (SED-300 to SED-306) will be advanced 2 feet bgs by hand to assess MGP impacts potentially discharging from the sewer or bedding material to the Hudson River. The locations of each proposed sediment sample location are included in Figure 4. One sediment sample per location will be analyzed for:

- VOCs via EPA Method 8260C
- SVOCs via EPA Method 8270D
- TAL Metals via EPA Method 6000/7000 Series
- Total Cyanide via EPA Method 9012B
- Fingerprint/Forensic Analysis via EPA Method 8015 (if NAPL is observed)

The sediment sample will be collected at the location with the highest degree of impact based on visual and olfactory observations and PID readings. If no impacts are encountered, a sample will be collected from the top 6-inches of sediment. If a DNAPL seep is observed, an additional sample will be collected in this area. If NAPL is identified in the samples collected within the Hudson River, forensic analysis will be conducted on the sediment NAPL to compare it to on-site NAPL to determine if the two NAPL substances are related.

Quality Assurance/Quality Control Samples

The RIWP QAPP details the number of quality assurance/quality control (QA/QC) samples that will be collected. QA/QC samples will be collected on a frequency of 1 set per 20 samples. Each set of QA/QC samples will consist of a blind duplicate, a trip blank, an equipment rinsate blank (field duplicate), and a MS and MSD.

Investigation Derived Waste

Investigation-derived waste (IDW) will be containerized in appropriate waste containers and staged in an onsite area prior to offsite disposal. Soil cuttings, personal protective equipment (PPE), and spent disposable sampling materials will be placed in new DOT-approved steel 55-gallon drums. Decontamination water and drilling water will be stored in new closed-top DOT-approved steel 55-gallon steel drums. Storage vessels will be appropriately labeled with the contents, generator, location, and date for appropriate offsite transportation and disposal by GEI.

Survey

The boring locations will be surveyed by a New York State Licensed Land Surveyor. The elevation of each sample location will be determined to ±0.01 foot and will be tied into the Site

benchmark. All locations and elevations will be referenced to the New York State Plane Eastern Zone North American Datum 1983 and North American Vertical Datum 1988.

Data Validation and Management

Soil samples will be analyzed by a NYSDOH environmental lab approval program (ELAP) accredited laboratory. The laboratory will provide analytical results in a New York State Category B data deliverable format. The data will be validated in accordance with New York State Analytical Service Protocols (ASP) and a data usability summary report (DUSR) will be prepared documenting the adequacy of the analytical data obtained from the laboratory and discussing any pertinent data excursions or limitations on the use of the data. All validated laboratory data will be submitted to the NYSDEC Environmental Information Management System.

Report Preparation

At the completion of the field work, a RI Report will be prepared for submittal to the NYSDEC. The RI Report will meet the reporting requirements of the NYSDEC *DER-10 Technical Guidance for Site Characterization and Remedial Investigation,* dated May 2010 and include all findings and data from this investigation as well as available and relevant data from neighboring BCP investigations and sampling completed during utility work, boring logs, and overburden soil cross sections.

Schedule

Field work for the OU-2 RI will be scheduled after receipt of NYSDEC approval of this work plan. We anticipate that intrusive work can be completed in approximately 4 weeks. Scheduling of the work on adjacent properties will be dependent on the ability to secure access agreements.

If you have any questions or require additional information, please feel free to contact me at (718) 204-4331 or by e-mail at abtm@coned.com.

Sincerely,

Melissa Abt, P.G.
Project Manager
EH&S, Remediation
Con Edison

Enc.

TABLES

Table 1. Sample Location Rationale
OU-2 Remedial Investigation Work Plan
Woodworth Avenue Works Former MGP
Yonkers, New York

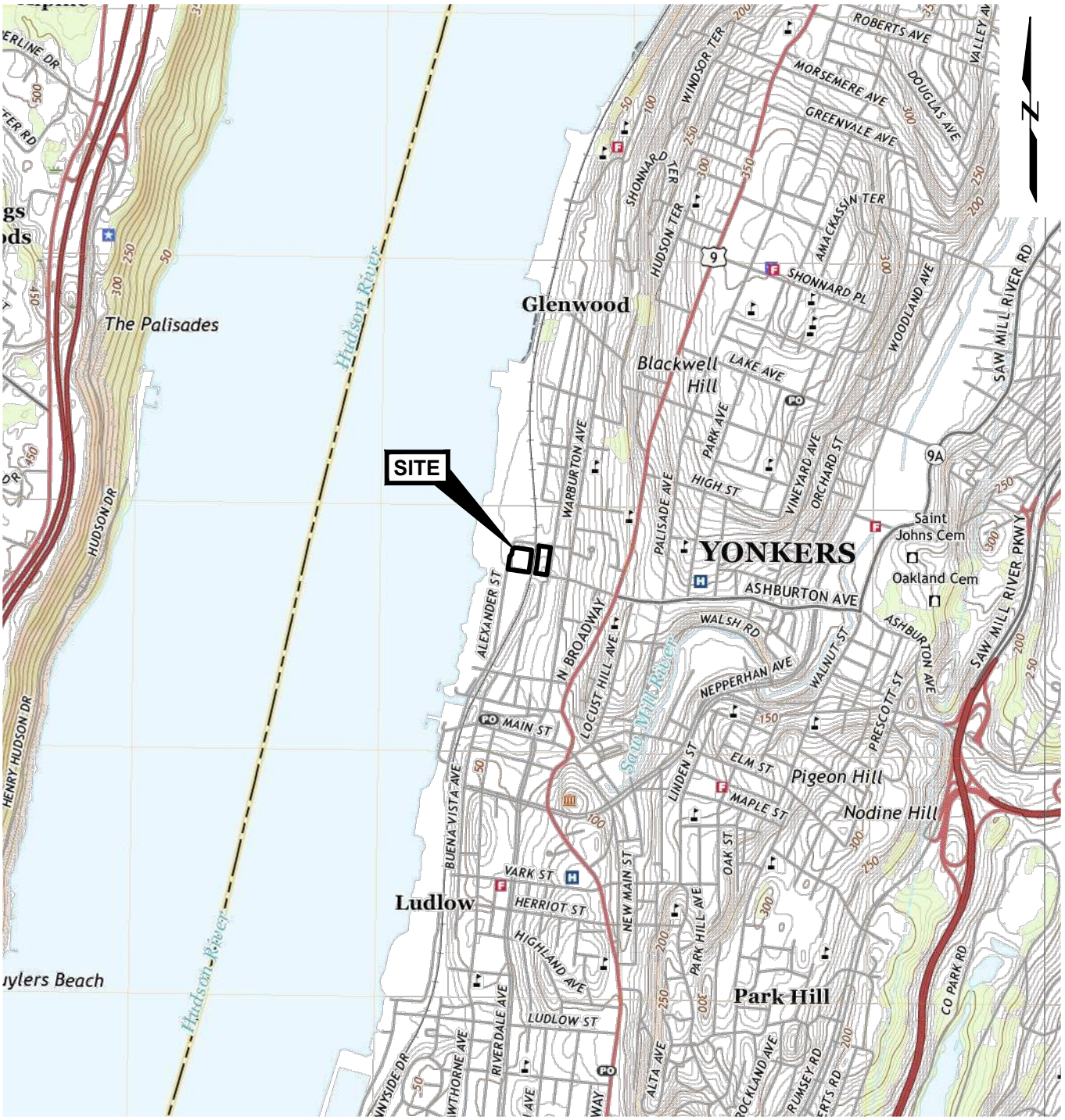
Sample Location	Sample Location Rationale	Exploration Depth (feet bgs)	Sample Collection Criteria	Number of Soil Samples at Each Location	Sample Analyses									
					VOCs (8260D)	SVOCs (8270E)	TAL Metals (6000/7000 Series)	Total Cyanide (9012B)	Fingerprint (8015)[1]	PCBs (8082)	Pesticides (8081B)	Herbicides (8151A)	Trivalent and Hexavalent Chromium (7196A)	PFAS (1633)
Subsurface Soil Borings														
SB-206	Evaluate whether there are impacts present to the south of Ashburton Avenue to help delineate the extent of MGP-related impacts and if NAPL is migrating off-site.	50	Evaluate soil quality at depth with the highest degree of impacts (highest PID readings and NAPL coated soil). If no impacts are observed, a sample will be collected at the water table. Evaluate soil quality at the completion depth of boring.	2	X	X	X	X	X					
SB-301 SB-302 SB-303	Evaluate impacts on OU 1 west of the Metro-North Railroad to help delineate the extent of MGP-related impacts.	40	Evaluate soil quality in the top 5 feet below the soil cover (expected to be ~4 feet thick). Evaluate soil quality at depth with the highest degree of impacts (highest PID readings and NAPL coated soil). If no impacts are observed, a sample will be collected at the water table. Evaluate soil quality at the completion depth of boring.	3	X	X				X	X	X	X	X
SB-304 SB-305 SB-306 SB-307	To delineate the impacts associated with the former MGP Site in the northern direction.	90	Evaluate soil quality at depth with the highest degree of impacts (highest PID readings and NAPL coated soil). If no impacts are observed, a sample will be collected at the water table. Evaluate soil quality at the completion depth of boring.	2	X	X	X	X	X					
SB-308	Evaluate whether the fill material surrounding the 48-inch diameter brick sewer along Ashburton Avenue acts as preferential migration pathway for MGP impacts. To delineate the impacts associated with the former MGP Site in the southwestern direction.	70	Evaluate soil quality at depth with the highest degree of impacts (highest PID readings and NAPL coated soil). If no impacts are observed, a sample will be collected at the water table. Evaluate soil quality at the completion depth of boring.	2	X	X	X	X	X					
SB-309	Evaluate whether the fill material surrounding the 48-inch diameter brick sewer along Ashburton Avenue acts as preferential migration pathway for MGP impacts.	30	Evaluate soil quality at depth with the highest degree of impacts (highest PID readings and NAPL coated soil). If no impacts are observed, a sample will be collected at the elevation of the bottom of the sewer, which is estimated to be 10 feet bgs.	1	X	X	X	X	X					
SB-310	To delineate the impacts associated with the former MGP Site in the southwestern direction.	70	Evaluate soil quality at depth with the highest degree of impacts (highest PID readings and NAPL coated soil). If no impacts are observed, a sample will be collected at the water table. Evaluate soil quality at the completion depth of boring.	2	X	X	X	X	X					

Table 1. Sample Location Rationale
OU-2 Remedial Investigation Work Plan
Woodworth Avenue Works Former MGP
Yonkers, New York

Sample Location	Sample Location Rationale	Exploration Depth (feet bgs)	Sample Collection Criteria	Number of Soil Samples at Each Location	Sample Analyses									
					VOCs (8260D)	SVOCs (8270E)	TAL Metals (6000/7000 Series)	Total Cyanide (9012B)	Fingerprint (8015)[1]	PCBs (8082)	Pesticides (8081B)	Herbicides (8151A)	Trivalent and Hexavalent Chromium (7196A)	PFAS (1633)
Subsurface Soil Borings (continued)														
SB-311 SB-313	Evaluate impacts on OU 1 east of the Metro-North Railroad to help delineate the extent of MGP-related impacts.	40	Evaluate soil quality in the top 5 feet. Evaluate soil quality at depth with the highest degree of impacts (highest PID readings and NAPL coated soil). If no impacts are observed, a sample will be collected at the water table. Evaluate soil quality at the completion depth of boring.	3	X	X				X	X	X	X	X
SB-312	Evaluate impacts on OU 1 east of the Metro-North Railroad to help delineate the extent of MGP-related impacts.	60	Evaluate soil quality of the recent fill material (top 20 feet) Evaluate soil quality in the top 5 feet below recent fill (20-25 feet). Evaluate soil quality at depth with the highest degree of impacts (highest PID readings and NAPL coated soil). If no impacts are observed, a sample will be collected at the water table. Evaluate soil quality at the completion depth of boring.	4	X	X	X[2]	X[2]		X	X	X	X	X
Sediment Samples														
SED-300 SED-301 SED-302 SED-303 SED-304 SED-305	Evaluate sediment quality near the sewer outfall to assess MGP impacts potentially discharging from the sewer or fill material surrounding the sewer to the Hudson River.	1	Evaluate sediment quality at the location with the highest degree of impact based on visual and olfactory observations and PID readings. If no impacts are encountered, a sample will be collected from the top 6-inches of sediment. If a DNAPL seep is observed, an additional sample will be collected in this area.	1	X	X	X	X	X					

Notes:
Chemical analysis test methods specified are from U.S. EPA SW-846 test methods
EPA - Environmental Protection Agency
VOCs - Volatile Organic Compounds
SVOCs - Semivolitile Organic Compounds
TAL - Target Analyte List
PCBs - Polychlorinated Biphenyls
PFAS - Per- and Polyfluoroalkyl Substances
1 Fingerprint analysis will be conducted if NAPL is observed
2 To be analyzed from recent fill material only

FIGURES



0 2000 4000

SCALE, FEET

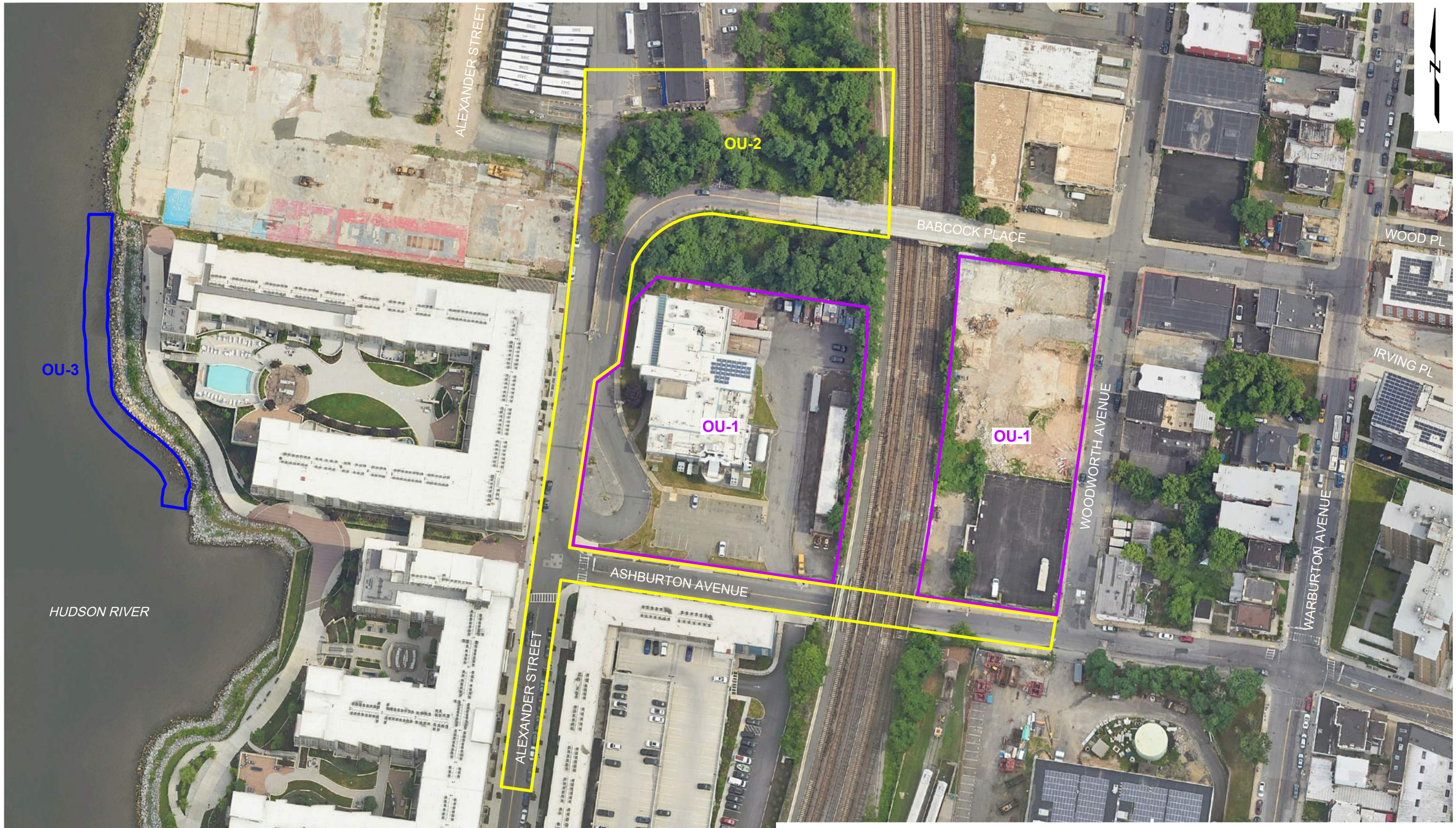


SOURCE:

USGS TOPOGRAPHIC QUADRANGLES, 7.5 MINUTE SERIES:
MOUNT VERNON AND YONKERS, NY, 2019.
NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88)
10-FOOT CONTOUR INTERVAL

OU-2 Remedial Investigation Work Plan Woodworth Avenue Works Former MGP Site City of Yonkers, New York	GEI Consultants	SITE LOCATION MAP
Consolidated Edison Company of New York New York, New York	Project 2101005	April 2026 Fig. 1

---- B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\00_CAD\Figures\OU2RIWP\1_2101005_O2RIWP_SLM.dwg - 9/26/2023



0 100 200

SCALE: 1" = 100'

SOURCE:

GOOGLE EARTH PRO, ©2022 GOOGLE LLC,
IMAGE DATE: 6/13/2022.

OU-2 Remedial Investigation Work Plan
Woodworth Avenue Works Former MGP Site
City of Yonkers, New York

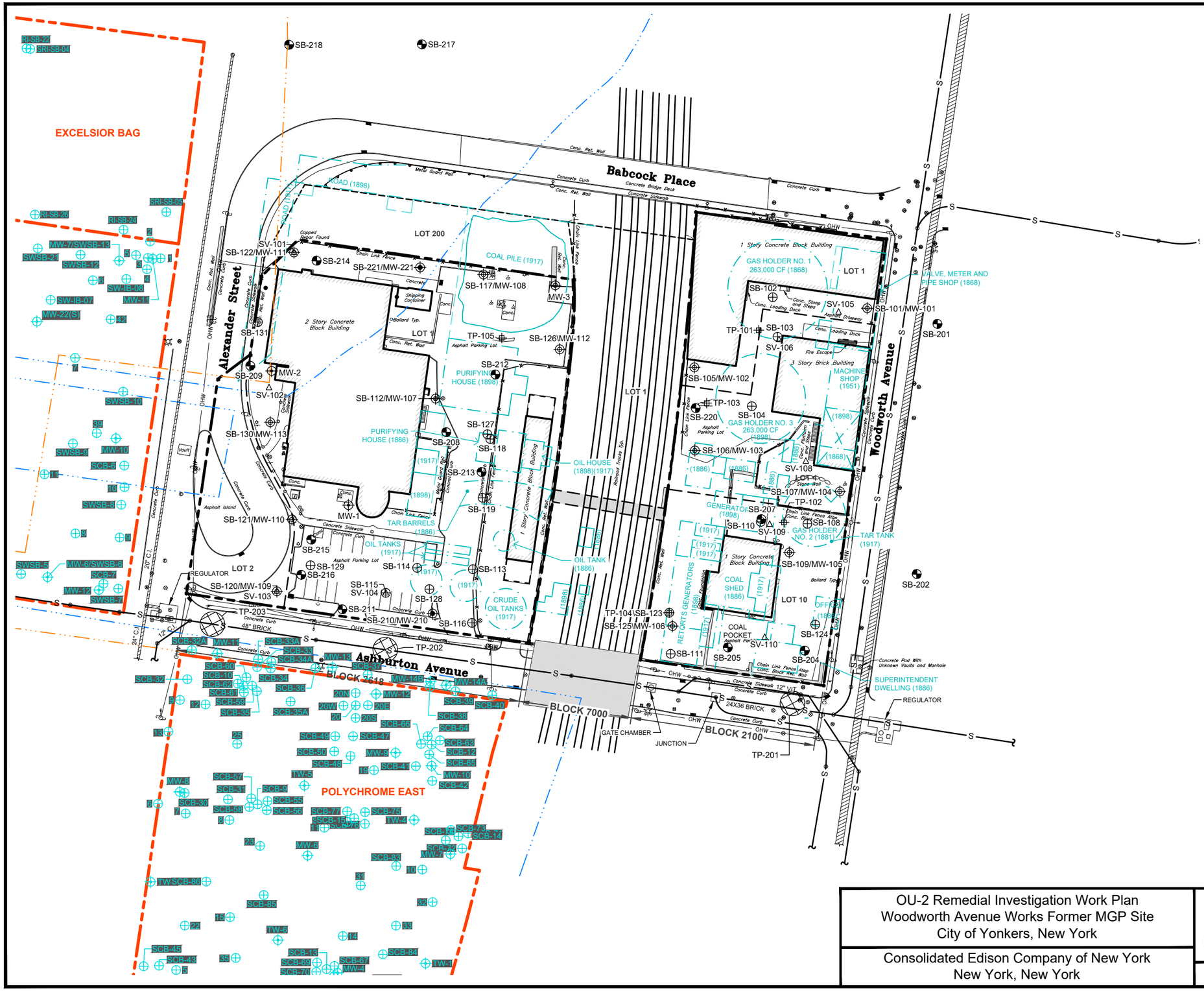
Consolidated Edison Company of New York
New York, New York

GEI Consultants

OPERABLE UNITS

Project 2101005 | April 2026 | Fig. 2

---- B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\00_CAD\Figures\OU2RIWP\2_2101005_O2RIWP_OUS.dwg - 9/27/2023



LEGEND:

SAMPLE LOCATIONS

- MONITORING WELL/SOIL BORING (REMEDIAL INVESTIGATION)
- SOIL BORING (REMEDIAL INVESTIGATION)
- TEST PIT (REMEDIAL INVESTIGATION)
- MONITORING WELL (PREVIOUS INVESTIGATION)
- MONITORING WELL/SOIL BORING (SITE CHARACTERIZATION)
- SOIL BORING (SITE CHARACTERIZATION)
- SOIL VAPOR SAMPLE (SITE CHARACTERIZATION)
- TEST PIT (SITE CHARACTERIZATION)

OFFSITE SAMPLE LOCATIONS COMPLETED BY OTHERS

- MONITORING WELL
- SOIL BORING
- PROPERTY BOUNDARY
- CHAIN-LINK FENCE
- CURRENT STRUCTURE
- FORMER STRUCTURE
- 1968 SHORELINE
- 1881 SHORELINE

SOURCES:

1. PLAN BASED ON *FIGURE 4: PROPOSED SAMPLING LOCATION* PREPARED BY ARCADIS, SCALE: 1" = 50', DATE: 8/1/2008.
2. SURVEY OF PREVIOUS AND SUPPLEMENTAL WELLS, SOIL BORINGS TEST PITS AND SOIL VAPOR POINTS BASED ON *SHEET 1 OF 1: BOUNDARY SURVEY PREPARED FOR GEI CONSULTANTS,* PREPARED BY TEC LAND SURVEYING, SCALE: 1" = 30', DATE: 8/15/2019.
3. WORLD IMAGERY LAYER FROM ARCGIS.COM, SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.

0 80 160

SCALE: 1" = 80'

OU-2 Remedial Investigation Work Plan
Woodworth Avenue Works Former MGP Site
City of Yonkers, New York

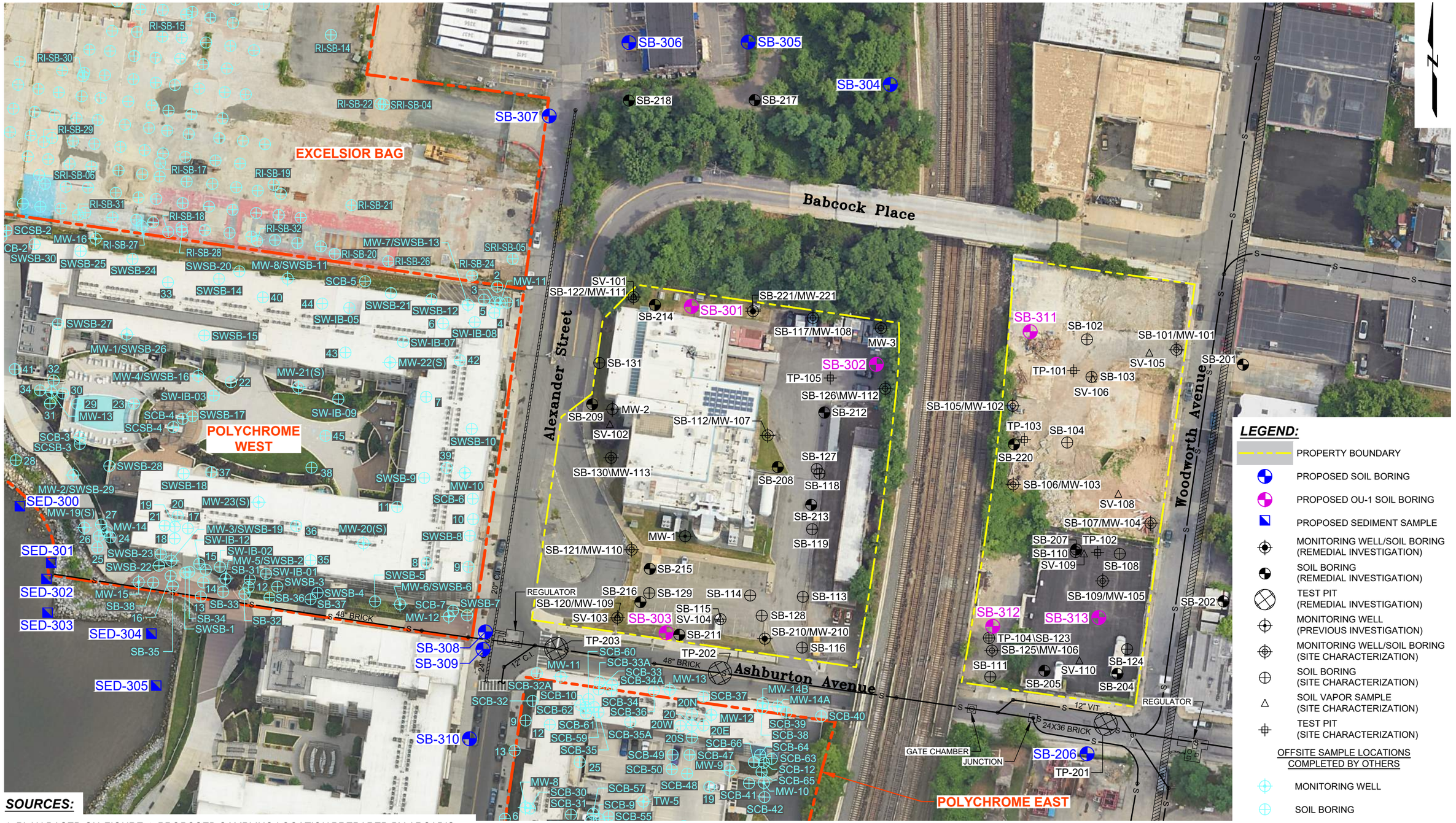
Consolidated Edison Company of New York
New York, New York

GEI Consultants

CURRENT AND HISTORIC STRUCTURES AND PREVIOUS SAMPLE LOCATION MAP

Project 2101005 | April 2026 | Fig. 3

---- B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\00_CAD\Figures\OU2RIWP\3-4_2101005_O2RIWP_SAMP.dwg - 12/22/2023



LEGEND:

- PROPERTY BOUNDARY
- PROPOSED SOIL BORING
- PROPOSED OU-1 SOIL BORING
- PROPOSED SEDIMENT SAMPLE
- MONITORING WELL/SOIL BORING (REMEDIAL INVESTIGATION)
- SOIL BORING (REMEDIAL INVESTIGATION)
- TEST PIT (REMEDIAL INVESTIGATION)
- MONITORING WELL (PREVIOUS INVESTIGATION)
- MONITORING WELL/SOIL BORING (SITE CHARACTERIZATION)
- SOIL BORING (SITE CHARACTERIZATION)
- SOIL VAPOR SAMPLE (SITE CHARACTERIZATION)
- TEST PIT (SITE CHARACTERIZATION)

OFFSITE SAMPLE LOCATIONS COMPLETED BY OTHERS

- MONITORING WELL
- SOIL BORING

SOURCES:

1. PLAN BASED ON *FIGURE 4: PROPOSED SAMPLING LOCATION* PREPARED BY ARCADIS, SCALE: 1" = 50', DATE: 8/1/2008.
2. SURVEY OF PREVIOUS AND SUPPLEMENTAL WELLS, SOIL BORINGS TEST PITS AND SOIL VAPOR POINTS BASED ON *SHEET 1 OF 1: BOUNDARY SURVEY PREPARED FOR GEI CONSULTANTS,* PREPARED BY TEC LAND SURVEYING, SCALE: 1" = 30', DATE: 8/15/2019.
3. GOOGLE EARTH PRO, ©2022 GOOGLE LLC, IMAGE DATE: 6/13/2022.

0 80 160

SCALE: 1" = 80'

OU-2 Remedial Investigation Work Plan
Woodworth Avenue Works Former MGP Site
City of Yonkers, New York

Consolidated Edison Company of New York
New York, New York

GEI Consultants

PROPOSED SAMPLE LOCATION MAP

Project 2101005 | April 2026 | Fig. 4

---- B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\00_CAD\Figures\OU2RIWP\3-4_2101005_O2RIWP_SAMP.dwg - 12/22/2023

APPENDIX A – HEALTH AND SAFETY PLAN



GEI Consultants

Consulting
Engineers and
Scientists

Health and Safety Plan

Former Woodworth Avenue Works

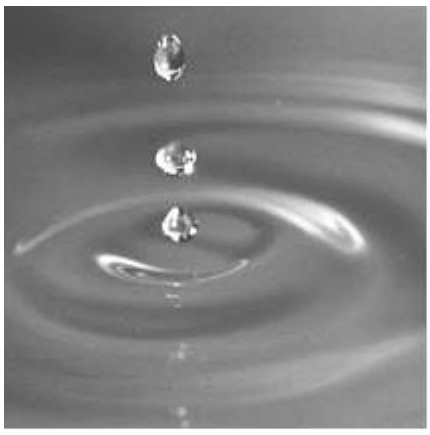
Yonkers, New York
Site ID: V00564

Prepared For:
Consolidated Edison Company of New York
31-01 20th Avenue
Astoria, NY 11105

Submitted by:
GEI Consultants, Inc.
5586 Post Road, Suite 1
East Greenwich, RI 02818
401.533.5152

October 2023

Project No. 2101005 and 2201010



Melissa Felter, P.G.
Project Manager

Jessie Papageorge
Regional Safety Manager

Table of Contents

1. Emergency Contact Information 1

2. Background Information 2
2.1 General 2
2.2 Project Description 3
2.3 Site Description 3
2.4 Con Edison Corporate Environmental, Health and Safety Procedures 3

3. Statement of Safety and Health Policy 5
3.1 GEI 5
3.2 Con Edison 5
3.3 Contractors 5

4. Hazard/Risk Analysis 7
4.1 Personal Safety 7
4.2 Activity Hazard Analysis 8
4.2.1 Handling Drums and Containers 16
4.2.2 Utilities 16
4.2.2.1 Underground Utilities 16
4.2.2.2 Overhead Utilities 17
4.2.3 Excavations and Trenches 17
4.2.4 Fire and Explosion 18
4.2.5 Heat Stress 18
4.2.6 Cold Stress 18
4.2.7 Noise 19
4.2.8 Hand and Power Tools 19
4.2.9 Slips, Trips, and Falls 19
4.2.10 Manual Lifting 19
4.2.11 Projectile Objects and Overhead Dangers 19
4.2.12 Cuts and Lacerations 20
4.3 Chemical Hazards 20
4.3.1 Volatile Organic Compounds (VOCs) 20
4.3.2 Coal Tar and Coal Tar Products 21
4.3.3 Heavy Metals 21
4.3.4 Polychlorinated Biphenyls 23
4.3.5 Hydrogen Sulfide 23
4.3.6 Evaluation of Organic Vapor Exposure 23
4.3.7 Evaluation of Respirable Dust Inhalation 24
4.3.8 Evaluation of Skin Contact and Absorption 24
4.3.9 Other Chemical Hazards 24
4.4 Biological Hazards 31
4.4.1 Poisonous Plants 31

4.4.2 Ticks 32
4.4.2.1 Lyme Disease 32
4.4.2.2 Rocky Mountain Spotted Fever 32
4.4.2.3 Prevention 33
4.4.3 Mosquito- Borne Disease – West Nile Virus 33
4.4.4 Wasps and Bees 34
4.4.5 Sun Exposure 34

5. Personal Protective Equipment 35
5.1 OSHA Requirements for PPE 36

6. Key Project Personnel/Responsibilities and Lines of Authority 37
6.1 GEI Personnel 37
6.1.1 GEI Project Manager 37
6.1.2 GEI Corporate Health and Safety Officer 38
6.1.3 GEI Site Safety Officer 38
6.1.4 GEI Field Personnel 39
6.1.5 Lines of Authority will be as follows: 39
6.2 Subcontractors 40

7. Training Program 41
7.1 HAZWOPER Training 41
7.2 Annual 8-Hour Refresher Training 41
7.3 Supervisor Training 41
7.4 Site-Specific Training 41
7.5 On-Site Safety Briefings 42
7.6 First Aid and CPR 42

8. Medical Surveillance Program 43

9. Monitoring 44

10. Site Control Measures 47
10.1 Site Zones 47
10.2 Buddy System 48
10.3 Sanitation for Temporary Work Sites 48
10.4 Illumination 48

11. Accident Reporting 49
11.1 Incident Reporting 49
11.1.1 Injury Triage Service 50

12. Decontamination Procedures 51
12.1 Personnel Decontamination Station 51
12.2 Heavy Equipment Decontamination 52
12.3 Decontamination Equipment Requirements 52

13. Supplemental Contingency Plan Procedures 53

13.1 Hazard Communication Plan 53
13.2 Fire 53
13.3 Medical Support 53
13.4 Severe Weather 53
13.5 Spills or Material Release 54
13.6 Alcohol and Drug Abuse Prevention 55
13.7 Working Around New York City Trees 55

14. Health and Safety Plan Sign-Off 56

Tables

1. Emergency Contact Information
2. Activity Hazard Analysis
3. Chemical Data
4. Summary of PPE by Level
5. OSHA Standards for PPE
6. Real-Time Work Zone Air Monitoring Action Levels

Appendices

A. Map to Hospital and Occupational Health Clinic
B. Safety Data Sheets
C. Heat and Cold Stress Guidelines
D. Forms
E. GEI Health and Safety SOPs
F. Con Edison Corporate Environmental, Health, and Safety Procedures
G. Hazard Communication (HAZCOM) Program
H. Job Hazard Analyses (JHAs)
I. HASP Addendums

MJO/ah\\gtb1v-fs01\Data\WPROC\Project\CON-ED\Rye\RDR\Draft-ConEd-082117\Appendix E - HASP\HASP.v00571.2017-08-21.docx

1. Emergency Contact Information

Table 1. Emergency Information

Important Phone Numbers	
Local Police:	911
Fire Department:	911
Ambulance:	911
State Police or County Sheriff:	911
Hospital and Occupational Clinic Information *(See Attached Maps and Directions in Appendix A)*	
St. John Riverside Hospital: 2 Park Avenue Yonkers, NY 10703 **Sancia Health Care:** 10 Pallisade Avenue Yonkers, NY 10701	(914) 964-7300 (914) 423-4466
Contacts	
Project Manager: Melissa Felter	(860) 368-5328 office (860) 608-9717 cell
Corporate Health and Safety Officer: Steve Hawkins	(860) 368-5348 office (860) 916-4167 cell
Regional Health and Safety Officer: Jessie Papageorge	(973) 873-7117 office (862) 432-2283 cell
GEI People Team:	(781) 721-4117 Boston (916) 631-4596 Sacramento
Medcor Triage	1-800-775-5866
Client Contact: Melissa Reindl	(718) 204-4331 office (646) 860-5143 cell
Other Information	
Contractor Requesting/Performing Utility Clearance: Utility Clearance Ticket Number:	TBD
Nearest Telephone Location (or alternate means of communication)	On-site Cellular

2. Background Information

2.1 General

Engineer GEI Consultants, Inc., P.C. (GEI)
5586 Post Road, Suite 1
East Greenwich, RI 02818

Project Name Former Woodworth Avenue Works
Woodworth Avenue and Ashburton Avenue
Yonkers, New York

This Health and Safety Plan (HASP) establishes policies and procedures to protect GEI personnel from the potential hazards posed by the activities at the Former Woodworth Avenue Works located between Woodworth Avenue and Ashburton Avenue in Yonkers, New York. Reading of the HASP is required of on-site GEI personnel and will be reviewed by GEI subcontractors. Subcontractors for this project will be required to develop their own HASP for protection of their employees, but at a minimum must adhere to applicable requirements set forth in this HASP. GEI will verify that its subcontractor's HASP includes Con Edison's site-specific requirements, as outlined in this HASP. Additionally, federal, state and local representatives, as well as Con Edison employees may be required to sign and adhere to this HASP, depending on the nature of their presence onsite during activities conducted by GEI. The plan identifies measures to minimize accidents and injuries, which may result from project activities or during adverse weather conditions. Activities performed under this HASP will comply with applicable parts of OSHA Regulations, primarily 29 Code of Federal Regulations (CFR) Parts 1910 and 1926, and Con Edison policies and procedures. A copy of this HASP will be maintained on site for the duration of the work.

Included in Section 1 and Appendix A is a route to the nearest medical facility from the Site with directions and contact information. Safety data sheets (formerly known as Material Safety Data Sheets [MSDS]), specific to chemicals that may be used while working at the Site, are in Appendix B. Appendix C details the signs, symptoms, care and procedures to both heat and cold stress. Appendix D includes the Tailgate Safety Briefing form, the Project Safety Briefing form, the Accident/Incident Report Form and the Near Miss Reporting Form. Appendix E contains the GEI Health and Safety (H&S) Standard Operating Procedures (SOPs) that apply to this project. Appendix F contains the Con Edison Corporate Environmental, Health, and Safety Procedures that apply to this project. Appendix G contains the GEI's Hazard Communication (HAZCOM) Program. Appendix H contains the Job Hazard Analyses (JHAs). Appendix I contains previously approved HASP Addendums.

2.2 Project Description

The project will include tasks associated with the investigation of the presence and extent of manufactured gas plant (MGP)-related by-products on the Former Woodworth Avenue Works Site. These activities will be conducted in accordance with this Health and Safety Plan (HASP) and Field Sampling Plan (FSP).

Current investigation activities include:

- Non-aqueous phase liquid (NAPL) recovery
- Soil sampling, Community Air Monitoring Program (CAMP), and odor control for excavations in right of ways (ROWs) (using Biosolve)

Future investigation activities include:

- Soil sampling via drill rig
- Groundwater sampling
- Sediment sampling (using a hand auger to two feet at low tide when sediment is exposed)

The site-specific tasks, potential hazards, and control measures established to reduce the risk of injury or illness are identified in step-by-step JHAs included in Appendix H. Prior to the start of work, project team members will determine what tasks are covered in the scope of work (described above) and then develop a JHA for each of these tasks and have them reviewed by the Project Manager (PM) or their designee and approved by a member of the Safety Team. Indicated in each JHA are the specific personal protective equipment (PPE), training, equipment, health and safety SOPs and programs that apply to each task.

Addendums associated with prior changes in scope of work and other updates to the HASP are included as Appendix I.

2.3 Site Description

The Former Woodworth Avenue Works is located in Yonkers, New York on the west side of Woodworth Avenue between Babcock Place and Ashburton Avenue in the city of Yonkers, Westchester County, New York. As shown on Figure 2, the Site is bifurcated into western and eastern sections by rail lines of the Metro-North Commuter Railroad. The Site and surrounding area are zoned industrial (I) by the City of Yonkers. Surrounding land use zoning includes Wholesale Business and Commercial Storage/Light Manufacturing. The Greyston Bakery (constructed on the western portion of the site during 2004) is identified as an important existing feature. The Greyston Bakery is a non-profit commercial bakery operated by the Greyston Foundation that employees economically disadvantaged people. Remedial activities have previously been implemented in the western portion of the site in connection with the construction of the bakery building under the New York State Voluntary Cleanup Program (VCP Site No. V00361).

2.4 Con Edison Corporate Environmental, Health and Safety Procedures

GEI and GEI's Subcontractors agree to abide by the conditions of the Con Edison Corporate Environmental, Health, and Safety Procedures (CEHSPs) included in Appendix F of this HASP while conducting work at the Site. Specifically, the applicable CEHSPs included are:

- CEHSP E08.02 – Noise Construction and Utility Activities
- CEHSP S05.03 – Personal Protective Equipment – Protective Clothing
- CEHSP S12.00 – Lockout Tagout Procedures
- CEHSP S17.01 – Electrical Enclosed Spaces
- CEHSP A28.00 – Calling a Time Out
- CEHSP A32.00.01 – Rules We Live By, with 2016 (January 31, 2016) 'Rules' Table*
- Utility Clearance Process for Intrusive Activities – Corporate EH&S Remediation Program, Revision 1A, December 31, 2007
- Work Area Protection Field Manual

*Work at this Site will comply with the Central Operations Column of the Rules We Live By table.

3. Statement of Safety and Health Policy

3.1 GEI

GEI is committed to providing a safe and healthy work environment for its employees. To maintain a safe work environment, GEI has established an organizational structure and a Corporate Health and Safety Program to promote the following objectives:

- Reduce the risk of injury, illness, and loss of life to GEI employees.
- Maintain compliance with federal, state, and other applicable safety regulations; and minimize GEI employees' work exposure to potential physical, chemical, biological, and radiological hazards.

Safety policy and procedure on any one project cannot be administered, implemented, monitored, and enforced by any one individual. The total objective of a safe, accident free work environment can only be accomplished by a dedicated, concerted effort by every individual involved with the project from management down to all employees.

Each GEI employee must understand their value to the company; the costs of accidents, both monetary, physical, and emotional; the objective of the safety policy and procedures; the safety rules that apply to the safety policy and procedures; and what their individual role is in administering, implementing, monitoring, and compliance of their safety policy and procedures. This allows for a more personal approach to compliance through planning, training, understanding, and cooperative effort, rather than by strict enforcement. If for any reason an unsafe act persists, strict enforcement will be implemented.

3.2 Con Edison

Con Edison will have final responsibility and authority for all aspects of the project, and is also responsible for approving all changes to this HASP. GEI provides general health and safety oversight as Con Edison's Agent. The Consultant also conducts perimeter air monitoring and work zone monitoring for GEI employees. The Consultant will monitor daily operations and will serve as the Contractor's primary point of contact with Con Edison and regulatory agencies for health-and-safety related matters.

3.3 Contractors

Contractors are responsible for all work detailed in the project work plan and/or Contractor Statement of Work. Contractors are also responsible for the health and safety of Contractor and Subcontractor employees, and conduct work zone monitoring for Contractor and Subcontractor workers. GEI requires its Contractors (e.g. drillers, air monitoring equipment

vendors, etc.) to work in a responsible and safe manner, and is responsible for work zone monitoring for them. Contractors for this project will be required to develop their own HASP for protection of their employees and at a minimum must adhere to applicable requirements set forth in this HASP.

4. Hazard/Risk Analysis

The potential hazards associated with site conditions and activity hazards related to GEI on-site activities have been identified in this section.

1. Special Site Conditions or Concerns

- Traffic – The majority of traffic on the project site will be construction traffic and city traffic.
- Drill Rig/Equipment – Drilling contractor will use truck-mounted rotary drill rigs. Specific attention given to rotating equipment, pinch points, and overhead equipment.
- Difficult site access – Site access is moderate to difficult due to small roads and city parking.
- Hazardous winter conditions – Cold stress, slippery surfaces, and icy Hazardous Summer Conditions – heat stress, dehydration and heat stroke are possible dangers.

Safety equipment will include: First aid kit, fire extinguisher, eye wash bottles, adequate supply of drinking water and electrolyte fluids, hand cleaner, insect repellent, sunscreen, and cell phone. Personal Protective equipment is discussed in section 5.

Physical hazards associated with heavy equipment and drilling operations are present. The heavy equipment associated with this project will include drilling and material removal equipment. Some of the hazards associated with this equipment include being struck-by equipment or caught in between equipment potentially resulting in crushing of limbs, slipping, tripping, or falling, and heavy lifting.

The Drilling/Excavation Contractor should verify that electric, gas, water, steam, sewer, and other service lines are shut off, capped, or otherwise controlled, at or outside the building before demolition work is started. In each case, any utility company that is involved should be notified in advance by the Contractor, and its approval or services, if necessary, will be obtained.

Smoking is prohibited at or in the vicinity of hazardous operations or materials. Where smoking is permitted, safe receptacles will be provided for smoking materials. The hazards for this operation are listed in the following Activity Hazard Analysis and Site Hazards sections.

4.1 Personal Safety

Field activities have the potential to take employees into areas which may pose a risk to personal safety. The following websites (sources) have been researched to identify potential crime activity in the area of the project:

- www.crimereports.com: No crimes identified in the past 30 days within a mile of the Site
- www.cityrating.com/crimestatistics.asp: n 2016 the city violent crime rate in Yonkers was higher than the violent crime rate in New York by 23.91% and national average violent crime rate (by 17.4%).
- www.crimemapping.com: No crimes identified in the past 30 days within a mile of the Site.

To protect yourself, take the following precautions:

- If deemed necessary by the PM, use the buddy system (teams of a minimum of two persons present);
- Let the Site Safety Officer (SSO) know when you begin work in these areas and when you leave;
- Call in regularly;
- Pay attention to what is going on around you; and
- If you arrive in an area and it does not look safe to get out of your vehicle, lock the doors and drive off quickly but safely.

Employees must not knowingly enter into a situation where there is the potential for physical and violent behaviors to occur. If employees encounter hostile individuals or a confrontation develops in the work area, suspend work activities, immediately leave the area of concern, and contact local 911 for assistance. Notify the SSO and Corporate Health and Safety Officer (CHSO) of any incidents once you are out of potential danger.

In the event of an emergency, prompt communications with local emergency responders is essential. At least one charged and otherwise functioning cell phone to facilitate emergency communications will be on-site. Confirmation of cellular phone operation will be confirmed at the start of each working day.

4.2 Activity Hazard Analysis

The potential hazards for this project associated with site conditions and activity hazards associated with GEI on-site activities have been identified in Table 2. General hazards and control measures that are applicable to all site activities are identified in the General Hazards

section. The site-specific tasks, potential hazards, and control measures established to reduce the risk of injury or illness are identified in the Activity Hazard section of Table 2. Health and Safety SOPs for routine hazards and common site conditions are referenced in the table below and included in Appendix E.

Table 2. Activity Hazard Analysis

General Hazards These Hazards Apply to All Site Activities	Control Measure
Chemical / Contaminant Exposure – Skin and eye injury/irritation	• Wear protective coveralls (e.g. Tyvek®) with shoe covers, safety glasses, face shield, Nitrile gloves. • Dispose of gloves after use and wash hands. • Avoid contact with pooled liquids and limit contact with contaminated soils/groundwater.
Cold Stress – Hypothermia, Frostbite	• Take breaks in heated shelters when working in extremely cold temperatures. • Drink warm liquids to reduce the susceptibility to cold stress. • Wear protective clothing (recommended three layers: an outside layer to break the wind, a middle layer to provide insulation, and an inner layer of cotton of synthetic weave to allow ventilation). • Wear a hat and insulated boots. • Keep a change of dry clothing available in case clothes become wet. • Do heavy work during the warmer parts of the day and take breaks from the cold. • If possible shield work areas from drafts of wind and use insulating material on equipment handles when temperatures are below 30°F • Watch for symptoms of cold stress. (see Appendix C in HASP)

General Hazards These Hazards Apply to All Site Activities	Control Measure
Driving	• Employees must wear their safety belt while in a moving vehicle. • Vehicle accidents will be reported in accordance with GEI's accident reporting procedures. • Vehicles will be properly maintained and safely operated (refer to GEI's Fleet Maintenance Program). • Employees will follow safe driving behaviors, which include limiting distractions such as manipulating radios or other equipment that may cause a distraction. Employees should not exceed the posted speed limit and should maintain a safe distance between other vehicles. • Use defensive driving techniques. • Driving distance and time after a 12-hour shift should not exceed 30 miles or 30 minutes (whichever is greater). • See SOP HS-004
Dusty Conditions – Eye and respiratory irritation	• Use water mist to suppress dust • Avoid travel at extreme times • Wear protective gear – dust masks, safety glasses
Heat stress – Fainting, Fatigue, Heat Stroke	• Increase water intake while working. • Increase number of rest breaks and/or rotate workers in shorter work shifts. Rest in cool, dry areas. • Watch for signs and symptoms of heat exhaustion and fatigue. • Plan work for early morning or evening during hot months. • Use ice vests when necessary. • In the event of heat stroke, bring the victim to a cool environment and initiate first aid procedures. • See Appendix C of the HASP
Inclement Weather	• Listen to local forecasts for warnings about specific weather hazards such as tornados, thunder storms, and flash floods. • If the storms produce thunder and/or lightning, leave the work area immediately and move to a safe area. • Discuss an action plan prior to the severe weather. • Wear appropriate PPE for the type of weather that could be encountered. • Stop work until conditions are suitable. Take cover in vehicles or shelter as appropriate. • See SOP HS-010

General Hazards These Hazards Apply to All Site Activities	Control Measure
Insects – Bites, Stings, Allergic Reactions	• Apply insect repellent prior to performing field work and as often as needed throughout the work shift • Wear proper protective clothing (work boots, socks and light colored clothing) • Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many insects are most active (between dawn and dusk). • When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible • Field personnel who may have insect allergies should have bee sting allergy medication on site and should provide this information to the SSO and the CHSO prior to commencing work. • Field personnel should perform a self-check at the end of the day for ticks. • See SOP HS-001
Physical Injury – Slips, Trips and Falls	• Wear PPE that properly fits, is in good condition and appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Maintain weed growth in sampling areas, especially on slopes. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to sampling areas, on steeply sloped areas, or where steep areas must be traversed to arrive at sample points.

General Hazards These Hazards Apply to All Site Activities	Control Measure
Poisonous Plants - Poison Ivy, Poison Oak, and Poison Sumac	• Avoid areas infested with poisonous plants. • Use a barrier cream to provide some protection. • Wash exposed clothing separately in hot water with detergent. • After use, clean tools, and soles of boots with rubbing alcohol or soap and lots of water. • Immediately wash with soap and water any areas that come into contact with poisonous plants. • If exposed to a poisonous plant, wash with soap and water or a product such as TechnuTM. First aid kits are available in the company vehicles. • See SOP HS-001
Repetitive Motion Injury - Standing, Squatting, and Bending Over	• Take regular breaks and do not work in unusual positions for long periods of time. • Walk and stretch between tasks. • See SOP HS-025
Unsecured or High Crime Areas	• Be aware of your surroundings. • Use the buddy system. Do not remain on site alone. Accompany or be accompanied by others to vehicles. • Request police detail when appropriate. • Let the Site Safety Officer (SSO) know when you begin work in these areas and when you leave. • Call in regularly. • If you arrive in an area and it does not look safe to get out of your vehicle, lock the doors and drive off quickly but safely.
Utilities – Shock, Electrocution, Fire, Explosion	• A thorough underground utility survey must be conducted prior to intrusive activities. Coordination with utility locating services, property owner(s) or utility companies must be conducted. • Utilities are to be considered live or active until documented otherwise. • For overhead utilities within 50 feet, determine with the utility company the appropriate distance. Minimum distance for clearance is based on voltage of the line. • If exposing a utility, proper support and protection must be provided so that the utility will not be damaged. • If a gas line is contacted, the contractor must notify police, fire, and emergency personnel, and evacuate employees according to the site evacuation procedures. No attempt should be made to tamper with or correct the damaged utility. • See SOP HS-014

General Hazards These Hazards Apply to All Site Activities	Control Measure
Vehicular Traffic – Struck by injury, crushing	• Increase visibility of the work area to others by using cones, flags, barricades, proper lighting and caution tape to define work area. • Use a "spotter" to locate oncoming vehicles. • Use vehicle to block work area. • Engage police detail for all work conducted in appropriate areas. • Wear high-visibility, reflective vest at all times. • Maintain minimum DOT defined distances to other traffic lanes. • See SOP HS-016.
Wildlife – Bites, Allergic Reaction, Disease	• Wear boots, avoid as much as possible and approach with caution as necessary. • Avoid contact with wild animals. Put on hip or chest waders (if available) prior to walking through vegetation. • See SOP HS-001

Activity	Potential Hazard	Control Measures
Carrying Equipment	Heavy lifting, strains/sprains, slips/trips/falls, pinch points	• Use proper lifting techniques as defined in the heavy lifting activity analysis below • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions and cause disorders like tendinitis or carpal tunnel syndrome • Take breaks when carrying items frequently and/or for long distances • Do not over reach when picking up or placing items. • Use the buddy system when necessary • When climbing ladders, maintain three points of contact at all times. DO NOT carry equipment up or down ladders unless it is in a secure backpack or similar hands-free shoulder-strap bag or case. Lower or raise larger equipment by crane or rope
Drilling Oversight/ Sampling	Contaminant Exposure, Noise, Contact with Utilities, Cuts/Scrapes, Heavy Lifting, Repetition, Slips/Trips/Falls	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or composite toe and shank; safety glasses; Nitrile/neoprene gloves; and earplugs. • Confirm utility locate has been completed. • Confirm adequate clearance from overhead utilities. • Dispose of gloves after use and wash hands. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards. • If cutting through concrete, follow the work practices and respiratory protection recommended in **Table 1 of the GEI Silica Program based on the type of equipment being used to cut through the concrete.**

Activity	Potential Hazard	Control Measures
Drum Handling	Contaminant Contact • Wear proper PPE during sampling including nitrile gloves and safety glasses. Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	• Wear proper PPE during sampling including nitrile gloves and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards. • See SOP HS-003
Excavation and Trenching Oversight	Crushing, entrapment, falls, fire/explosion	• Prior to excavating, determine utility locations and have locations marked by utility companies and the property owner. • Utilities shall be properly supported and barriers should be erected around excavations in remote areas. • Backfill temporary excavations when work is completed. • Personnel must remain 2 feet from the face of the excavation. • Sides, slopes, and faces shall meet OSHA requirements. • Excavation entry will be allowed only with proper sloping or shoring. • See **SOP HS-006**
Groundwater Sampling	Contaminant Exposure, Heavy Lifting, Repetition, Slips/Trips/Falls	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or composite toe and shank; safety glasses and Nitrile/neoprene gloves. • Dispose of gloves after use and wash hands. • User proper lifting techniques. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
Handling/Mixing Cement	Chemical exposure, heavy lifting	• Wear appropriate PPE including:, Waterproof gloves, a long-sleeved shirt, and long pants should be worn and safety glasses. • Use proper lifting techniques • Avoid prolonged contact with fresh concrete – contact with skin surfaces, eyes, and clothing may result in burns that are quite severe • Wash hands and arms immediately afterwards with clean water, non-alkaline soap, and clean towels. • Use all available work practices to control dust exposures.
Heavy Lifting	Back injury, knee injury	• Use proper lifting techniques. • Ask fellow worker for help. • Use a mechanical lifting device or a lifting aid where appropriate. • If you must lift, plan the lift before doing it. • Check your route for clearance. • Bend at the knees and use leg muscles when lifting. • Use the buddy system when lifting heavy or awkward objects. • Do not twist your body while lifting. • See SOP HS-025

Activity	Potential Hazard	Control Measures
Heavy Equipment – Working Near	Struck-by, caught-in-between equipment, crushing, pinch points	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or (electrical hazard) EH-rated safety boots with composite toe and shank; safety glasses; nitrile/neoprene gloves; and earplugs. • Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Coordinate hand signals with operators. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Wear a high-visibility, reflective vest when working near equipment or motor vehicle traffic. • Position yourself in a safe location when filling out logs talking with the contractor. • Notify the contractor immediately if any problems arise. • Do not stand or sit under suspended loads or near any pressurized equipment lines. • Do not operate cellular telephones in the vicinity of heavy equipment operation. • See **SOP HS-018**
Non-Powered Hand Tools Use (loppers, pruning shears, machete, and honeysuckle hopper)	Cuts/Scrapes, Slips/Trips/Falls, Heavy Lifting, Repetition, caught-in-between equipment, pinch points	• Wear appropriate PPE including: gloves, steel toed/shank safety boots, safety glasses, high visibility reflective clothing, and hard hat (as necessary). • Keep hands away from pinch points or cutting parts • Use proper lifting techniques. • Do not remove equipment guards on equipment. • Take regular breaks and do not work in unusual positions for long periods of time. • Inspect equipment or tools prior to use. Tag and remove from service if tool is damaged.
Shift Hours or Night Operations	Fatigue, vehicle accident, injury	• Work shifts should not be greater than 12 hours. • Driving distance and time after a 12-hour shift should not exceed 30 miles or 30 minutes (whichever is greater). • Night operations will include proper lighting, security measures (phone, police detail, guards), sanitary facilities, food and water.
Soil Sampling/Soil Vapor Sampling	Contaminant Exposure, Cuts/Scrapes, Heavy Lifting, Repetition, Slips/Trips/Falls	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or composite toe and shank; safety glasses; Nitrile/neoprene gloves; and earplugs as necessary. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Excavation entry will be allowed only with proper sloping or shoring. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.

Activity	Potential Hazard	Control Measures
Waste Characterization	Contaminant Contact • Wear proper PPE during sampling including nitrile gloves and safety glasses. Cuts or Abrasions, Slips/Trips/Falls	• Wear proper PPE during sampling including nitrile gloves and safety glasses. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Keep trafficked areas free from slip/trip/fall hazards.

Personal Protective Equipment (PPE) is the initial level of protection based on the activity hazards and Site conditions which have been identified. Upgrades to respiratory protection may be required based on the designated Action Levels found in Section 9. General on-site provisions will include: extra nitrile, leather, and/or Kevlar gloves, extra protective coveralls (e.g. Tyvek®) with boot covers, drinking water and electrolyte fluids, reflective vest, first aid kit, fire extinguisher, hearing protection, and washing facilities.

If Site conditions suggest the existence of a situation more hazardous than anticipated, the Site personnel will evacuate the immediate area. The hazard, the level of precautions, and the PPE will then be reevaluated with the assistance and approval of the CHSO (Steven Hawkins) and the Project Manager (PM) Melissa Felter.

4.2.1 Handling Drums and Containers

Regulations for handling drums and containers are specified by Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(j). Potential hazards associated with handling drums include vapor generation, fire, explosions, and possible physical injury. Handling of drums/containers during the Site investigation and remediation activities may be necessary. If drum/container handling is necessary, it will be performed in accordance with applicable regulations.

4.2.2 Utilities

The Site may have shallow, buried utilities and also overhead utilities in certain areas. It will be necessary for parties disturbing the existing ground surface and conducting operations with heavy equipment having high clearances to exercise caution in performing project-related work with respect to the presence of utilities. Utility companies with active, buried lines in the Site area will be asked by the Contractor performing intrusive activities to mark their facilities. Employees will use these data to choose work locations.

4.2.2.1 Underground Utilities

No excavating, drilling, boring, or other intrusive activities will be performed until an underground utility survey, conducted by knowledgeable persons or agencies, has been made. This survey will identify underground and in-workplace utilities such as the following:

- Electrical lines and appliances;
- Telephone lines;
- Cable television lines;
- Gas lines;
- Pipelines;
- Steam lines;
- Water lines;
- Sewer lines; and/or
- Pressurized air lines.

Please refer to GEI's SOP HS-014 Utility Mark Out (Appendix E) and Con Edison's – Utility Clearance Process for Intrusive Activities – Corporate EH&S Remediation Program (Appendix F). Dig Safely New York (Call 811) will be contacted to mark out utilities at the Site address prior to start of any intrusive activities. Be sure to have receipt of a utility mark out across the entire work area. Look for visible evidence of utility markings on the ground in the form of painted identifications for sewer, water, gas, communications, storm water, oil or petroleum, etc. It is required that prior to drilling, hand excavation occur, to minimally, 5 feet below ground surface, to pre-clear locations from utilities.

The location of utilities will be discussed with GEI employees and subcontractors during a Site Safety Briefing. Identified utilities should be marked or access otherwise restricted to avoid chance of accidental contact.

Even when a utility search has been completed, drilling, boring, and excavation should commence with caution until advanced beyond the depth at which such utilities are usually located. Utilities will be considered "live" or active until reliable sources demonstrate otherwise.

4.2.2.2 Overhead Utilities

Overhead transmission and distribution lines will be carried on towers and poles which provide adequate safety clearance over roadways and structures. Clearances will be adequate for the safe movement of vehicles and for the operation of construction equipment.

Overhead or above-ground electric lines should be considered active until a reliable source has documented them to be otherwise. Elevated work platforms, ladders, scaffolding, man-lifts,

and drill or vehicle superstructures will be erected a minimum of 20 feet (the actual distance is dependent upon the voltage of the line) from overhead electrical lines until the line is de-energized, grounded, or shielded so arcing cannot occur between the work location or superstructure.

4.2.3 Excavations and Trenches

The safety requirements for excavations and trenches must be determined by a competent person who is capable of identifying existing and predictable hazards and work conditions that are unsanitary, hazardous, or dangerous to GEI employees. The competent person must also have the authorization to take prompt corrective measures to eliminate unsatisfactory conditions. GEI employees will not enter trenches.

The following are general requirements for work activities in and around excavations:

- Prior to initiation of excavation activity (or ground intrusive activity, such as drilling), the location of underground installations will be determined. The New York 811 at 811 or 1-800-272-4480 will be contacted by the Contractor/Subcontractor a minimum of 72 hours prior to excavation activities. It may also be necessary to temporarily support underground utilities during excavation. When excavations approach the estimated location of underground installations, the exact location of the underground installations will be determined by means that are safe for GEI employees, i.e., hand dig, test pits, etc.
- Excavations should be inspected daily by the excavating company's competent person prior to commencement of work activities. Evidence of cave-ins, slides, sloughing, or surface cracks or excavations will be cause for work to cease until necessary precautions are taken to safeguard employees.
- Excavated and other materials or equipment that could fall or roll into the excavation, and vehicular traffic and heavy equipment will be placed at least 5 feet from the edge of the excavation.
- Excavation operations will cease immediately during hazardous weather conditions such as high winds, heavy rain, lightning, and heavy snow.

Employees will refer to GEI's Excavation Safety SOP for further information.

4.2.4 Fire and Explosion

When conducting excavating activities, the opportunity for encountering fire and explosion hazards exists from contamination in soil and the possibility of free product in underground structures and pipelines. Additionally, the use of diesel-powered excavating equipment could present the possibility of encountering fire and explosion hazards.

4.2.5 Heat Stress

Employees may be exposed to the hazards associated with heat stress when ambient temperatures exceed 70ºF. Employees should increase water intake while working in conditions of high heat. Enough water should be available so that each employee can consume 1 quart of water per hour. In addition, they should increase number of rest breaks and/or rotate employees in shorter work shifts. Employees should rest in cool, dry, shaded areas for at least 5 minutes. Employees should not wait until they feel sick to cool down. Watch for signs and symptoms of heat exhaustion and fatigue. In the event of heat stroke, bring the victim to a cool environment, call for help, and initiate first aid procedures

The procedures to be followed regarding avoiding heat stress are provided in Appendix C – Heat Stress Guidelines and in GEI's Heat Stress program.

4.2.6 Cold Stress

Employees may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia, as well as slippery surfaces, brittle equipment, and poor judgment. The procedures to be followed regarding avoiding cold stress are provided in Appendix C – Cold Stress Guidelines and in GEI's Cold Stress program.

4.2.7 Noise

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps, and generators. Employees who will perform suspected or established high noise tasks and operations will wear hearing protection. If deemed necessary by the SSO, the CHSO will be consulted on the need for additional hearing protection and the need to monitor sound levels for Site activities. Other employees who do not need to be in proximity of the noise should distance themselves from the equipment generating the noise.

4.2.8 Hand and Power Tools

In order to complete the various tasks for the project, personnel may use hand and power tools. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. Work gloves, safety glasses, and hard hats will be worn by the operating personnel when using hand and power tools and Ground Fault Circuit Interrupter (GCFI)-equipped circuits will be used for power tools.

4.2.9 Slips, Trips, and Falls

Working in and around the Site may pose slip, trip, and fall hazards due to slippery and uneven surfaces. Excavation at the Site may cause uneven footing in trenches and around the soil

piles. Steep slope and uneven terrain conditions at the Site are also a primary concern. GEI employees will wear proper foot gear and will employ good work practice and housekeeping procedures to minimize the potential for slips, trips, and falls.

4.2.10 Manual Lifting

Manual lifting of objects and equipment may be required. Failure to follow proper lifting technique can result in back injuries and strains. Employees should use a buddy system and/or power equipment to lift heavy loads whenever possible and should evaluate loads before trying to lift them (i.e., they should be able to easily tip the load and then return it to its original position). Carrying heavy loads with a buddy and proper lifting techniques include: 1) make sure footing is solid; 2) make back straight with no curving or slouching; 3) center body over feet; 4) grasp the object firmly and as close to your body as possible; 5) lift with legs; and 6) turn with your feet, don't twist.

4.2.11 Projectile Objects and Overhead Dangers

Overhead dangers, including but not limited to falling debris and equipment, can occur while operating drill rigs. GEI employees will maintain a minimum distance from large overhead operations and to maintain proper communication with heavy equipment operators and their handlers, should work necessitate their presence beyond the minimum safety distance. Proper PPE will be worn during these types of activities including steel-toed/shank boots, safety vests, and hard hats.

4.2.12 Cuts and Lacerations

The core sampling program may require employees to use powered cutting tools (circular saw or shears) or a hooked knife to cut open the sample liner. Safety box cutters will be utilized for routine operations such as opening boxes of supplies or cutting rope or string. When using cutting tools, follow the safety precautions listed below:

- Keep free hand out of the way.
- Secure work if cutting through thick material.
- Use only sharp blades; dull blades require more force that results in less knife control.
- Pull the knife through the object but away from your body; pulling motions are easier to manage.
- Do not put the knife in your pocket.
- Wear leather or Kevlar® gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.

4.3 Chemical Hazards

The characteristics of compounds at the Site are discussed below for information purposes. Adherence to the safety and health guidelines in this HASP should reduce the potential for exposure to the compounds discussed below.

4.3.1 Volatile Organic Compounds (VOCs)

Volatile organic chemicals (VOCs), such as benzene, toluene, ethyl benzene, and xylene (BTEX) are present as soil and groundwater contaminants, and in some cases chemical components in non-aqueous phase liquids (NAPL) such as oil or tar within soils and abandoned pipelines. These compounds are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. These compounds generally have a depressant effect on the Central Nervous System (CNS), may cause chronic liver and kidney damage, and some are suspected human carcinogens. Benzene is a known human carcinogen. Acute exposure may include headache, dizziness, nausea, and skin and eye irritation. The primary route of exposure to VOCs is through inhalation and therefore respiratory protection is the primary control against exposure to VOCs.

4.3.2 Coal Tar and Coal Tar Products

Coal tar products, which are semi-volatile organic compounds (SVOCs) consist of a mixture of acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluorethene, benz(a)pyrene, benzo(e)pyrene, benzo(g,h,i)peryline, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3cd)pyrene, 2-methyl naphthalene, naphththalene, phenanthrene, phenols, pyrene.

Coal tar products and other SVOCs are present at the Site within impacted soil and groundwater and as a dense non-aqueous phase liquid (DNAPL) by-product of gas production within soils, former manufactured gas plant (MGP) structures, and abandoned pipelines.

Coal tar products such as those listed above may cause contact dermatitis. Direct contact can be irritating to the skin and produce itching, burning, swelling, and redness. Direct contact or exposure to the vapors may be irritating to the eyes. Conjunctivitis may result from prolonged exposure. Coal tar is considered to be very toxic, if ingested. High levels of exposure to coal tar, though not anticipated during work activities conducted during this project, may increase the risk of cancer including lung, kidney, and skin cancer. Naphthalene is also an eye and skin irritant and can cause nausea, headache, fever, anemia, liver damage, vomiting, convulsions, and coma. Poisoning may occur by ingestion of large doses, inhalation, or skin absorption.

The major route of entry for the work activities to be conducted at this Site is through direct contact. Exposure is most likely when handling soil and water samples. Inhalation may occur when the soil is disturbed causing respirable and nuisance dust particles to become airborne.

4.3.3 Heavy Metals

The subsurface soil may contain elevated levels of metals including: arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, thallium, and zinc.

Exposure to high concentrations of arsenic can cause dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, and hyper pigmentation of skin. Chronic exposure to arsenic has resulted in lung cancer in humans.

Exposure to high concentrations of beryllium can result in "beryllium sensitization", which is an allergic response to beryllium. Symptoms of the disease include cough, shortness of breath, fatigue, fevers, skin rash, and night sweats. In the later stages, lung tissue becomes scarred. In severe cases, the right side of the heart may be strained due to increased pressure in the pulmonary artery from lung damage.

Exposure to high concentrations of cadmium can cause acute symptoms such as pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness and pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; loss of the sense of smell), mild anemia; and is considered a potential occupational carcinogen.

Exposure to chromium can cause acute symptoms such as irritation of the eyes, nose and throat as well as wheezing and coughing. Chronic effects include nosebleeds, nasal congestion, dermatitis, and loss of sight.

Exposure to high concentrations of copper through inhalation can cause irritation of the eyes, nose, pharynx, nasal septum. Ingestion may cause a metallic taste. Skin irritation may result from direct contact with skin. Damage to the liver and kidneys may occur.

Exposure to lead may cause acute symptoms such as eye irritation, weakness, weight loss, abdominal pain, and anemia. Chronic exposure to lead may result in kidney disease, effects to the reproductive system, blood forming organs, and CNS.

Lead and arsenic are regulated by specific OSHA standards. They are 29 CFR 1910.1025/1926.52 and 29 CFR 1910.1018/1926.1118, respectively. These standards include specific requirements for air monitoring, signs and labels, training and medical surveillance.

Exposure to high concentrations of nickel may cause sensitization dermatitis, allergic asthma, and pneumonitis. Exposure to mercury can cause dizziness, salivation nausea, vomiting, diarrhea, constipation, emotional disturbance, and kidney injury. Chronic exposure to mercury can cause CNS damage.

Exposure to high concentrations of selenium can cause mucous membrane irritation, coughing, sneezing, shortness of breath, chills, headaches, hypotension, and CNS depression. Chronic exposure to selenium could cause bronchial irritation, gastrointestinal distress, excessive fatigue, and skin discoloration.

Exposure to high concentrations of thallium can cause nausea, diarrhea, abdominal pain, vomiting; tremor; chest pain, pulmonary edema; convulsions, psychosis; liver, kidney damage; and alopecia.

Exposure to high concentrations of zinc through ingestion can cause abdominal pain, nausea, vomiting, and diarrhea. Chronic exposure can lead to low blood pressure, jaundice, and seizures.

These metals are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. As with SVOCs, the primary route of exposure is through inhalation of dust particles when soil is disturbed and becomes airborne.

4.3.4 Polychlorinated Biphenyls

It is not likely that polychlorinated biphenyls (PCBs) are of concern based on previous land uses at the Site. PCBs have historically been used from a number of sources including, but not limited to; electrical systems, hydraulic oils, lubricants, cutting oils, printer's ink, and asphalt. Exposure to PCBs can occur through unbroken skin without immediate pain or irritation. PCBs detected at the site are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. Acute effects of exposure to high concentrations of PCB can include eye, skin, nose, and throat irritation. Chronic effects of PCB exposure can include skin swelling and redness, gastro-intestinal disturbances, and neurological effects such as headache, dizziness, nervousness, and numbness of extremities. PCBs are suspected human carcinogens that can cause liver cancer. PCBs can accumulate in fatty tissues and result in health effects after the initial exposure has occurred. The primary route of exposure for PCBs is inhalation, dermal contact, and ingestion. Analysis of soils from the Site did not indicate elevated PCB concentrations.

4.3.5 Hydrogen Sulfide

Hydrogen sulfide is another common by-product of manufactured gas production and is also associated with the breakdown of sewage by bacteria in sewer pipes. Exposure to lower concentrations can result in eye irritation, a sore throat and cough, shortness of breath, and fluid in the lungs. These symptoms usually go away in a few weeks. Long-term, low-level exposure may result in fatigue, loss of appetite, headaches, irritability, poor memory, and dizziness. Breathing very high levels (> 800 parts per million [ppm]) of hydrogen sulfide can cause death within just a few breaths. The primary route of exposure is through inhalation and therefore respiratory protection is the primary control against exposure to hydrogen sulfide.

4.3.6 Evaluation of Organic Vapor Exposure

Air monitoring reduces the risk of overexposure by indicating when action levels have been exceeded and when PPE must be upgraded or changed. Action Levels for VOCs and associated contingency plans for the work zone are discussed within Section 9 of this HASP. Community air monitoring of the area immediately surrounding the work zone will be completed in accordance with the specific agency approved Work Plan.

Exposure to organic vapors will be evaluated and/or controlled by:

- Monitoring air concentrations for organic vapors in the breathing zone with a photoionization detector (PID) or a flame ionization detector (FID).
- When possible, engineering control measures will be utilized to suppress the volatile organic vapors. Engineering methods can include utilizing a fan to promote air circulation, utilizing volatile suppressant foam, providing artificial ground cover, or covering up the impacted material with a tarp to mitigate volatile odors.
- When volatile suppression engineering controls are not effective and organic vapor meters indicate concentrations above the action levels, then appropriate respiratory protection (i.e., air purifying respirator with organic vapor cartridge) will be employed.

4.3.7 Evaluation of Respirable Dust Inhalation

Inhalation of respirable dust containing metals, asbestos, and SVOCs is possible when surrounding ground cover is disturbed by heavy equipment, conducting demolition work, or using power tools on surfaces that contain these materials. Contaminated particulate matter (soil, pavement, lead paint, insulation, etc.) becomes suspended in air due to a combination of factors including lack of vegetative cover and/or dry or dusty conditions. Air monitoring reduces the risk of overexposure to respirable dust inhalation by indicating when action levels have been exceeded and when PPE must be upgraded or changed. Action levels for respirable dust and associated contingency plans for the work zone and perimeter of the Site are discussed within Section 7 of this HASP.

Control of respirable dust shall be conducted at this Site as follows:

- When possible, dust control measures will be utilized to suppress the dust. These methods include wetting down the area, providing artificial ground cover, or covering up the material with a tarp.
- When dust suppression is not possible and respirable dust meters indicate concentrations above the action levels, respiratory protection must be used to prevent against inhalation of contaminated dusts.

4.3.8 Evaluation of Skin Contact and Absorption

Skin contact by contaminants may be controlled by use of proper hygiene practices, PPE, and good housekeeping procedures. The proper PPE (e.g., Tyvek®, gloves, safety glasses) as described in Section 5 will be worn for activities where contact with potential contaminated media or materials are expected.

SDSs for decontamination chemicals and laboratory reagents that may be used on Site are included in Appendix B. Specific chemical hazards information from the occupational health sources are summarized in Table 3.

4.3.9 Other Chemical Hazards

Chemicals not identified in this HASP may be used during the Site characterization activities. Prior to the initiation of any on-site tasks, each Contractor, Subcontractor, or Consultant shall provide Safety Data Sheets (SDS) to the SSO for each of the chemicals to be used. The SDS will be maintained at the Site by the SSO and all Site workers and visitors who may potentially be exposed to the chemicals will be made aware of these hazards and the location of the on-site SDSs during a hazard briefing session by the SSO. SDS of commonly used compounds are located in Appendix B. Only Con Edison approved chemicals/products may be used/stored at the Site.

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Arsenic	7440-38-2	0.01 mg/m^3	0.01 mg/m^3 A.L. .005mg/m3	Inhalation Skin Absorption Ingestion Skin Contact	Ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, potential carcinogen	Liver, kidneys, skin, lungs, lymphatic system	Metal: Silver-gray or tin-white, brittle, odorless solid FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm
Benzene	71-43-2	0.5 ppm (Skin)	1 ppm TWA 5 ppm STEL	Inhalation Skin Absorption Ingestion Skin Contact	Irritation of eyes, skin, nose, respiratory system, giddiness, headache, nausea; staggering gait, fatigue, anorexia, weakness, dermatitis, bone marrow depression, potential carcinogen	Eyes, skin, CNS, bone marrow, blood	FP: 12^o F IP: 9.24 eve LEL: 1.2% UEL:7.8% VP: 75 mm
Beryllium	7440-41-7	NIOSH REL: Ca C 0.0005 mg/m3	TWA 0.002 mg/m3 C 0.005 mg/m3 (30 minutes), with a maximum peak of 0.025 mg/m3	Inhalation, skin and/or eye contact	Berylliosis (chronic exposure): anorexia, weight loss, lassitude (weakness, exhaustion), chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation eyes; dermatitis; [potential occupational carcinogen]	Eyes, skin, respiratory system	A hard, brittle, gray-white solid.. FP: none LEL:N/A UEL: N/A VP: 0 mm
Cadmium	7440-43-9 (metal)	CA	TWA 0.005 mg/m^3	Inhalation, ingestion	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]	Respiratory system, kidneys, prostate, blood; **Cancer Site** [prostatic & lung cancer]	Silver-white, blue-tinged lustrous, odorless solid. FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Chromium (Chromic Acid and Chromates)	1333-82-0	0.05 mg/m^3	0.1 mg/m^3	Inhalation Ingestion Skin Contact	Irritates respiratory system, nasal, septum perforation, liver and kidney damage, leucocytosis (increased blood leucocytes), leukopenis (reduced blood leucocytes), monocytosis (increased monocytes), Eosinophilia, eye injury, conjunctivitis, skin ulcer, sensitivity dermatitis, potential carcinogen	Blood, respiratory system, liver, kidney, eyes, skin, lung cancer	FP:NA IP:NA VP: Very Low LEL: NA UEL: NA
Copper (as a fume)	1317-38-0	NIOSH REL: TWA 0.1 mg/m3	TWA 0.1 mg/m3	Inhalation, skin and/or eye contact	Irritation eyes, upper respiratory system; metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough, lassitude (weakness, exhaustion); metallic or sweet taste; discoloration skin, hair	Eyes, skin, respiratory system (increased risk with Wilson's disease)	Finely divided black particulate dispersed in air FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm
Ethylbenzene	100-41-4	100 ppm	100 ppm	Inhalation Ingestion Skin Contact	Eye, skin, mucous membrane irritation; headache; dermatitis, narcosis; coma	Eyes, skin, respiratory system, CNS	FP: 55° F IP: 8.76 eV LEL: 0.8% UEL:6.7% VP: 7 mm
Hydrogen sulfide	7783-06-4	10 ppm TWA, 15 ppm STEL	20 ppm C, 50 ppm [10-min. Maximum peak]	Inhalation Skin/Eye Contact	Irritation eyes, respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, fatigue, irritability, insomnia; gastrointestinal disturbance; liquid: frostbite	Eyes, respiratory system, CNS	Colorless gas with a strong odor of rotten eggs. VP: 17.6 atm IP: 10.46 eV
Lead	7439-92-1	0.050 mg/m^3	0.05 mg/m^3 A.L. 0.03 mg/m3	Inhalation Ingestion Skin Contact	Weakness, insomnia; facial pallor; pal eye, anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis of wrist and ankles; irritates eyes, hypo tension	Eyes, GI tract, CNS, kidneys, blood, gingival tissue	A heavy, ductile, soft, gray solid. FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Mercury	7439-97-6	0.025 mg/m^3	0.10 mg/m3	Inhalation Ingestion Skin Contact Skin Absorption	Irritates eyes and skin, chest pain, cough, difficulty breathing, bronchitis, pneumonitis, tremor, insomnia, irritability, indecision, headache, fatigue, weakness, stomatitis, salivation, Gastrointestinal disturbance, weight loss, proteinuria	Eyes, skin, respiratory tract, central nervous system	Silver-white, heavy odorless liquid FP: NA IP:? LEL: NA UEL:NA VP: 0.0012 mm
Nickel	7440-02-0 (Metal)	NIOSH REL*: Ca TWA 0.015 mg/m3 [*Note: The REL does not apply to Nickel carbonyl.]	TWA 1 mg/m3 [*Note: The PEL does not apply to Nickel carbonyl.]	Inhalation, ingestion, skin and/or eye contact	Sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]	Nasal cavities, lungs, skin **Cancer Site:** **[lung and nasal cancer]**	Metal: Lustrous, silvery, odorless solid FP: none LEL:N/A UEL: N/A VP: 0 mm
PCBs	11097-69-1	0.5 mg/m^3 (Skin)	0.5 mg/m^3 (Skin)	Inhalation Skin Absorption Ingestion Skin Contact	Irritate eyes; chloracne; liver damage;	Skin, eyes, liver, reproductive system	Colorless liquid or solid with a mild, hydro-carbon odor VP = 0.00006 mm
Selenium	7782-49-2	0.2 mg/m^3	0.2 mg/m^3	Inhalation Ingestion Skin Contact	Irritant to eyes, skin, nose and throat, visual disturbance, headache, chills, fever, breathing difficulty, bronchitis, metallic taste, garlic breath, GI disturbance, dermatitis, eye and skin burns,	Eyes, skin, respiratory system, liver, kidneys, blood spleen	Amphorous or crystalline, red to gray solid FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Thallium		NIOSH REL: TWA 0.1 mg/m3 [skin]	OSHA PEL: TWA 0.1 mg/m3 [skin]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs	Eyes, respiratory system, central nervous system, liver, kidneys, gastrointestinal tract, body hair	Properties vary depending upon the specific soluble thallium compound.
Toluene	108-88-3	50 ppm	200 ppm	Inhalation Skin Absorption Ingestion Skin Contact	Eye, nose irritation; fatigue, weakness, confusion, euphoria, dizziness, headache; dilated pupils, tearing of eyes; nervousness, muscle fatigue, insomnia, tingling in limbs; dermatitis	Eyes, skin, respiratory system, CNS, liver, kidneys	FP: 40° F IP: 8.82 eV LEL: 1.1% UEL:7.1% VP: 21 mm
Xylene	1330-20-7	100 ppm	100 ppm	Inhalation Skin Absorption Ingestion, Skin Contact	Eye, skin, nose, throat irritation; dizziness, excitement, drowsiness; incoordination, staggering gait; corneal damage; appetite loss, nausea, vomiting, abdominal pain; dermatitis	Eyes, skin, respiratory system, Central Nervous System, GI tract, blood, liver, kidneys	FP: 90° F LEL: 0.9% UEL: 6.7% VP: 9 mm
Zinc	1314-13-2	5 mg/m3 (TWA), 10 mg/m3 (STEL) for zinc oxide fume	10 mg/m3 (TWA), for zinc oxide fume	Inhalation	Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function	Respiratory system	Colorless liquid FP: NA? IP: 11 eV LEL: 7.5% UEL: 12.5% VP: 100 mmHg

Abbreviations:

°F = degrees Fahrenheit

ACGIH = American Conference of Industrial Hygienists

A.L. = Action Level

IP = Ionization Potential

LEL = Lower explosive limit

mg/m^3 = micrograms per cubic meter

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data

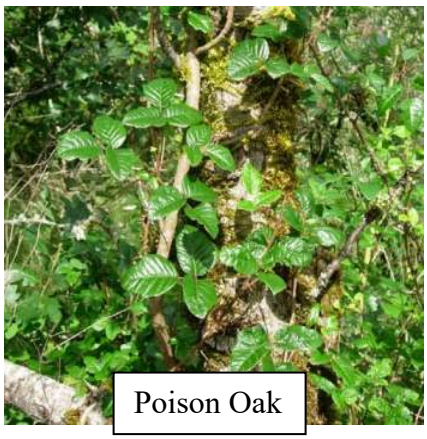
atm = atmosphere
C = ceiling limit, not to be exceeded
CAS # = chemical abstract services number
CNS = Central Nervous System
CTPV = Coal Tar Pitch Volatiles
CVS = Cardiovascular System
eV = electron volt
f/cc = fibers per cubic centimeter
FP = Flash point
GI = Gastro-intestinal
H2S = Hydrogen Sulfide
HCN = Hydrogen Cyanide
hr = hour
min = minute
mm = millimeter
mmHg = millimeters of mercury
N/A = not applicable
OSHA = Occupational Safety and Health Administration
PAH = Polycyclic Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
PEL = Permissible exposure limit
ppm = parts per million
Skin = significant route of exposure
STEL = Short-term exposure limit (15 minutes)
TWA = Time-weighted average (8 hours)
VP = vapor pressure approximately 68°F in mm Hg

4.4 Biological Hazards

Areas of the Site may be wooded, surrounded with brush, or landscaped. Therefore, employees working on this project should be aware of the potential biological hazards at this Site. Each is discussed in detail below:

4.4.1 Poisonous Plants

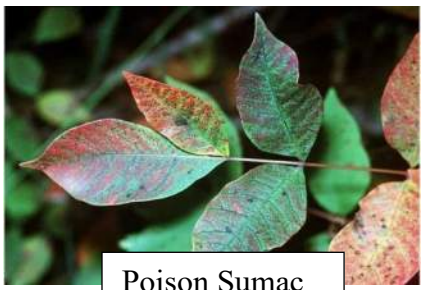
Persons working on the Site should be aware of the possible presence of poisonous plants and insects. Poison ivy is a climbing plant with leaves that consist of three glossy, greenish leaflets. Poison ivy has conspicuous red foliage in the fall. Small yellowish-white flowers appear in May through July at the lower leaf axils of the plant. White berries appear from August through November. Poison ivy is typically found east of the Rockies. Poison oak is similar to poison ivy but its leaves are oak-like in form. Poison oak occurs mainly in the south and southwest. Poison sumac typically occurs as a small tree or shrub and may be 6 to 20 feet in height. The bark is smooth, dark and speckled with darker spots. Poison sumac is typically found in swampy areas and east of the Mississippi. The leaves have 7 to 13 smooth-edged leaflets and drooping clusters of ivory-white berries that appear in August and last through spring.



Poison Oak



Poison Ivy



Poison Sumac

The leaves, roots, stems and fruit of these poisonous plants contain urushiol. Contact with the irritating oil causes an intensely itching skin rash and characteristic, blister-like lesions. The oil can be transmitted on soot particles when burned and may be carried on the fur of animals, equipment, and apparel.

Proper identification of these plants is the key to preventing contact and subsequent dermatitis. Wear long sleeves and pants when working in wooded areas. In areas of known infestation, wear Tyvek® coveralls and gloves. Oils are easily transferred from one surface to another. If you come in contact with these poisonous plants, wash exposed areas immediately with cool water to remove the oils. Some commercial products such as Tecnu's Poison Oak-n-Ivy Cleanser claim to further help with the removal of oils.

4.4.2 Ticks

4.4.2.1 Lyme Disease

Ticks are bloodsuckers, attaching themselves to warm-blooded vertebrates to feed. Deer ticks are associated with the transmission the bacteria that causes Lyme disease. Female deer ticks are about ¼-inch in length and are black and brick red in color. Males are smaller and all black. If a tick is not removed, or if the tick is allowed to remain for days feeding on human blood, a condition known as tick paralysis can develop. This is due to a neurotoxin, which the tick apparently injects while engorging. This neurotoxin acts upon the spinal cord causing incoordination, weakness, and paralysis.

The early stages of Lyme disease, which can develop within a week to a few weeks of the tick bite, are usually marked by one or more of these signs and symptoms:

- Tiredness
- Chills and fever
- Headache
- Muscle and/or join pain
- Swollen lymph glands
- Characteristic skin rash (i.e. bullseye rash)

4.4.2.2 Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is spread by the American dog tick, the lone-star tick, and the wood tick, all of which like to live in wooded areas and tall, grassy fields. The disease is most common in the spring and summer when these ticks are active, but it can occur anytime during the year when the weather is warm.

Initial signs and symptoms of the disease include sudden onset of fever, headache, and muscle pain, followed by development of a rash. Initial symptoms may include fever, nausea, vomiting, severe headache, muscle pain, and/or lack of appetite.

The rash first appears 2 to 5 days after the onset of fever and is often not present or may be very subtle. Most often it begins as small, flat, pink, non-itchy spots on the wrists, forearms,

and ankles. These spots turn pale when pressure is applied and eventually become raised on the skin. Later signs and symptoms include rash, abdominal pain, joint pain, and/or diarrhea.

The characteristic red, spotted rash of Rocky Mountain spotted fever is usually not seen until the 6th day or later after onset of symptoms, and this type of rash occurs in only 35% to 60% of patients with Rocky Mountain spotted fever. The rash involves the palms or soles in as many as 50% to 80% of patients; however, this distribution may not occur until later in the course of the disease.

4.4.2.3 Prevention

Tick season lasts from April through October; peak season is May through July. You can reduce your risk by taking these precautions:

- During outside activities, wear long sleeves and long pants tucked into socks. Wear a hat, and tie hair back.
- Use insecticides to repel or kill ticks. Repellents containing the compound n,n-diethyl-meta-toluamide (DEET) can be used on exposed skin except for the face, but they do not kill ticks and are not 100% effective in discouraging ticks from biting. Products containing permethrin kill ticks, but they cannot be used on the skin -- only on clothing. When using any of these chemicals, follow label directions carefully.
- After outdoor activities, perform a tick check. Check body areas where ticks are commonly found: behind the knees, between the fingers and toes, under the arms, in and behind the ears, and on the neck, hairline, and top of the head. Check places where clothing presses on the skin.
- Remove attached ticks promptly. Removing a tick before it has been attached for more than 24 hours greatly reduces the risk of infection. Use tweezers, and grab as closely to the skin as possible. Do not try to remove ticks by squeezing them, coating them with petroleum jelly, or burning them with a match. Keep ticks in a zip-lock baggie in case testing needs to be performed.

Report any of the above symptoms and all tick bites to the PM and Safety Team for evaluation.

4.4.3 Mosquito- Borne Disease – West Nile Virus

West Nile encephalitis is an infection of the brain caused by the West Nile virus, which is transmitted by infected mosquitoes. Following transmission from an infected mosquito, West Nile virus multiplies in the person's blood system and crosses the blood-brain barrier to reach the brain. The virus interferes with normal CNS functioning and causes inflammation of the brain tissue. However, most infections are mild and symptoms include fever, headache, and body aches. More severe infections may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and rarely, death. Persons over the age of 50 have the highest risk of severe disease.

Prevention centers on public health action to control mosquitoes and on individual action to avoid mosquito bites. Any individuals who have been bitten or stung by an insect shall notify the SSO and the Con Edison Construction Representative immediately. To avoid being bitten by the mosquitoes that cause the disease, use the following control measures:

If possible, stay inside between dusk and dark. This is when mosquitoes are most active. When outside (between dusk and dark), wear long pants and long-sleeved shirts. Spray exposed skin with an insect repellent, preferably containing DEET.

4.4.4 Wasps and Bees

Wasps (hornets and yellow-jackets) and bees (honeybees and bumblebees) are common insects that may pose a potential hazard to the field team if work is performed during spring, summer, or fall. Bees normally build their nests in the soil. However, they use other natural holes such as abandoned rodent nests or tree hollows. Wasps make a football-shaped, paper-like nest either below or above the ground. Yellow-jackets tend to build their nests in the ground but hornets tend to build their nests in trees and shrubbery. Bees are generally more mild-mannered than wasps and are less likely to sting. Bees can only sting once while wasps sting multiple times because their stinger is barbless. Wasps sting when they feel threatened. By remaining calm and not annoying wasps by swatting, you lessen the chance of being stung.

Wasps and bees inject a venomous fluid under the skin when they sting. The venom causes a painful swelling that may last for several days. If the stinger is still present, carefully remove it with tweezers. Some people may develop an allergic reaction (i.e. anaphylactic shock) to a wasp or bee sting. If such a reaction develops, seek medical attention at once. If a GEI employee is allergic to bees or wasps notify the SSO and if, needed, the location of the epi pen. Any individuals who have been bitten or stung by an insect shall notify the SSO and the Con Edison Construction Representative immediately.

4.4.5 Sun Exposure

Employees are encouraged to liberally apply sunscreen, with a minimum sun protection factor (SPF) of 15, when working outdoors to avoid sunburn and potential skin cancer, which is associated with excessive sun exposure to unprotected skin. Additionally, employees should wear safety glasses that offer protection from ultraviolet A and B (UVA/UVB) rays.

5. Personal Protective Equipment

The PPE specified in Table 4 represents PPE selection required by 29 CFR 1910.132, and is based on the Activity Hazard Analysis of Section 4 (Table 2). Specific information on the selection rationale activity can be found in the GEI Health and Safety Manual.

The PPE program addresses elements, such as PPE selection based on Site hazards, use and limitations, donning and doffing procedures, maintenance and storage, decontamination and disposal, training and proper fitting, inspection procedures prior to / during / and after use, evaluation of the effectiveness of the PPE program, and limitations during temperature extremes, heat stress, and other appropriate medical considerations. A summary of PPE for each level of protection is in Table 4.

Table 4. Site-Specific PPE

Task	PPE Level	Site-Specific Requirements	Respirator
Mobilization/Demobilization			
Reconnaissance	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D - None
Mobilization/Demobilization of Equipment and Supplies	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D – None
Establishment of Site Security, Work Zones, and Staging Area	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D - None
Investigation/Construction			
Drilling, Groundwater Well Installation, Excavation, Backfilling, Sampling, Monitoring Well Repair	D	Hard hat, safety glasses, steel toe/shank safety boot with overboot as needed, reflective vest, leather work gloves as needed, nitrile gloves, hearing protection as needed, Tyvek as needed	Level D initially, Level C-If action levels exceeded (see Section 9 of HASP)
Remediation Observation			
Observe Contractor Activities	D	Hard hat, safety glasses, steel toe/shank safety boot with overboot as needed, reflective vest, leather work gloves as needed, nitrile gloves, hearing protection as needed, Tyvek as needed	Level D initially, Level C-If action levels exceeded (see Section 9 of HASP)
Odor Control			
Biosolve® Pinkwater® Mixing and Application	D	Face shield or chemical googles and nitrile gloves	D - None

Use of Level A or Level B PPE is not anticipated. If conditions indicating the need for Level A or Level B PPE are encountered, personnel will leave the Site and this HASP will be revised with oversight of the CHSO or GEI personnel will not re-enter the Site until conditions allow.

For most work conducted at the site, Level D PPE will include long pants, hard hats, safety glasses with side shields, and steel toe/shank or EH-rated safety boots. When work is conducted in areas where non-aqueous phase liquid (NAPL) or tar-saturated soil is anticipated, employees will wear, at a minimum, Level D PPE, which can include Tyvek® coveralls and safety boots with overboots.

5.1 OSHA Requirements for PPE

Personal protective equipment used during the course of this field investigation must meet the following OSHA standards:

Table 5. OSHA Standards for PPE

Type of Protection	Regulation	Source
Eye and Face	29 CFR 1910.133	ANSI Z87.1 1968
Respiratory	29 CFR 1910.134	ANSI Z88.1 1980
Head	29 CFR 1910.135	ANSI Z89.1 1969
Foot	29 CFR 1910.136	ANSI Z41.1 1999 or ASTM F-2412-2005, and ASTM F-2413-2005

CRF = Code of Federal Regulations
ANSI = American National Standards Institute
ASTM = American Society For Testing and Materials

On-site GEI personnel who have the potential to don a respirator must have a valid fit test certification and documentation of medical clearance. The CHSO will maintain such information on file for on-site personnel. The PM will obtain such information from the subcontractor's site supervisor prior to the initiation of such work. Both the respirator and cartridges specified for use in Level C protection must be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910.134). Air purifying respirators cannot be worn under the following conditions:

- Oxygen deficiency (less than 20.7%).
- Imminent Danger to Life and Health (IDLH) concentrations.
- If contaminant levels exceed designated use concentrations.

6. Key Project Personnel/Responsibilities and Lines of Authority

6.1 GEI Personnel

- Melissa Felter, P.G — Project Manager
- Matthew O'Neil, P.E — Project Engineer
- Ricky Perryman — Site Safety Officer
- Steven Hawkins — Safety Director
- Jessie Papageorge — Regional Safety Manager

The implementation of health and safety at this project location will be the shared responsibility of the PM, the CHSO, the SSO, other GEI personnel implementing the proposed scope of work.

6.1.1 GEI Project Manager

The PM, Melissa Felter, is responsible for confirming that the requirements of this HASP are implemented. Some of the PM's specific responsibilities include:

- Conducting and documenting the Project Safety Briefing for GEI project employees and forwarding the signed form (Appendix D) to the Health and Safety Committee;
- Verifying that the GEI staff selected to work on this program are sufficiently trained for Site activities;
- Assuring that personnel to whom this HASP applies, including subcontractor personnel, have received a copy of it;
- Providing the CHSO with updated information regarding conditions at the Site and the scope of Site work;
- Providing adequate authority and resources to the on-site SSO to allow for the successful implementation of necessary safety procedures;
- Supporting the decisions made by the SSO and CHSO;
- Maintaining regular communications with the SSO and, if necessary, the CHSO;
- Verifying that the subcontractors selected by GEI to work on this program have completed GEI environmental, health and safety requirements and has been deemed acceptable for the proposed scope of work; and
- Coordinating the activities of GEI subcontractors and confirming that they are aware of the pertinent health and safety requirements for this project.

6.1.2 GEI Corporate Health and Safety Officer

The CHSO, Steven Hawkins, is the individual responsible for the review, interpretation, and modification of this HASP. Modifications to this HASP which may result in less stringent precautions cannot be undertaken by the PM or the SSO without the approval of the CHSO. Specific duties of the CHSO include:

- Writing, approving, and amending the HASP for this project;
- Advising the PM and SSO on matters relating to health and safety on this Site;
- Recommending appropriate PPE and safety equipment to protect personnel from potential Site hazards;
- Conducting accident investigations; and
- Maintaining regular contact with the PM and SSO to evaluate Site conditions and new information which might require modifications to the HASP.

6.1.3 GEI Site Safety Officer

GEI field staff are responsible for implementing the safety requirements specified in this HASP. However, one person will serve as the SSO. For this program, Mathew Sandefur will serve as the SSO. The SSO will be on-site during all activities covered by this HASP. The SSO is responsible for enforcing the requirements of this HASP once work begins. The SSO has the authority to immediately correct situations where noncompliance with this HASP is noted and to immediately stop work in cases where an immediate danger is perceived. Some of the SSO's specific responsibilities include:

- Conducting/attending the Project Safety Briefing prior to beginning work, and subsequent safety meetings as necessary;
- Conduct daily Safety Tailgate meeting in accordance with Con Edison requirements (can be combined with "pre-entry") briefing for Site-related work;
- Verifying that personnel to whom this HASP applies have attended and participated in the Project Safety Briefing and subsequent safety meetings that are conducted during the implementation of the program;
- Maintaining a high level of health and safety consciousness among employees implementing the proposed activities;
- Procuring the air monitoring instrumentation required and performing air monitoring for investigative activities;
- Procuring and distributing the PPE and safety equipment needed for this project for GEI employees;

- Verifying that PPE and health and safety equipment used by GEI is in good working order;
- Verifying that the selected contractors are prepared with the correct PPE and safety equipment and supplies;
- Notifying the PM of noncompliance situations and stopping work in the event that an immediate danger situation is perceived;
- Monitoring and controlling the safety performance of personnel within the established restricted areas to confirm that required safety and health procedures are being followed;
- Stopping work in the event that an immediate danger situation is perceived; and
- Reporting accident/incident and preparing accident/incident reports, if necessary.

6.1.4 GEI Field Personnel

GEI field personnel covered by this HASP are responsible for following the health and safety procedures specified in this HASP and for performing their work in a safe and responsible manner. Some of the specific responsibilities of the field personnel are as follows:

- Reading and signing the HASP in its entirety prior to the start of on-site work;
- Attending and actively participating in the required Project Safety Briefing prior to beginning on-site work and any subsequent safety meetings that are conducted during the implementation of the program;
- Stopping work in the event that an immediate danger situation is perceived;
- Bringing forth any questions or concerns regarding the content of the HASP to the PM or the SSO, prior to the start of work;
- Reporting accidents, injuries, and illnesses, regardless of their severity, to the SSO, CHSO, and HR; and
- Complying with the requirements of this HASP and the requests of the SSO.

6.1.5 Lines of Authority will be as follows:

On Site – GEI will have responsibility for safety of its employees during the work performed at the Former Woodworth Avenue Works. GEI's field representative will have a cell phone available to contact the appropriate local authorities, in the event of an emergency. GEI's field representative will be available for communication with the GEI PM and with the Con Edison representative.

GEI employees have the authority to stop work activities if an unanticipated hazard is encountered or a potential unsafe condition is observed. The GEI employee should

contact the Corporate Health and Safety Officer and the Project Manager to discuss the stop work conditions and potential control methods that can be implemented.

6.2 Subcontractors

GEI requires its subcontractors to work in a responsible and safe manner. Subcontractors for this project will be required to develop their own HASP for protection of their employees, but, at a minimum, must adhere to applicable requirements set forth in this HASP.

7. Training Program

7.1 HAZWOPER Training

In accordance with OSHA Standard 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response" (HAZWOPER) responders will, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations. At a minimum, the training will have consisted of instruction in the topics outlined in the standard. Personnel who have not met the requirements for initial training will not be allowed to work in any Site activities in which they may be exposed to hazards (chemical or physical). Proof of training will be submitted to the PM or his/her representative prior to the start of field activities. Copies of training documentation will be given to the Con Edison Construction Representative and will be retained onsite by GEI Staff.

7.2 Annual 8-Hour Refresher Training

Annual 8-hour refresher training will be required of hazardous waste site field personnel in order to maintain their qualifications for fieldwork. The training will cover a review of 29 CFR 1910.120 requirements and related company programs and procedures. Proof of current 8-hour refresher training will be submitted to the PM or his/her representative prior to the start of field activities. Copies of training documentation will be given to the Con Edison Construction Representative and will be retained onsite by GEI Staff.

7.3 Supervisor Training

Personnel acting in a supervisory capacity will have received 8 hours of instruction in addition to the initial 40-hour training. In addition supervisors will have 1 year of field experience and training specific to work activities (i.e., sampling, construction observation, etc.)

7.4 Site-Specific Training

Prior to commencement of field activities, the PM or the SSO will verify GEI field personnel assigned to the project will have completed training that will specifically address the activities, procedures, monitoring, and equipment used in the Site operations. It will include Site and facility layout, hazards, and emergency services at the Site, and will highlight the provisions contained within this HASP and applicable GEI H&S SOPs (Appendix E). This training will be documented on the Project Safety Briefing Form Appendix D). The signed form will be forwarded to the Safety Team at Safety_Team@geiconsultants.com. In addition, GEI personnel will sign the plan to document that they understand the hazards and control measures presented and agree to comply with the procedures established in the HASP. Personnel that have not received project-specific training will not be allowed on-site. Copies of do

cumentation of GEI's full HASP review to all workers on Site shall be given to the Con Edison Construction Inspector on Site.

7.5 On-Site Safety Briefings

Other GEI personnel will be given health and safety briefings daily by the SSO or field representative to assist GEI personnel in safely conducting work activities. The briefing will include GEI subcontractors. The briefings can include information on new operations to be conducted, changes in work practices, or changes in the Site's environmental conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. Documentation of these briefings will be recorded in the GEI field book, if the project duration is less than 5 days. If the project is longer than 5 days, the Tailgate Safety Briefing Form (Appendix D) will be used to document briefings. The meetings will also be an opportunity to periodically update the employees on monitoring results.

Copies of documentation of each day's pre-job safety briefings shall be given to the Con Edison Construction Inspector on Site.

Additionally, should an incident occur on Site, Con Edison's Construction Environmental Health and Safety (EH&S) Representative must receive a copy of that day's pre-job safety briefing sheet along with the RCIR. Con Edison will look to see that appropriate topics were discussed during that day, as well as noting the person(s) involved in the incident were in attendance for that safety briefing (signatures).

7.6 First Aid and CPR

The PM will verify that GEI field staff has current certifications in first aid and Cardiopulmonary Resuscitation (CPR), so that emergency medical treatment is available during field activities. The training will be consistent with the requirements of the American Red Cross Association. GEI employees also attend annual Bloodborne Pathogens training in compliance with OSHA regulations.

8. Medical Surveillance Program

GEI maintains a continuous, corporate, medical surveillance program that includes a plan designed specifically for field personnel engaged in work at sites where hazardous or toxic materials may be present. Steven Hawkins is GEI's CHSO and is responsible for the administration and coordination of medical evaluations conducted for GEI's employees at branch office locations. Comprehensive examinations are given to GEI field personnel on an annual or biennial basis (as determined to be appropriate by the CHSO) participating in hazardous waste operations. The medical results of the examinations aid in determining the overall fitness of employees participating in field activities.

Under the CHSO's supervision, field personnel undergo a complete initial physical examination, including a detailed medical and occupational history, before they participate in hazardous waste site investigations. Extensive annual/biennial reexaminations are also performed. Upon completion of these tests, personnel are certified by an occupational health physician as to whether they are fit for field work in general, and fit to use respiratory protection.

If a GEI employee or other project worker shows symptoms of exposure to a hazardous substance and wishes to be rechecked, he/she will be directed to the nearest area hospital or medical facility.

GEI subcontractor personnel that will enter any active waste handling or other active non-"clean" area must certify that they are participating in a medical surveillance program that complies with OSHA regulations for hazardous waste operations (i.e., 29 CFR 1910.120 and 29 CFR 1926.65). Proof of medical clearance will be submitted to the GEI PM or SSO prior to the start of field activities.

9. Monitoring

Air monitoring will be performed to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of worker protection needed on-site in the event that intrusive work is conducted. Work requiring air monitoring includes the installation and/or abandonment of monitoring wells, DNAPL recovery wells, oxygen injection wells, and soil vapor points. Additionally, PID screening of the well head space will be conducted during groundwater sampling activities.

GEI may conduct perimeter air monitoring, and work zone monitoring for on-site GEI employees during intrusive activities only. Activities requiring air monitoring will be conducted in accordance with a pre-approved work plan. GEI will monitor and document daily Site conditions and operations and inform field representatives of results. If Action Levels are exceeded, the SSO will immediately implement Site action(s) according to Table 6 below and notify the PM and CHSO.

GEI will provide the following equipment for health and safety monitoring of on-site GEI personnel:

- PID with 10.6 eV lamp or equivalent;
- Drager CMS sampling system and Sensidyne detector tubes and sampling pump
- Particulate Meter (PM-10 capable)
- Four Gas Meter: Lower Explosive Level (LEL) / Oxygen (O_2) / hydrogen sulfide (H_2S) / hydrogen cyanide (HCN) meter;

Air monitoring equipment will be calibrated and maintained in accordance with manufacturer's requirements. Calibrations will be recorded in the project notes daily or on a daily calibration form.

Organic vapor concentrations will be measured using a PID during intrusive activities. During intrusive operations, organic vapor concentrations will be measured continuously. Organic vapor concentrations will be measured upwind of the work site(s) to determine background concentrations at least twice a day, (once in the morning and once in the afternoon). The SSO will interpret monitoring results using professional judgment and according to the alert and Action Limits set forth in the associated Site Work Plan.

A dust meter will be used to measure airborne particulate matter during intrusive activities. Monitoring will be continuous and readings will be averaged over a 15-minute period for comparison with the Action Levels. Monitoring personnel will make a best effort to collect dust monitoring data from downwind of the intrusive activity. If off-site sources are considered to be the source of the measured dust, upwind readings will also be collected.

A four gas meter will be used to monitor for combustible gases and O_2 content in the work zone during intrusive activities. The meter will also be equipped with an H_2S sensor and an HCN sensor. H_2S monitoring will be completed every 15 minutes or, if a sulfur odor is present, monitoring will be continuous. HCN monitoring will be completed every 15 minutes or, if an almond odor is detected, monitoring will be continuous.

The perimeter and work zone air monitoring will be conducted during demolition activities. Table 6 provides a summary of real time air monitoring Action Levels and contingency plans for work zone activities. The below Action Levels are determined by halving the Permissible Exposure Limits (PELs) or Threshold Limit Values (TLVs) as set forth by OSHA and the American Conference of Government Industrial Hygienists (ACGIH). O_2 values are based on the maximum use limits of a full face respirator if oxygen were being displaced by a chemical.

Table 6. Real-Time Work Zone Air Monitoring Action Levels

Air Monitoring Instrument	Monitoring Location	Action Level (above background)	Site Action
PID	Work Zone	1.0 ppm	Use Drager CMS for benzene to verify if concentration is benzene. No respiratory protection is required if benzene is not present.
PID	Work Zone	10 ppm	Use Sensidyne detector tube for naphthalene to verify if concentration is naphthalene. No respiratory protection is required if naphthalene is not present.
		10 – 50 ppm	No respiratory protection is required if benzene or naphthalene is not present.
		50 – 100 ppm	Stop work, withdrawal from work area, institute engineering controls, if levels persist, upgrade to Level C.
		> 100 ppm	Stop work, withdraw from work area, notify PM and CHSO.
O_2 Meter	Work Zone	< 20.7%	Stop work, withdraw from work area, ventilate area, notify PM and CHSO.
		> 21.1%	Stop work, withdraw from work area, notify PM and CHSO.
H_2S Meter	Work Zone	< 5.0 ppm	No respiratory protection is required.
		> 5.0 ppm	Stop work, cover excavation, withdraw from work area, institute engineering controls, notify PM and CHSO.
HCN Meter	Word Zone	< 1.0 ppm	Run CMS Drager tube. Continue monitoring with real-time meter, and continue work if CMS Drager tube reading is less than 2.0 ppm.
		> 1.0 ppm HCN Concentrations < 2.0 ppm	Run CMS Drager tube and confirm concentration is less than 2.0 ppm, notify PM and CHSO. Run CMS tube for sulfur dioxide, hydrogen sulfide, and phosphine chip potential interferences. Continue to monitor with real-time meter.
		> 2.0 ppm	Stop work, and move (with continuous HCN monitoring meter) at lease 25 ppm upwind of the excavation until continuous meter reads less than 1 ppm, notify PM and CHSO. Run CMS Drager hydrogen cyanide chip and re-evaluate activity, continue monitoring with a real-time meter, resume work if concentrations read less than 1.0 ppm.
CGI	Work Zone	< 10% LEL	Investigate possible causes, allow excavation to ventilate, use caution during procedures.
		> 10% LEL	Stop work, allow excavation/borehole to ventilate to < 10% LEL, if ventilation does not result in a decrease to < 10% LEL, withdraw from work area, notify PM and CHSO.
Particulate Meter	Work Zone	150 µg/m^3	Implement work practices to reduce/minimize airborne dust generation, e.g., spray/misting of soil with water.

10. Site Control Measures

10.1 Site Zones

Site zones are intended to control the potential spread of contamination and to assure that only authorized individuals are permitted into potentially hazardous areas. A three-zone approach will be utilized. It will include an Exclusion Zone (EZ), Contamination Reduction Zone (CRZ) and a Support Zone (SZ). Specific zones will be established on the work site by the Contractor when operations begin for each task requiring such delineation. Maps depicting the zones will be available at the Site.

This project is being conducted under the requirements of 29 CFR 1910.120, and any personnel working in an area where the potential for exposure to Site contaminants exists, will only be allowed access after proper training and medical documentation.

The following will be used for guidance in revising these preliminary zone designations, if necessary.

Support Zone – The SZ is an uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for medical emergency. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone.

Contamination Reduction Zone – The CRZ is established between the EZ and the SZ. The CRZ contains the contamination reduction corridor and provides an area for decontamination of personnel and portable hand-held equipment, tools and heavy equipment. A personnel decontamination area will be prepared at each exclusion zone. The CRZ will be used for EZ entry and egress in addition to access for heavy equipment and emergency support services.

Exclusion Zone – Activities which may involve exposure to Site contaminants, hazardous materials, and/or conditions should be considered an EZ. This zone will be clearly delineated by cones, tapes, or other means. The Contractor may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ will be determined by the Contractor allowing adequate space for the activity to be completed, field members, and emergency equipment.

The Contractor is responsible for constructing, maintaining, and enforcing the zones.

10.2 Buddy System

GEI personnel should be in line-of-site or communication contact with another on-site person. The other on-site person should be aware of his or her role as a “buddy” and be able to provide

assistance in the event of an emergency. A copy of this plan will be given to any person acting as a GEI "buddy" for informational purposes.

10.3 Sanitation for Temporary Work Sites

Temporary sanitary facilities including toilets will be available on-site.

10.4 Illumination

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. Activities planned for the Site are anticipated to occur outside during daylight hours. However, if yard areas are used after dark, they will be equipped with illumination that meets or exceeds requirements specified in OSHA Standard 29 CFR 1926.56 "Illumination." Employees will not work on sites that are not properly lighted.

11. Accident Reporting

11.1 Incident Reporting

GEI will report incidents involving GEI personnel or subcontractor personnel, such as: lost time injuries, injuries requiring medical attention, near miss incidents, fires, fatalities, accidents involving the public, chemical spills and property damage. The following steps must be followed when an incident occurs:

1. In life-threatening situations, immediately call 9-1-1.
2. Stop work activity to address any injury, illness, property damage or emergency.
3. Immediately report any incidents to your Supervisor/Project Manager and Regional Health & Safety Officer.
4. If your injury or illness is not life-threatening, call Medcor Triage at 1-800-775-5866 to speak with a medical professional.
5. Complete an Incident Report Form immediately after addressing the incident.

For all vehicle accidents involving another vehicle or damage to property, the employee will take pictures of each vehicle or property involved in the incident and obtain a police report. In some municipalities police will not be dispatched to a non-injury accident, but every effort needs to be made to try and obtain the report.

The Incident Report Form and the Near Miss Reporting Form can be found in Appendix D, on the GEI Health and Safety smartphone app, or on the Health and Safety page of the GEI Intranet. To report subcontractor injuries or incidents, follow the same verbal reporting procedures and submit an email describing the event to the PM and H&S Committee.

The Con Edison Construction Inspector shall be notified immediately of any incidents that occur on the project.

For any incident on Site, all work on the activity where the incident occurred shall cease. GEI will prepare a RCIR / PAP and submit it to Con Edison's Construction EH&S Representative for review/acceptance. Work on the activity where the incident occurred may only resume once Con Edison considers the RCIR / PAP acceptable, at which time it will become an Addendum to the HASP. Work on all other project activities may continue.

Should the incident be an injury or fatality, GEI shall submit, electronically, a completed Con Edison Contractor Injury Report Form within 1 business day of the incident.

11.1.1 Injury Triage Service

If a GEI employee experiences a work related injury that is not life-threatening, the employee will initiate a call to Medcor Triage at 1-800-775-5866. The injured employee will detail any medical symptoms or complaints which will be evaluated by a Registered Nurse (RN) specially trained to perform telephonic triage. The RN will recommend first aid self-treatment or refer the injured employee for an off-site medical evaluation by a health professional at a clinic within GEI's workers compensation provider network. GEI employees are still required to follow our Accident Reporting procedures as listed above.

12. Decontamination Procedures

12.1 Personnel Decontamination Station

A personnel decontamination station where employees can drop equipment and remove PPE will be set up at the decontamination pad by the Contractor. It will be equipped with basins for water and detergent, and trash bag(s), or cans for containing disposable PPE and discarded materials. Once personnel have decontaminated at this station and taken off their PPE, they will proceed to a sink where they will wash themselves wherever they have potentially been exposed to any contaminants (e.g., hands, face, etc.)

The following specific decontamination procedure will be used as necessary by GEI personnel or subcontractor personnel wearing PPE from Level D through Level C.

- ***Step 1 –*** Equipment drop (respirator, tools, monitoring equipment, etc.) Decontaminate as appropriate (per GEI's field representative's instructions).
- ***Step 2 –*** Boot wash/rinse (wash with non-foaming detergent, rinse with fresh water spray). Remove boots. If inner and outer gloves are worn, wash outer gloves, remove and save for later use, or remove and discard outer gloves and place in trash bag/can provided in the decontamination area.
- ***Step 3 –*** Hard hat removal; wash if visibly contaminated (use same wash as in Step 2).
- ***Step 4 –*** If Tyvek® (or equivalent) suit was worn and is visibly contaminated, remove and place in trash bag/can provided in the decontamination area or decontaminate (wash) and store for reuse. Contaminated washable coveralls should be removed and bagged for washing.
- ***Step 5 –*** Respirator and/or eye protection removal (as applicable). Wash (per Step 2) to remove visible contamination.
- ***Step 6 –*** Remove outer gloves.
- ***Step 7 –*** Wash potentially exposed skin (use water and soap at indoor sink).
- ***Step 8 –*** Disinfect respirator per manufacturer's recommendations.

Contaminated PPE (gloves, suits, etc.) will be decontaminated and stored for reuse or placed in plastic bags (or other appropriate containers) and disposed of in an approved facility.

Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with applicable state and federal regulations.

12.2 Heavy Equipment Decontamination

Modify for the specific project or delete if not applicable (then delete this note).

Heavy equipment decontamination will be performed by the Contractor within the limits of the on-site decontamination pad in accordance with the contract specifications. A steam generator and brushes will be used to clean demolition equipment and other tools. No heavy equipment will be permitted to leave the Site unless it has been thoroughly decontaminated.

Wastewater from the heavy equipment and personnel decontamination areas will be collected and disposed of in accordance with applicable state and federal regulations. The Contractor will be responsible for ultimate disposal of investigation-derived wastes.

12.3 Decontamination Equipment Requirements

The following equipment, if required, should be in sufficient supply to implement decontamination procedures for GEI's equipment.

- Buckets
- Alconox™ detergent concentrate
- Hand pump sprayers
- Long handled soft bristle brushes
- Large sponges
- Cleaning wipes for respirators
- Bench or stool(s)
- Methanol and/or Nitric Acid
- Liquid detergent and paper towels
- Plastic trash bags

The Contractor performing decontamination procedures is responsible for verifying that the above materials, as required for their operation, are in sufficient supply.

13. Supplemental Contingency Plan Procedures

13.1 Hazard Communication Plan

GEI personnel have received hazard communication training as part of their annual health and safety training and new employee health and safety orientation training. Hazardous materials used on the Site will be properly labeled, stored, and handled. SDS will be available to potentially exposed employees. Subcontractors will be required to provide documentation of hazard communication training. GEI will only use Con Edison-approved chemicals on Site. A copy of GEI's Hazard Communication (HAZCOM) Program is provided in Appendix G.

13.2 Fire

In the event of a fire personnel will evacuate the area. GEI's field representative will contact the local fire department with jurisdiction and report the fire. Notification of evacuation will be made to the PM and the CHSO. The field representative will account for GEI personnel and subcontractor personnel and report their status to the PM.

13.3 Medical Support

In case of minor injuries, on-site care will be administered with the Site first aid kit. For serious injuries, call 911 and request emergency medical assistance. Seriously injured persons should not be moved, unless they are in immediate danger. Notify the PM and the CHSO of the emergency.

Section 1 and Table 1 of this HASP contain detailed emergency information, including directions to the nearest hospital, and a list of emergency services and their telephone numbers. In addition, Appendix A includes maps to the hospital and/or occupational health clinic. GEI field personnel will carry a cellular telephone.

13.4 Severe Weather

The contingency plan for severe weather includes reviewing the expected weather to determine if severe weather is in the forecast. Severe weather includes high winds over 30 miles per hour (mph), heavy rains or snow squalls, thunderstorms, tornados, and lightning storms. If severe weather is approaching, the decision to evacuate GEI personnel and subcontractor personnel from the Site will be the responsibility of GEI's field representative. Notification of evacuation will be made to the PM and the CHSO. The field representative will account for GEI personnel and subcontractor personnel and report their status to the PM. If safe, work can resume 30 minutes after the last clap of thunder or flash of lightening.

13.5 Spills or Material Release

If a hazardous waste spill or material release occurs, if safe, the SSO or their representative will immediately assess the magnitude and potential seriousness of the spill or release based on the following:

- SDS for the material spilled or released;
- Source of the release or spillage of hazardous material;
- An estimate of the quantity released and the rate at which it is being released;
- The direction in which the spill or air release is moving;
- Personnel who may be or may have been in contact with the material, or air release, and possible injury or sickness as a result;
- Potential for fire and/or explosion resulting from the situation; and
- Estimates of area under influence of release.

If the spill or release is determined to be within the on-site emergency response capabilities, the SSO will verify implementation of the necessary remedial action. If the release is beyond the capabilities of the Site personnel, personnel will be evacuated from the immediate area and the local fire department will be contacted. The SSO will notify the PM and the CHSO.

All small hazardous spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the SDS will be consulted to assist in determining the best means of containment and cleanup. For small spills, absorbent materials such as sand, sawdust, or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid or caustic spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. Drains or drainage areas shall be blocked. All spill-containment materials will be properly disposed. An exclusion zone of 50 to 100 feet around the spill area should be established depending on the size and type of the spill.

Refueling of sampling equipment will be done with National Fire Protection Association (NFPA)-approved safety cans and by approved United States Coast Guard (USCG) refueling methods. Fuel will be stored in containers meeting applicable fuel storage safety regulations. Refueling of any equipment will take place off Site. Fuel will not be stored on Site. Fuel present on Site will be contained in the fuel tanks of the vehicles or equipment required to perform the work tasks previously described.

The Emergency Coordinator should take the following steps:

1. Determine the nature, identity and amounts of major spill components;

2. Make sure all unnecessary persons are removed from the spill area;

3. Notify appropriate response teams and authorities;

4. Use proper PPE in consultation with the SSO and information provided on the SDS for the spilled material;

5. If a flammable liquid, gas or vapor is involved, remove all ignition sources and use non-sparking and/or explosive proof equipment to contain or clean up the spill (diesel only vehicles, air operated pumps, etc.);

6. If possible, try to stop the leak with appropriate material;

7. Remove all surrounding materials that can react or compound with the spill; and

8. Notify the Client Project Manager and the Con Edison Construction Representative immediately. Con Edison will make any and all notifications to the various required agencies via Con Edison spill reporting procedures.

13.6 Alcohol and Drug Abuse Prevention

Alcohol and drugs will not be allowed on the work Site. Project personnel under the influence of alcohol or drugs will not be allowed to enter the Site.

13.7 Working Around New York City Trees

No work may occur within the drip line of trees in New York City without a NYCDPR permit. A certified arborist will need to be consulted to determine the need for a permit. This will be coordinated with Con Edison.

14. Health and Safety Plan Sign-Off

GEI personnel conducting site activities will be familiar with the information in this HASP. After reviewing this plan, please sign the copy in the project files, and bring a copy of the plan with you to the Site.

Site Name: Former Woodworth Avenue Works

Site Activities: Boring Advancement, Sampling Observation, Monitoring Well Installation, Recovery Well Installation, Excavation and Filling, Monitoring Well Repair, Air Monitoring, NAPL Recovery

GEI Project No: 2101005 and 2201010

Print Name/Company	Signature	Date
Project Manager: Melissa Felter, PG		

Appendix A

Map to Hospital and Occupational Health Clinic

Appendix B

Safety Data Sheets

Appendix C

Heat Stress and Cold Stress Guidelines

Heat Stress Guidelines

Form	Signs & Symptoms	Care	Prevention[3]
Heat Rash	Tiny red vesicles in affected skin area. If the area is extensive, sweating can be impaired.	Apply mild lotions and cleanse the affected area.	Cool resting and sleeping areas to permit skin to dry between heat exposures.
Heat Cramps	Spasm, muscular pain (cramps) in stomach area and extremities (arms and legs).	Provide replacement fluids with minerals (salt) such as Gatorade.	Adequate salt intake with meals[1]. ACCLIMATIZATION[2]
Heat Exhaustion	Profuse sweating, cool (clammy) moist skin, dizziness, confusion, pale skin color, faint, rapid shallow breathing, headache, weakness, and/or muscle cramps.	Remove from heat, sit or lie down, rest, replace lost water with electrolyte replacement fluids (water, Gatorade) take frequent sips of liquids in amounts greater than required to satisfy thirst.	ACCLIMATIZATION[2] Adequate salt intake with meals[1], only during early part of heat season. Ample water intake, frequently during the day.
Heat Stroke	HOT Dry Skin. Sweating has stopped. Mental confusion, dizziness, nausea, chills, severe headache, collapse, delirium, and/or coma.	HEAT STROKE IS A MEDICAL EMERGENCY • Remove from heat. • COOL THE BODY AS RAPIDLY AS POSSIBLE by immersing in cold (or cool) water, or splash with water and fan. • Call for Emergency Assistance. • Observe for signs of shock.	ACCLIMATIZATION[2] Initially moderate workload in heat (8 to 14 days). Monitor worker's activities.

Footnotes:

1.) American diets are normally high in salt, sufficient to aid acclimatization. However, during the early part of the heat season, (May, June), one extra shake of salt during one to two meals per day may help, so long as this is permitted by your physician. Check with your personal physician.

2.) ACCLIMATIZATION - The process of adapting to heat is indicated by worker's ability to perform hot jobs less fluid loss, lower concentrations of salt loss in sweat, and a reduced core (body) temperature and heart rate.

3.) Method to Achieve Acclimatization - Moderate work or exercise in hot temperatures during early part of heat season. Adequate salt (mineral) and water intake. Gradually increasing work time in hot temperatures. Avoid alcohol. Normally takes 8 to 14 days to achieve acclimatization. Lost rapidly, if removed from strenuous work (or exercise) in hot temperature for more than approximately 5 days.

Cold Stress Guidelines

Stress	Symptoms	What to do
Mild Hypothermia	• Body Temp 98 to 90°F • Shivering • Lack of coordination, stumbling, fumbling hands • Slurred speech • Memory loss • Pale, cold skin	• Move to warm area • Stay active • Remove wet clothes and replace with dry clothes or blankets • Cover the head • Drink warm (not hot) sugary drink

Moderate Hypothermia	• Body temp 90 to 86°F
	• Shivering stops
	• Unable to walk or stand
	• Confused and/or irrational
		• All of the above, plus:
		  ○ Call 911
		  ○ Cover all extremities completely
		  ○ Place very warm objects, such as hot packs on the victim's head, neck, chest, and groin

Severe Hypothermia	• Body temp 86 to 78°F • Severe muscle stiffness • Very sleepy or unconscious • Ice cold skin • Death	• Call 911 • Treat victim very gently • Do not attempt to re-warm
Frostbite	• Cold, tingling, stinging, or aching feeling in the frostbitten area, followed by numbness • Skin color turns red, then purple, then white or very pale skin • Cold to the touch • Blisters in severe cases	• Call 911 • Do not rub the area • Wrap in soft cloth • If help is delayed, immerse in warm (not hot) water
Trench Foot	• Tingling, itching, or burning sensation • Blisters	• Soak feet in warm water, then wrap with dry cloth bandages • Drink a warm (not hot) sugary drink

Appendix D

Forms

Appendix E

GEI's Health and Safety SOPs

Appendix F

Con Edison Corporate Environmental, Health and Safety Procedures

- CEHSP E08.02 – Noise Construction and Utility Activities
- CEHSP S05.03 – Personal Protective Equipment – Protective Clothing
- CEHSP S12.00 – Lockout Tagout Procedures
- CEHSP S17.01 – Electrical Enclosed Spaces
- CEHSP A28.00 – Calling a Time Out
- CEHSP A32.00.01 – Rules We Live By, with 2015 (January 1, 2015) 'Rules' Table*
- Utility Clearance Process for Intrusive Activities – Corporate EH&S Remediation Program, Revision 1A, December 31, 2007
- Work Area Protection Field Manual

Appendix G

Hazard Communication (HAZCOM) Program

Appendix H

Job Hazard Analyses

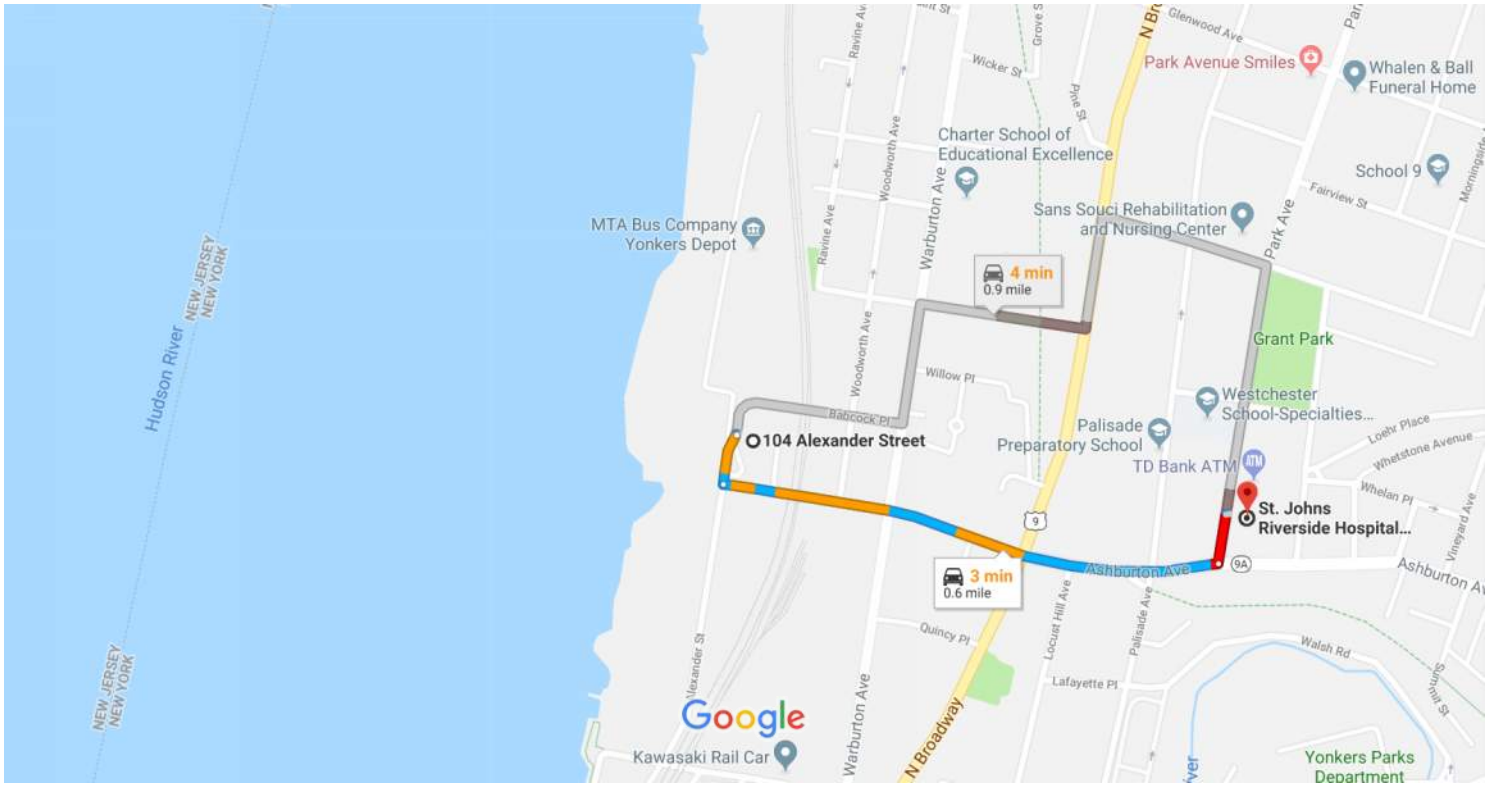
Appendix I

HASP Addendums

Google Maps

104 Alexander Street, Yonkers, NY to St. Johns Riverside Hospital ParkCare Pavilion

Drive 0.6 mile, 3 min



Map data ©2019 Google 500 ft

104 Alexander St

Yonkers, NY 10701

1. Head south on Polychrome Pl toward Ashburton Ave

253 ft

2. Turn left onto Ashburton Ave

0.5 mi

3. Turn left onto Park Ave

Destination will be on the right

240 ft

St. Johns Riverside Hospital ParkCare Pavilion

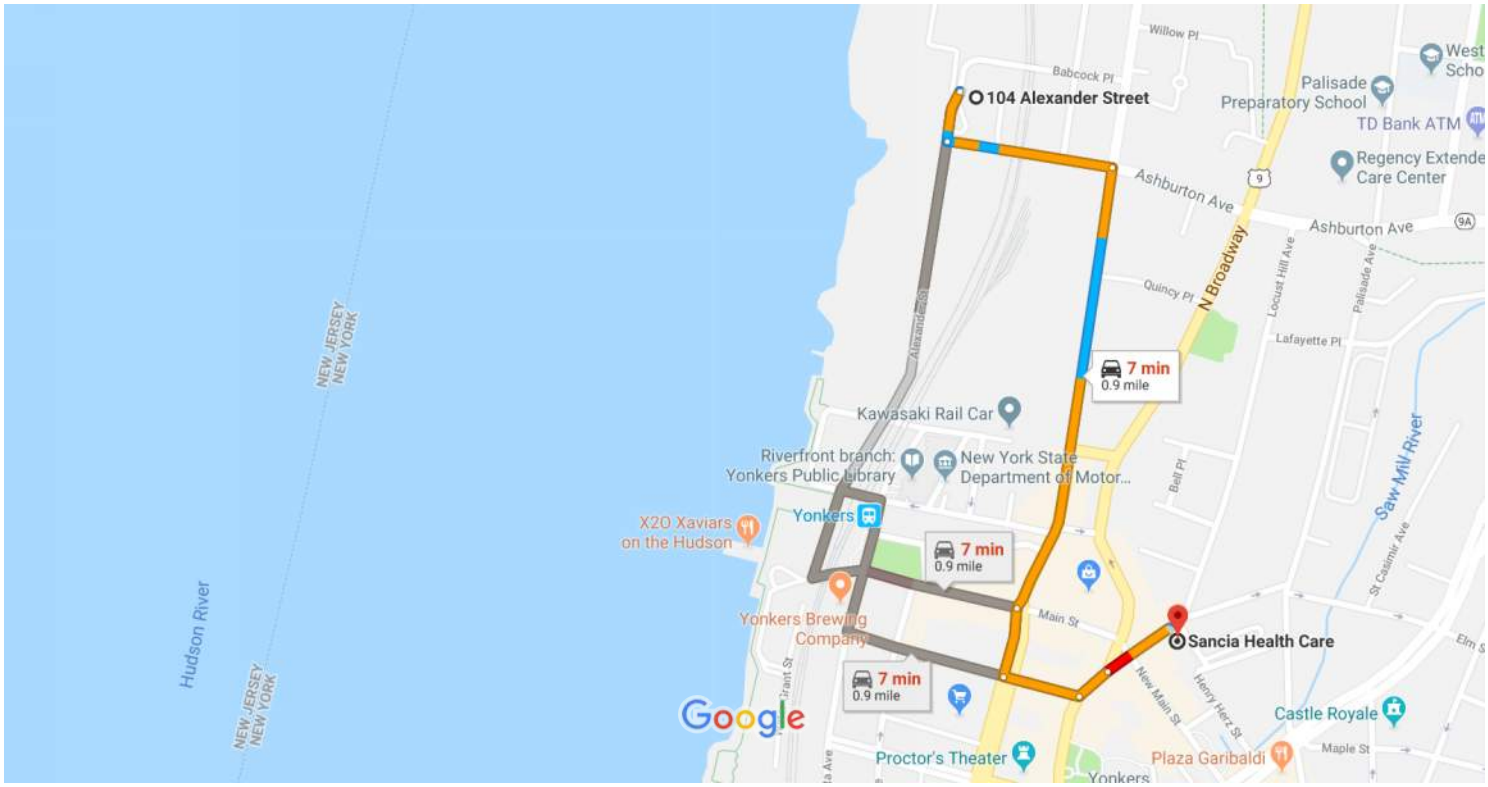
2 Park Ave, Yonkers, NY 10703

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Google Maps

104 Alexander Street, Yonkers, NY to health clinic near 104 alexander st yonkers NY

Drive 0.9 mile, 7 min



Map data ©2019 Google 500 ft

104 Alexander St

Yonkers, NY 10701

1. Head south on Polychrome Pl toward Ashburton Ave

253 ft

2. Turn left onto Ashburton Ave

0.2 mi

3. Turn right onto Warburton Ave

0.4 mi

4. Continue onto New York State Reference Rte 984H/Riverdale Ave

338 ft

5. Turn left onto Hudson St

374 ft

6. Turn left onto S Broadway

184 ft

7. Continue straight onto Palisade Ave

Destination will be on the right

364 ft

Sancia Health Care

10 Palisade Ave, Yonkers, NY 10701

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 316
Benzene

Issued: 11/78 Revision: E, 8/90

Section 1. Material Identification

Benzene (C_6H_6) Description: Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.
Other Designations: CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R 1
I 4
S 2*
K 4
*Skin absorption

NFPA
3
2 0
-

HMIS
H 3
F 3
R 0
PPG†
† Sec. 8

Cautions: Benzene is a confirmed *human carcinogen* by the IARC. *Chronic low-level exposure may cause cancer (leukemia) and bone marrow damage, with injury to blood-forming tissue.* It is also a dangerous fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)
8-hr TWA: 1 ppm, 3 mg/m³
15-min STEL: 5 ppm, 15 mg/m³

(29 CFR 1910.1000, Table Z-2)
8-hr TWA: 10 ppm
Acceptable Ceiling Concentration: 25 ppm
Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH
TLV-TWA: 10 ppm, 32 mg/m³

1988 NIOSH RELs
TWA: 0.1 ppm, 0.3 mg/m³
Ceiling: 1 ppm, 3 mg/m³

1985-86 Toxicity Data‡
Man, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted
Man, inhalation, TC_{Lo}: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)
Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.
† Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.
‡ See NIOSH, *RTECS* (CY1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)
Melting Point: 42 °F (5.5 °C)
Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)
Vapor Density (Air = 1): 2.7
Evaporation Rate (Ether = 1): 2.8

Molecular Weight: 78.11
Specific Gravity (15 °C/4 °C): 0.8787
Water Solubility: Slightly (0.180 g/100 g of H_2O at 25 °C)
%Volatile by Volume: 100
Viscosity: 0.6468 mPa at 20 °C

Appearance and Odor: A colorless liquid with a characteristic sweet, aromatic odor. The odor recognition threshold (100% of panel) is approximately 5 ppm (unfatigued) in air. Odor *is not* an adequate warning of hazard.

Section 4. Fire and Explosion Data

Flash Point: 12 °F (-11.1 °C), CC	Autoignition Temperature: 928 °F (498 °C)	LEL: 1.3% v/v	UEL: 7.1% v/v

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.
Unusual Fire or Explosion Hazards: Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Benzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and peroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide + water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric acid, and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine trifluoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).
Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.
Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.
Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).
Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.
Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."
Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)
DOT Hazard Class: Flammable liquid
ID No.: UN1114
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Benzene
IMO Hazard Class: 3.2
ID No.: UN1114
IMO Label: Flammable liquid
IMDG Packaging Group: II

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE-NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

MSDS Collection **References:** 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 409
Cresol (Mixed Isomers)

Issued: 12/78 Revision: B, 3/92

Section 1. Material Identification

Cresol, *mixed isomers* ($CH_3C_6H_4OH$) Description: Derived from coal tar or petroleum. Cresol is marketed by individual isomer and as pure or crude cresol. Pure cresol is a mixture of *ortho*, *meta*, and *para* isomers. Crude cresol (commercial cresol) is prepared by distilling "grey phenic acid" at 356 to 401 °F (180 to 205 °C) and is comprised of 20% *ortho*, 40% *meta*, and 30% *para* isomers, plus small amounts of phenol and xylenols. Each isomer can be prepared synthetically by diazotization of the specific corresponding toluidine. Used in manufacturing synthetic resins, explosives, photographic developers, petroleum, paint, disinfectants, and fumigants; as an ore flotation agent; and in the agriculture industry for herbicides and insecticides.
Other Designations: CAS No. 1319-77-3, Bacillol, cresylic acid, Tekresol, tricresol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Cresol is severely irritating to mucous membranes, eyes, and skin. Depending on the cresol concentration, extent of exposure, and amount of skin exposed, toxicity may be slight (irritation) or severe (permanent injury or death).

R 1
I 4
S 3*
K 2
* Skin absorption

NFPA
2
3 0
—

HMIS
H 3
F 2
R 0
PPG†
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Cresol (*mixed isomers*) National Formulary (NF) grade contains < 5% phenol

1990 OSHA PEL (Skin)
8-hr TWA: 5 ppm (22 mg/m³)

1990 NIOSH REL
TWA: 5 ppm (22 mg/m³)

1990 IDLH Level
250 ppm

1991-92 ACGIH TLV (Skin)
TWA: 5 ppm (22 mg/m³)

1990 DFG (Germany) MAK
TWA: 5 ppm (22 mg/m³) (H)*
Peak Exposure Limit: 10 ppm, 5 min, momentary value/8 per shift

1985-86 Toxicity Data†
Rat, oral, LD_{50}: 1454 mg/kg; toxic effects not yet reviewed
Mouse, inhalation, LC_{50}: 179 mg/m³/2 hr; no toxic effects noted (*o*-)
Rabbit, eye: 103 mg produced severe irritation (*p*-)
Rabbit, skin: 517 mg applied for 24 hr produced severe irritation (*m*-)
Rabbit, skin, LD_{50}: 2000 mg/kg; toxic effects not yet reviewed

* Danger of cutaneous absorption.
† See NIOSH, *RTECS* (GO5950000), for additional toxicity data. For data on specific isomers, see *RTECS* (GO6125000, *meta*; GO6300000, *ortho*; and GO6475000, *para*).

Section 3. Physical Data

Boiling Point Range: 375.8 to 397.4 °F (191 to 203 °C)
Melting Point Range: 51.8 to 95 °F (11 to 35 °C)
Vapor Pressure: 0.25 (*ortho*), 0.15 (*meta*), 0.11 (*para*) mm Hg at 68 °F (20 °C)
Vapor Density (air = 1): 3.72
pH: Saturated solutions are neutral or slightly acidic to litmus
Viscosity: 4.49 to 7.0 cP at 104 °F (40 °C)
Molecular Weight: 108.13
Specific Gravity: 1.030 to 1.038 at 77 °F (25 °C)
Water Solubility: Soluble, 1%
Other Solubilities: Soluble in alcohol, ether, dilute alkalies, glycol and vegetable oils
Refraction Index: 1. 5353 at 75.2 °F (24 °C)
Odor Threshold: Low, 0.012 mg/m³; high, 22 mg/m³

Appearance and Odor: Colorless, yellow, or pinkish liquid turning brown on exposure to air or light with a phenolic odor and pungent taste.

Section 4. Fire and Explosion Data

Flash Point: 178 °F (81.11 °C, *ortho*), 187 °F (86.11 °C, *meta* and *para*), CC	**Autoignition Temperature:** 1110 °F (559 °C, *ortho*), 1038 °F (558 °C, *meta* and *para*)	**LEL:** 1.4% (*ortho*), 1.1% (*meta* and *para*) at 302 °F (150 °C)	**UEL:** None reported

Extinguishing Media: While cresol does not ignite easily, it burns. For small fires, use dry chemical, carbon dioxide (CO_2), water spray, or regular foam. For large fires, use water spray, fog, or regular foam. Do not scatter material with more water than is necessary to put out fire.
Unusual Fire or Explosion Hazards: Container may explode in heat of fire.
Special Fire-fighting Procedures: Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is ineffective for fires involving cresol. Use clothing the manufacturer recommends specifically for use with cresol. If possible without risk, remove container from fire area. Fight fire from maximum distance. Stay away from ends of tanks. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Cresol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Cresol reacts with oxidizing materials and causes a temperature and pressure increase with chlorosulfonic acid, nitric acid, and oleum.
Conditions to Avoid: Ignition sources and contact with incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition of cresol can produce carbon dioxide (CO_2) and toxic cresol fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(142) and OSHA(164) do not list cresol as a carcinogen. **Summary of Risks:** Cresol is corrosive to eyes, skin, and mucous membranes. Degree of toxicity depends on the cresol concentration involved, amount of surface area exposed, and duration of exposure. Ingestion is corrosive to the digestive tract's mucous membranes and can pose serious problems if not treated promptly. Because cresol has a low vapor pressure, it is not volatile enough under normal conditions to present an inhalation hazard. If heated, vapor inhalation is likely. Severe chemical burns and dermatitis are the main hazards in industry. Note that cresol's *ortho* and *para* isomers (if used individually) are in crystal form and thus are a dust inhalation hazard. By all routes of exposure, cresol produces toxic symptoms similar to phenol's. **Medical Conditions Aggravated by Long-Term Exposure:** Skin diseases. **Primary Entry Routes:** Skin and eye contact/absorption. **Acute Effects: Target Organs:** Eyes, skin, central nervous system (CNS), liver and kidney. Cresol is absorbed through skin, open wounds, and the mucous membranes of the respiratory and digestive tracts. The rate at which skin absorbs cresol depends more on the size of exposure area than on the concentration of material applied. Cresol is corrosive to the skin causing smarting; tingling; redness; swelling; burns that may be very painful and become white and wrinkled with softening that may become gangrenous; blisters; possible shock as a result

Continue on next page

Copyright © 1992 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

of pain; and, in severe cases of absorption, coma and death. Contact with eyes may cause stinging, and burning, watering of eyes, redness and swelling of lids, corneal opaqueness causing blurred vision and possible loss of sight. In rare cases, a pigment disorder called ochronosis occurs characterized by darkening of skin, conjunctiva, and cartilage of the nose and ears. Ingestion leads to burning of lips, mouth, and throat, pain in swallowing, ulceration of the mucous membranes of the mouth, color change of the tongue (white), thirst, throat swelling, cramps, nausea and vomiting (sometimes of coffee grounds-like material due to digestive hemorrhage). In severe cases symptoms might progress to shock, convulsions, coma, and death. If vapor inhalation occurs, symptoms include irritation of mucous membranes of nose, eyes, and mouth, watering of eyes, sneezing, coughing, difficulty breathing, headache, nausea, muscle weakness, and possible pulmonary edema. In most cases of exposure, if death occurs, it is usually caused by respiratory failure. **Chronic Effects:** Repeated exposure to cresol may cause digestive disturbances, liver, kidney, spleen and pancreatic damage, and skin eruptions or dermatitis. Some people can become allergic or hypersensitive to cresol.

FIRST AID: *Emergency personnel should protect against contamination.*

Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* allow victim to rub or keep eyes tightly shut. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing to prevent burns. Rinse with flooding amounts of water for at least 15 min. If clothing is stuck to skin after flushing with water, *do not* remove! Thoroughly wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting with 2 tablespoons of Ipecac (adult dose). After patient vomits, give activated charcoal in 8 oz. of water to drink. **After first aid, get appropriate in-plant, paramedic, or community medical support.**

Note to Physicians: Since effects may be delayed, keep victim under observation. Irrigate eyes and wash skin with a mixture of polyethylene glycol 300 and industrial methylated spirits (PEG 300/IMS, 2:1 by volume). Recommended treatment for ingestion is repeated gastric lavage with large quantities of olive oil.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area (with fixed or portable fan systems for cross-ventilation), deny entry, and stay upwind. Shut off all ignition sources. Spilled liquid can be neutralized with crushed limestone or soda ash. Take up small spills with earth, sand, vermiculite or other absorbent, noncombustible material and place into suitable containers. For large spills, dike far ahead of liquid for later disposal or reclamation. For water spills, you may need to trap cresol at the bottom with sandbag barriers, apply activated charcoal, and then remove trapped material with dredges or lifts. Follow applicable OSHA regulations (29 CFR 1910.120).

Environmental Degradation: When released into the atmosphere, cresol degrades by reacting with photochemically produced hydroxyl radicals during the day (half-life = 8 to 10 hr), and with nitrate radicals at night (half-life = 2 to 5 min). Cresol biodegrades in eutrophic (nutrient-rich) waters.

Ecotoxicity Values: Blue gill, TL_m, 24 mg/L/96 hr (fresh water); shrimp, TL_m, 10 to 100 ppm/48 hr (saltwater).

Soil Absorption/Mobility: Cresol is mobile in soil but biodegradation is probable. Cresols probably leach due to water solubility.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U052*

Listed as a CERCLA Hazardous Substance† (40 CFR 302.4): Reportable Quantity (RQ), 1000 lb (454 kg) [† per RCRA, Sec. 3001 and CWA, Sec. 311(b)(4)]

Listed (*o-cresol only*) as a SARA Extremely Hazardous Substance (40 CFR 355)

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

* When a spent solvent and classified as a hazardous waste from nonspecific sources, cresol has Hazardous Waste No. F004.

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles or faceshields to protect against droplets or spray, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. At 50 to 500 ppm use a full face gas mask. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes: training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Rubber is suggested as a material suitable for protection against cresol.

Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103]

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in properly labelled (with trade name) iron or steel containers in cool, dry, well-ventilated location. Protect from light and keep away from incompatibles (Sec. 5). Outside or detached storage is preferred. To prevent static sparks, electrically ground and bond all equipment used in cresol manufacture, use, and storage.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level.

Administrative Controls: Consider preplacement and periodic examinations of exposed workers that emphasize skin, kidney, liver, and respiratory system.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Cresol
DOT Hazard Class: Corrosive material
ID No.: UN2076
DOT Label: Corrosive
DOT Packaging Exceptions: 173.244
DOT Packaging Requirements: 173.245

IMO Shipping Name: Cresols (*o-, m-, p-*)
IMO Hazard Class: 6.1
ID No.: UN2076
IMO Label: Poison
IMDG Packaging Group: II

***MSDS Collection* References:** 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 140, 153, 159, 162, 163, 164

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MPH, MD; **Edited by:** JR Stuart, MS

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 385
Ethylbenzene

Issued: 8/78 Revision: B, 9/92

Section 1. Material Identification

Ethylbenzene ($C_6H_5C_2H_5$) Description: Derived by heating benzene and ethylene in presence of aluminum chloride with subsequent distillation, by fractionation directly from the mixed xylene stream in petroleum refining, or dehydrogenation of naphthenes. Used as a solvent, an antiknock agent in gasoline; and as an intermediate in production of synthetic rubber, styrene, cellulose acetate, diethylbenzene, acetophenone, ethyl anthraquinone, propyl oxide, and α-methylbenzol alcohol.
Other Designations: CAS No. 100-41-4, ethylbenzol, EB, phenylethane, NCI-C56393.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

R 1
I 3
S 2*
K 4
* Skin absorption

NFPA



HMIS
H 2†
F 3
R 0
PPE - Sec. 8
† Chronic effects

Cautions: Ethylbenzene is a skin and mucous membrane irritant considered the most irritating of the benzene series. Inhalation causes acute and chronic central nervous system (CNS) effects. It is highly flammable and forms explosive mixtures with air.

Section 2. Ingredients and Occupational Exposure Limits

Ethylbenzene, ca >99.0%. Impurities include ~ 0.1% *meta* & *para* xylene, ~ 0.1% cumene, and ~ 0.1% toluene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m³)
15-min STEL: 125 ppm (545 mg/m³)
Action Level: 50 ppm (217 mg/m³)

1990 IDLH Level
2000 ppm

1990 NIOSH REL
TWA: 100 ppm (435 mg/m³)
STEL: 125 ppm (545 mg/m³)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m³)
STEL: 125 ppm (545 mg/m³)

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m³)
Category 1: local irritants
Peak Exposure Limit: 200 ppm, 5 min momentary value, max of 8/shift
Danger of cutaneous absorption

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 100 ppm/8 hr caused eye effects, sleep, and respiratory changes.
Human, lymphocyte: 1 mmol/L induced sister chromatid exchange.
Rat, oral, LD_{50}: 3500 mg/kg; toxic effects not yet reviewed
Rat (female), inhalation, TC_{Lo}: 1000 ppm/7 hr/day, 5 days/wk, for 3 wk prior to mating and daily for 19 days of gestation produced pups with high incidence of extra ribs.[179]

* See NIOSH, *RTECS* (DA0700000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 277 °F (136 °C)
Melting Point: -139 °F (-95 °C)
Surface Tension: 31.5 dyne/cm
Ionization Potential: 8.76 eV
Viscosity: 0.64 cP at 77 °F (25 °C)
Refraction Index: 1.4959 at 68 °F (20 °C)
Relative Evaporation Rate (ether = 1): 0.0106
Bulk Density: 7.21 lb/Gal at 77 °F (25 °C)
Critical Temperature: 651 °F (343.9 °C)
Critical Pressure: 35.6 atm

Molecular Weight: 106.16
Density: 0.863 at 77 °F (25 °C)
Water Solubility: Slightly, 14 mg/100 mL at 59 °F (15 °C)
Other Solubilities: Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia
Odor Threshold: 2.3 ppm
Vapor Pressure: 7.1 mm Hg at 68 °F (20 °C); 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg 165.38 °F (74.1 °C)
Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.0768 lb/ft³ or 1.2298 kg/m³

Appearance and Odor: Colorless, flammable liquid with a pungent odor.

Section 4. Fire and Explosion Data

Flash Point: 64 °F (18 °C) CC	Autoignition Temperature: 810 °F (432 °C)	LEL: 1.0% v/v	UEL: 6.7% v/v

Extinguishing Media: Class 1B Flammable liquid. For small fires, use dry chemical, carbon dioxide, or 'alcohol-resistant' foam. For large fires, use fog or 'alcohol-resistant' foam. Use water only if other agents are unavailable; EB floats on water and may travel to an ignition source and spread fire. **Unusual Fire or Explosion Hazards:** Burning rate = 5.8 mm/min. Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. EB poses a vapor explosion hazard indoors, outdoors, and in sewers. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Cool container sides with water until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Withdraw immediately if you hear rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Ethylbenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Reacts vigorously with oxidizers.
Conditions to Avoid: Exposure to heat and oxidizers.
Hazardous Products of Decomposition: Thermal oxidative decomposition of EB can produce acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list EB as a carcinogen. **Summary of Risks:** Occupational exposure to EB alone is rare since it is usually present together with other solvents. EB is irritating to the eyes, skin, and respiratory tract. Vapor inhalation produces varying degrees of CNS effects depending on concentration. The liquid is absorbed through the skin but vapors are not. 56 to 64% of inhaled ethylbenzene is retained and metabolized. Urinary metabolites following exposure to 23 to 85 ppm for 8 hr are mandelic acid (64%), phenylglyoxylic acid (25%), and methylphenylcarbinol/1-phenyl ethanol (5%). Concurrent exposure to xylene and ethylbenzene causes slower excretion of EB metabolites. Based on the rat LD_{50}, one manufacturer gives 3 to 4 oz. as the lethal dose for a 100 lb person.

Continue on next page

Copyright © 1992 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Skin and CNS diseases and impaired pulmonary function (especially obstructive airway disease). **Target Organs:** Eyes, respiratory system, skin, CNS, blood. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Vapor inhalation of 200 ppm caused transient eye irritation; 1000 ppm caused eye irritation with profuse watering (tolerance developed rapidly); 2000 ppm caused severe and immediate eye irritation and watering, nasal irritation, chest constriction, and vertigo; 5000 ppm was intolerable and caused eye and nose irritation. Inhalation of high concentrations may cause narcosis, cramps, and death due to respiratory paralysis. Skin exposed to pure ethylbenzene for 10 to 15 min absorbed 22 to 33 mg/cm^2/hr. Immersion of hand in solutions of 112 & 156 mg/L for 1 hr absorbed 118 & 215.7 µg/cm^2/hr, respectively. **Chronic Effects:** Repeated skin contact may cause dryness, scaling, and fissuring. Workers chronically exposed to > 100 ppm complained of fatigue, sleepiness, headache, and mild irritation of the eyes and respiratory tract. Repeated vapor inhalation may result in blood disorders, particularly leukopenia (abnormally low level of white blood cells) and lymphocytosis.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting! Aspiration of even a small amount of EB in vomitus can cause severe damage since its low viscosity and surface tension will cause it to spread over a large area of the lung tissue.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: BEI = mandelic acid in urine (1.5 g/g of creatinine), sample at end of shift at workweeks end. Since this test is not specific, test for EB in expired air for confirmation.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate and ventilate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container. Dike far ahead of large spill for later reclamation or disposal. Report any release >1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, EB partially evaporates into the atmosphere, with a half-life of hrs to wks, and some leaches into groundwater, especially in soil with low organic carbon content. Biodegradation occurs with a half-life of 2 days. Some EB may absorb to sediment or bioconcentrate in fish. Evidence points to slow biodegradation in groundwater. In air, it reacts with photochemically produced hydroxyl radicals with a half-life of hrs to 2 days. Additional amounts may be removed by rain. **Ecotoxicity Values:** Shrimp (*Mysidopsis bahia*), LC_{50} = 87.6 mg/L/96 hr; sheepshead minnow (*Cyprinodon variegatus*) LC_{50} = 275 mg/L/96 hr; fathead minnow (*Pimephales promelas*) LC_{50} = 42.3 mg/L/96 hr in hard water & 48.5 mg/L/96 hr in softwater. **Disposal:** A candidate for rotary kiln incineration at 1508 to 2912°F (820 to 1600°C), liquid injection incineration at 1202 to 2912°F (650 to 1600°C), and fluidized bed incineration at 842 to 1796°F (450 to 980°C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.21): No. D001
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311 (b)(4) & CWA, Sec. 307 (a)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use a powered air-purifying respirator with an appropriate organic vapor cartridge, a supplied-air respirator (SAR), SCBA, or chemical cartridge respirator with appropriate organic vapor cartridge. For < 2000 ppm, use a SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or polyvinylchloride to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from ignition sources and oxidizers. Outside or detatched storage is preferred. If inside, store in a standard flammable liquids cabinet. Containers should have flame-arrester or pressure-vacuum venting. To prevent static sparks, electrically ground and bond all equipment used with ethylbenzene. Install Class 1, Group D electrical equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain levels as low as possible. Purge and ventilate reaction vessels before workers are allowed to enter for maintenance or cleanup. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, skin, blood, and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Ethylbenzene
DOT Hazard Class: 3
ID No.: UN1175
DOT Packing Group: II
DOT Label: Flammable liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60 L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: —

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 162, 163, 164, 167, 168, 171, 176, 179
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** W Silverman, MD

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Methanol

MSDS No. 354

Date of Preparation: 11/77 Revision: E, 3/98

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Methanol **Chemical Formula:** CH_4O or CH_3OH **CAS Number:** 67-56-1

Synonyms: carbinol; Coat-B1400; Colonial Spirits; Columbian Spirit; EPA pesticide chemical code 053801; methyl alcohol; methyl hydrate; methyl hydroxide; monohydroxymethane; pyroligneous spirit; pyroxylic spirit; pyroxylic spirits; Surflo-B17; wood alcohol; wood naphtha; wood spirit

Derivation: Prepared by wood pyrolysis; non-catalytic oxidation of hydrocarbons; as a by-product in the fisher-tropsch synthesis; or by reduction of carbon monoxide.

General Use: Used as an industrial solvent; starting material for organic synthesis; antifreeze for windshield washer fluid; in fuel antifreezes; gasoline octane booster; fuel for stoves; extractant for oils; denaturing ethanol; softening agent; food additive; in paint, varnish removers, and embalming fluids; in the manufacture of photographic film, celluloid, textile soap, wood stains, coated fabrics, shatterproof glass, paper coating, waterproofing formulations, artificial leather, dyes.

Vendors: Consult the latest *Chemical Week Buyers' Guide*. (73)

Section 2 - Composition / Information on Ingredients

Methanol, ca 100% vol

Trace Impurities (Grade A): Acetone and aldehydes < 30 ppm, acetic acid < 30 ppm

OSHA PELs
8- hr TWA: 200 ppm (260 mg/m^3)
Vacated 1989 Final Rule Limits:
TWA: 200 ppm (260 mg/m^3)
STEL: 250 ppm (325 mg/m^3)

ACGIH TLVs*
TWA: 200 ppm (262 mg/m^3), *Skin*
STEL: 250 ppm (328 mg/m^3)

NIOSH REL
10- hr TWA: 200 ppm (260 mg/m^3), *Skin*
STEL: 250 ppm (325 mg/m^3)

IDLH Level
6000 ppm

DFG (Germany) MAK
TWA: 200 ppm (260 mg/m^3), *Skin*
Category II, 1: Substances with systemic effects; onset of effect ≤ 2 hr; half life < 2 hr
Embryo/Fetus Risk of Damage Classification C†

Peak Exposure Limit:
400 ppm (520 mg/m^3), 30 min, average value. 4/shift

*There are also ACGIH Biological Exposure Indices (BEIs™).

†There is no reason to fear risk of damage to developing embryo or fetus when MAK or BAT values are observed.

Section 3 - Hazards Identification

ANSI Signal Word: Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Methanol is a colorless liquid with a slight alcohol odor when pure, or disagreeably pungent odor when crude. It is irritating to the eyes, skin, and respiratory tract. Exposure may result in headache, visual disturbance, blindness, and respiratory failure. Reproductive effects have been reported in animal testing. This flammable liquid is a moderate explosion hazard. When heated to decomposition, methanol emits carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes.

Wilson Risk Scale	
R	1
I	3
S	2*
K	3

*Skin absorption

HMIS	
H	2*
F	3
R	0
PPE†	

*Chronic effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact/absorption

Target Organs: Eyes, skin, central nervous system (CNS), gastrointestinal (GI) tract, respiratory system

Acute Effects

Inhalation: Irritation, breathing difficulty, headache, drowsiness, vertigo, light-headedness, nausea, vomiting, acidosis (decreased blood alkalinity), visual disturbance, and at high concentrations, CNS damage, convulsions, circulatory collapse, respiratory failure, coma and blindness can result from inhalation of methanol vapor. Concentration ≥ 200 ppm may cause headache; 50,000 ppm can cause death within 1-2 hrs. **Eye:** Contact with liquid may result in irritation, inflamed lids, light sensitization, and superficial lesions. **Skin:** Contact may cause irritation, dermatitis, swelling, scaling, and systemic effects listed under inhalation. **Ingestion:** GI irritation and systemic effects (see Inhalation). Symptoms may be delayed 18-48 hours. Fatal dose: 2-8 ounces.

Carcinogenicity: IARC, NTP, and OSHA do not list methanol as a carcinogen. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Chronic Effects:** Exposure to methanol vapors has caused conjunctivitis, headache, giddiness, insomnia, GI disturbance, impaired vision. CNS damage is also likely. Methanol is slowly eliminated from the body; exposure is considered cumulative over the short term.

Copyright © 1998 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purposes or for consequences of its use.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed. **Eye Contact:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain or irritation develops. **Skin Contact:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. ***After first aid, get appropriate in-plant, paramedic, or community medical support.*** **Note to Physicians:** Follow emesis with rehydration, correction of acidosis, and folate to enhance formate oxidation. Consider IV administration of ethanol (if blood methanol >20 mg/dL) to show metabolic oxidation of methanol. Assay formic acid in urine, blood pH and plasma bicarbonate.

Section 5 - Fire-Fighting Measures

Flash Point: 54 °F (12 °C) **Flash Point Method:** CC **Burning Rate:** 1.7 mm/min
Autoignition Temperature: 867 °F (464 °C) **LEL:** 6.0% v/v **UEL:** 36% v/v
Flammability Classification: OSHA Class IB Flammable Liquid.

NFPA



Extinguishing Media: Use dry chemical, carbon dioxide, water spray, fog or alcohol-resistant foam. A water spray may be used to cool fire-exposed containers, and flush spills away from ignition sources. **Unusual Fire or Explosion Hazards:** Can form explosive mixtures in the air. The heavier-than-air vapors of methanol may travel along low-lying surfaces to distant sources of ignition and flash back to the material source. Containers may explode in heat of fire. **Hazardous Combustion Products:** Heating methanol to decomposition can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes. **Fire-Fighting Instructions:** *Do not* scatter material with any more water than needed to extinguish fire. *Do not* release runoff from fire control methods to sewers or waterways. **Fire-Fighting Equipment:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Isolate spill area for at least 330-660 feet (100-200 m) in all directions. Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Ground all equipment used when handling this product. *Do not* touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. **Small Spills:** Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Use clean non-sparking tools to collect absorbed material. **Large Spills, Containment:** Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. **Cleanup:** Ground all equipment. Use non-sparking tools. **Regulatory Requirements:** Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor inhalation, and skin and eye contact. Use only with ventilation sufficient to reduce airborne concentrations to non-hazardous levels (see Sec. 2). Wear protective gloves, goggles, and clothing (see Sec. 8). Keep away from heat and ignition sources. Ground and bond all containers during transfers to prevent static sparks. Use non-sparking tools to open and close containers. **Storage Requirements:** Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Equip drums with self-closing valves, pressure vacuum bungs, and flame arrestors. **Regulatory Requirements:** Follow applicable OSHA regulations (29 CFR 1910.106) for Class 1B Flammable Liquids.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. **Ventilation:** Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source. **Administrative Controls:** Enclose operations and/or provide local explosion-proof exhaust ventilation at the site of chemical release. Where possible, transfer methanol from drums or other storage containers to process containers. Minimize sources of ignition in surrounding areas. **Respiratory Protection:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations ≤ 2000 ppm, use a supplied air respirator; ≤ 5000 ppm, supplied air (SA) respirator in continuous flow mode; ≤ 6000 ppm, SA respirator with tight-fitting face mask operated in continuous flow mode, or SCBA with full facepiece, or SA respirator with full facepiece; > IDLH/unknown/emergency, SCBA with full facepiece operated in pressure-demand or other positive-pressure mode, or SA respirator with full facepiece operated in pressure-demand

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

or other positive-pressure mode in combination with auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For escape, use an appropriate escape-type SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Protective Clothing/Equipment:** Wear chemically protective gloves, boots, aprons, and gauntlets of butyl rubber, Teflon™, Viton™, Saranex™, 4H™, Responder™, Trellchem HPS™, or Tychem 10000™ (Breakthrough Time (BT) >8 hr) to prevent skin contact. Natural rubber, neoprene, nitrile rubber, polyethylene, polyvinyl alcohol and CPF 3™ may degrade after contact and are not recommended. Wear splash-proof chemical safety goggles, and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, washing facilities available in work area. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance and Odor: Colorless; slight alcohol odor when pure, disagreeably pungent odor when crude
Odor Threshold Range: 13.1150 to 26840 mg/m^3
Vapor Pressure: 127 mm Hg at 77 °F (25 °C)
Vapor Density (Air=1): 1.11
Saturated Vapor Density (air=1.2 kg/m^3, 0.075 lb./ft^3): 1.221 kg/m^3
Formula Weight: 32.04
Density: 0.796 g/mL at 59 °F (15 °C)
Specific Gravity (H_2O=1, at 4 °C): 0.81 at 0 °C/4 °C
Bulk Density: 6.59 lbs/gal at 68 F (20 °C)
pH: Slightly acidic
Water Solubility: Miscible
Other Solubilities: Ethanol, acetone, benzene, chloroform, DMSO, ether, ketones, most organic solvents.
Boiling Point: 148 °F (64.7 °C) at 760 mm Hg
Freezing Point: -144.04 °F (-97.8 °C)
Viscosity: 0.614 mPa sec
Refractive Index: 1.3292 at 68 °F (20 °C)/D
Surface Tension: 22.61 dynes/cm
Ionization Potential (eV): 10.84
Henry's Law Constant (H): 4.55 x10^{-6} atm-m^3/mole at 77 °F (25 °C)
Octanol/Water Partition Coefficient: log K_{ow} = -0.77
Soil Sorption Coefficient (log K_{oc}): 0.44

Section 10 - Stability and Reactivity

Stability: Methanol is stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization: Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include beryllium dihydride, metals (potassium, magnesium), oxidants (barium perchlorate, bromine, chlorine, hydrogen peroxide, sodium hypochlorite, phosphorus trioxide), potassium tertbutoxide, carbon tetrachloride and metals, chloroform and heat, diethyl zinc, alkyl aluminum salts, acetyl bromide, chloroform and sodium hydroxide, cyanuric chloride, nitric acid, chromic anhydride, lead perchlorate.
Conditions to Avoid: Vapor inhalation, oxidizers. **Hazardous Decomposition Products:** Thermal oxidative decomposition of methanol can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes.

Section 11- Toxicological Information

Toxicity Data:*

Reproductive Effects:
Rat (female), oral: 7500 mg/kg, administered during gestational days 17-19 produced effects on newborn - behavioral.
Rat (female), oral: 35295 mg/kg administered during gestational days 1-15 produced effects on the fertility index; pre-implantation mortality; and post-implantation mortality.
Rat (female), inhalation: 20000 ppm/7 hr, administered during gestational days 1-22 produced specific developmental abnormalities - musculoskeletal system; cardiovascular (circulatory) system; urogenital system.
Rat (male), oral: 200 ppm/20 hr, 78 weeks prior to mating produced paternal effects - testes, epididymis, sperm duct.
Multiple Dose Toxicity Data:
Rat, oral: 12 g/kg/8 weeks intermittently produced toxic effects: behavioral - ataxia; behavioral - alteration of operant conditioning.
Rat, inhalation: 50 mg/m^3/12 hr/13 weeks intermittently produced degenerative changes to brain and coverings; muscle contraction or spasticity.
Rat, inhalation: 2610 ppm/6 hr/4 weeks intermittently produced toxic effects: endocrine - changes in spleen weight.
Eye Effects:
Rabbit, standard Draize test: 100 mg/24 hr resulted in moderate irritation.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 11- Toxicological Information, continued

Toxicity Data:*

Skin Effects:
Rabbit, standard Draize test: 20 mg/24 hr resulted in moderate irritation.

Acute Oral Effects:
Human, oral, LD_{Lo}: 428 mg/kg produced toxic effects: behavioral - headache; lungs, thorax, or respiration - other changes.
Human, oral, LD_{Lo}: 143 mg/kg produced optic nerve neuropathy, dyspnea, nausea or vomiting.
Rat, oral, LD_{50}: 5628 mg/kg

Acute Dermal Effects:
Monkey, skin, LD_{Lo}: 393 mg/kg
Rabbit, skin, LD_{50}: 15800 mg/kg

Acute Inhalation Effects:
Human, inhalation, TC_{Lo}: 300 ppm produced visual field changes, headache; lungs, thorax, or respiration - other changes.
Rat, inhalation, LC_{50}: 64000 ppm/4 hr

Mutagenicity:
Human, lymphocyte: 300 mmol/L resulted in DNA inhibition.
Rat, oral: 10 µmol/kg resulted in DNA damage.

* See NIOSH, *RTECS* (PC1400000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Trout, LC_{50}: 8,000 mg/L/48 hr; *Pimephales promelas* (fathead minnow) LC_{50}: 29.4 g/L/96 hr.

Environmental Fate: Bioconcentration (BCF, estimated at 0.2) is not expected to be significant. Physical removal from air can occur via rainfall. Relatively rapid evaporation from dry surfaces is likely to occur.

Environmental Degradation: If released to the atmosphere, it degrades via reaction with photochemically produced hydroxyl radicals with an approximate half-life of 17.8 days. If released to water or soil, biodegradation is expected to occur.

Soil Adsorption/Mobility: A low Koc indicates little sorption and high mobility in the soil column.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Methanol
Shipping Symbols: D
Hazard Class: 3
ID No.: UN1230
Packing Group: II
Label: FLAMMABLE LIQUID
Special Provisions (172.102): T*

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 1 L
b) Cargo Aircraft Only: 60 L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: 40

Section 15 - Regulatory Information

EPA Regulations:
Listed and Classified as a RCRA Hazardous Waste (40 CFR 261.33): Characteristic of Ignitability
RCRA Hazardous Waste Number: U154
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per (3) CAA, Sec. 112; (4) RCRA, Sec. 3001
CERCLA Final Reportable Quantity (RQ), 5000 lb (2268 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 1, 73, 99, 103, 124, 136, 149, 176, 190, 209, 216, 217, 218, 222, 223, 224, 227, 228, 230
Prepared By..... HM Spliethoff, MS
Industrial Hygiene Review..... PA Roy, MPH, CIH
Medical Review..... T Thoburn, MD, MPH

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Naphthalene

MSDS No. 624

Date of Preparation: 11/87 Revision: A, 9/97

Section 1 - Chemical Product and Company Identification 50

Product/Chemical Name: Naphthalene
Chemical Formula: $C_{10}H_8$
CAS Number: 91-20-3
Synonyms: Albocarbon; camphor tar; Dezodorator; Mighty 150; moth balls; moth flakes; naftalen (Polish); naphthalin; naphthaline; naphthalinum; naphthene; NTM; tar camphor; white tar
Derivation: From coal tar; from petroleum fractions after various catalytic processing operations.
General Use: Used as a moth repellent, an antiseptic, toilet bowl deodorant, heat transfer agent, fungicide, smokeless powder, cutting fluid, lubricant, wood preservative; an intermediate for naphthol, phthalic anhydride, chlorinated naphthalenes, Tertralin, Decalin, naphthyl and naphthol derivatives, and dyes; in synthetic resins, synthetic tanning, textile chemicals, scintillation counters, and emulsion breakers.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Naphthalene, ca 100% wt. Grade: By melting point, 165 °F (74 °C) min (crude) to greater than 174 °F (79 °C) (refined); scintillation 176-177 °F (80-81 °C)

OSHA PELs	ACGIH TLVs	NIOSH RELs	IDLH Level
8-hr TWA: 10 ppm (50 mg/m^3); *Vacated 1989 Final Rule Limit:* 15-min. STEL: 15 ppm (79 mg/m^3)	TWA: 10 ppm (52 mg/m^3) STEL: 15 ppm (79 mg/m^3)	10-hr TWA: 10 ppm (50 mg/m^3); 15-min. STEL: 15 ppm (75 mg/m^3)	500 ppm

DFG (Germany) MAK
10 ppm (50 mg/m^3)

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Naphthalene is a white crystalline solid with a 'moth ball' or coal-tar odor. It is toxic by ingestion. Irritating to skin, eyes, and respiratory system. Naphthalene is a combustible solid. Dust may form explosive mixtures in air if subjected to an ignition source.

Wilson Risk Scale	
R	1
I	3
S	2*
K	2

*Skin absorption

HMIS	
H	2†
F	2
R	0
PPE‡	

†Chronic Effects
‡Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, skin absorption, skin and/or eye contact
Target Organs: Blood (red blood cell effects), eyes, skin, central nervous system (CNS), liver and kidneys
Acute Effects
Inhalation: Vapor inhalation causes headache, confusion, nausea, sometimes vomiting, loss of appetite, extensive sweating, dysuria (painful urination), hematuria (blood in the urine), and hemolysis (destruction of red blood cells).
Eye: Irritation, conjunctivitis, and corneal injury upon prolonged contact.
Skin: Irritation and hypersensitivity dermatitis.
Ingestion: Unlikely. However, ingestion causes irritation of the mouth and stomach, hemolytic anemia with hepatic and renal lesions and vesical congestion, kidney failure, hematuria, jaundice, depression of CNS, nausea, vomiting, abdominal pain, blue face, lips, or hands, rapid and difficult breathing, headache, confusion, excitement, malaise, fever, perspiration, urinary tract pain, dizziness, convulsions, coma, and death. Symptoms may appear 2 to 4 hours after exposure.
Carcinogenicity: IARC, NTP, and OSHA do not list naphthalene as a carcinogen. EPA-D, Not Classifiable as to Human Carcinogenicity; MAK-B, Justifiably suspected of having carcinogenic potential; TLV-A4, Not Classifiable as a Human Carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver and kidneys; individuals with a hereditary deficiency of the enzyme glucose-6-phosphate dehydrogenase in red blood cells are particularly susceptible to the hemolytic properties of naphthalene metabolites.
Chronic Effects: May cause optical neuritis, corneal injuries, cataracts, kidney damage.
Other: There are two reports of naphthalene crossing the placenta in humans.

Copyright © 1997 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed. Contact a physician immediately if symptoms of systemic poisoning are present.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, or photophobia persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area thoroughly with soap and water. For reddened or blistered skin, consult a physician. Contact a physician immediately if symptoms of systemic poisoning are present.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Contact a physician immediately.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Obtain baseline CBC, electrolytes, liver and renal function rests, glucose-6-phosphatase dehydrogenase level, urinalysis, and benzidine dipstick to check for hemoglobinuria. Urinary metabolite, 1-naphthol or mercapturic acid, may help confirm the diagnosis.

Section 5 - Fire-Fighting Measures



Flash Point: 174 °F (79 °C); 190 °F (88 °C)

Flash Point Method: OC; CC

Burning Rate: Data not found.

Autoignition Temperature: 979 °F (526 °C)

LEL: 0.9% v/v

UEL: 5.9% v/v

Flammability Classification: Combustible solid

Extinguishing Media: Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water or foam may cause frothing. Use water spray to keep fire-exposed containers cool.

Unusual Fire or Explosion Hazards: Volatile solid that gives off flammable vapors when heated. Dust may explode in air if an ignition source is provided.

Hazardous Combustion Products: Toxic vapors including carbon monoxide.

Fire-Fighting Instructions: Move containers from the fire area if it can be done without risk. Otherwise cool fire-exposed containers until well after the fire is extinguished. *Do not* release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Wear full protective clothing (see Sec. 8). Structural clothing is permeable, remain clear of smoke, water fall out, and water run off.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Stop leak if you can do it without risk. Use spark-proof tools and explosion proof equipment. Cleanup personnel should wear personal protective equipment to protect against exposure (see Sec. 8).

Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite.

Large Spills

Containment: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: To avoid vapor inhalation use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels. Avoid skin and eye contact. Wear personal protective clothing and equipment to prevent any contact with skin and eyes (see Sec. 8). Practice good personal hygiene procedures to prevent inadvertently ingesting this material.

Storage Requirements: Store in tightly closed, explosion-proof containers in a cool, well-ventilated area away from heat, ignition sources, and incompatibles (see Sec. 10). May be stored under nitrogen gas. Protect containers against physical damage. Use monitoring equipment to measure the extent of vapor present in any storage facility containing naphthalene because of potential fire and explosion hazards.

Copyright © 1997 Genium Publishing Corporation. Any commercial use or ...

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid vapor and dust dispersion into the work area. Ventilate at the site of chemical release. During the fractional distillation of naphthalene and in any operation entailing the heating or volatilization of naphthalene, enclosed apparatus should be employed.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with naphthalene. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the eyes, skin, liver, kidneys, CBC (RBC count, WBC count, differential count of a stained smear, hemoglobin, and hematocrit), and urinalysis including at a minimum specific gravity, albumin, glucose, and a microscopic examination on centrifuged sediment.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Teflon® is recommended. *Do not* use butyl rubber, natural rubber, neoprene or polyvinyl chloride. Wear chemical dust-proof safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove naphthalene from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Crystalline solid

Appearance and Odor: White, volatile flakes, cakes, cubes, spheres, or powder; strong coal-tar or moth ball odor

Odor Threshold: 0.084 ppm to 0.3 ppm

Vapor Pressure: 0.05 mm Hg at 68 °F (20 °C); 1.0 mm Hg at 127 °F (53 °C)

Formula Weight: 128.2

Density: 1.145 g/cm^3 at 68 °F (20 °C)

Saturated Vapor Concentration: 100 ppm at 77 °F (25 °C) (approx.)

Water Solubility: Insoluble [31.7 mg/L at 68 °F (20 °C)]

Other Solubilities: Benzene, absolute alcohol; very soluble in ether, chloroform, carbon disulfide, hydronaphthalenes, fixed and volatile oils

Boiling Point: 424 °F (218 °C)

Melting Point: 176 °F (80.2 °C)

Volatility: Volatilizes appreciably at room temperature; volatile with steam

Octanol/Water Partition Coefficient: log K_{ow} = 3.30

Section 10 - Stability and Reactivity

Stability: Naphthalene is stable at room temperature in closed containers under normal storage and handling conditions. It volatilizes at room temperature.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include aluminum chloride, benzoyl chloride, chromic acid, chromium trioxide, oxidizers. Explosive reaction with dinitrogen pentaoxide. Melted naphthalene will attack some forms of plastics.

Conditions to Avoid: Exposure to heat and ignition sources, incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of naphthalene can produce toxic fumes including carbon monoxide.

Section 11- Toxicological Information

Toxicity Data:*

Acute Effects:

Human (child), oral, LD_{Lo}: 100 mg/kg

Man, unreported, LD_{Lo}: 74 mg/kg

Rat, oral, LD_{50}: 490 mg/kg

Reproductive Effects:

Rat, oral: 4500 mg/kg administered on gestational days 6-15 produced fetotoxicity and other developmental abnormalities.

Copyright © 1997 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 11- Toxicological Information, *continued*

Toxicity Data:*

Acute Effects: *continued*
Mouse, oral, LD_{50}: 533 mg/kg
Rat, inhalation, LC_{50}: >340 mg/m^3 produced lacrimation and somnolence.
Genetic Effects:
Hamster, ovary: 15 mg/L induced sister chromatid exchange.
Tumorigenicity:
Mouse, inhalation: 30 ppm/6 hr/2 yr administered intermittently produced toxic effects: tumorigenic - neoplastic by RTECS criteria; lungs, thorax, or respiration - tumors.
Skin Effects:
Rabbit, skin, open Draize test: 495 mg produced mild irritation.
Eye Effects:
Rabbit, eye, standard Draize test: 100 mg produced mild irritation.

*See *NIOSH RTECS* (QJ0525000) for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: *Oncorhynchus gorbuscha* (pink salmon): 1.37 ppm/96 hr at 39 °F (4 °C). *Pimephales promelas* (fathead minnow): 7.76 mg/L/24 hr.
Environmental Fate: If released to the atmosphere, naphthalene rapidly photodegrades with a half-life of 3-8 hr. Volatilization, photolysis, adsorption, and biodegradation are important loss mechanisms for naphthalene discharged into water. Depending on local conditions, the half-lives range from a couple of days to a few months. If released on land, it is adsorbed moderately to soil, undergoes biodegradation; but in some cases biodegradation may still occur if conditions are aerobic. Bioconcentration occurs to a moderate extent, but is a temporary problem since depuration and metabolism readily proceed in aquatic organisms.

Section 13 - Disposal Considerations

Disposal: Consider rotary kiln or fluidized bed incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
Container Cleaning and Disposal: Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Naphthalene, crude or Naphthalene, refined
Shipping Symbols: Not listed
Hazard Class: 4.1
ID No.: UN1334
Packing Group: III
Label: FLAMMABLE SOLID
Special Provisions (172.102): A1

Packaging Authorizations
a) Exceptions: 173.151
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 25 kg
b) Cargo Aircraft Only: 100 kg

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: Not listed

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste (40 CFR 261.33). Hazardous Waste Number: U165
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307(a); CAA, Sec. 112
CERCLA Final Reportable Quantity (RQ), 100 lb (45.4 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): Not listed

Section 16 - Other Information

References: 73, 99, 103, 124, 139, 140, 167, 168, 179, 190, 196, 197, 200, 220 PC-W6

Prepared By .....S Fleming, BS/MJ Wurth, BS
Industrial Hygiene Review.....DJ Wilson, CIH
Medical Review.....G Kelafant, MD

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1997 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 355
Phenol

Issued: 9/80 Revision: C, 11/90

Section 1. Material Identification

33

Phenol (C_6H_5OH) Description: One of many aromatic compounds in coal tar. Made by alkylating benzene with propylene then oxidizing the resulting cumene to produce phenol and acetone. Used as a feedstock in manufacturing various phenolic resins, caprolactum, bis-phenol-A, and other chemicals and drugs; a disinfectant; a fuel-oil sludge inhibitor; a reagent in chemical analysis; in producing or manufacturing a large variety of aromatic compounds including fertilizers, illuminating gas, coke, explosives, lampblack, paints, paint removers, asbestos goods, wood preservatives, textiles, perfumes, bakelite, rubber, and other plastics; in medical and industrial organic compounds and dyes; and in germicidal paints and slimicides. Phenol has been identified in cigarette smoke and automobile exhaust.
Other Designations: CAS No. 0108-95-2, carbolic acid, hydroxybenzene, monohydroxy benzene, oxybenzene, phenic acid, phenyl alcohol, phenyl hydroxide.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R 1
I 4
S 3*
K 2
* Skin absorption

NFPA
2
3 0
-

HMIS
H 3
F 2
R 0
PPG†
† Sec. 8

Cautions: Phenol has a marked corrosive effect on any tissue. Eye contact may cause severe damage and *blindness*. Its primary entry route is through *skin absorption*. Systemic absorption may cause *liver and kidney damage, convulsions (seizures), or death.*

Section 2. Ingredients and Occupational Exposure Limits

Phenol, ca 100%

1989 OSHA PEL (Skin)
8-hr TWA: 5 ppm, 19 mg/m³

1990-91 ACGIH TLV (Skin)
TWA: 5 ppm, 19 mg/m³

1988 NIOSH REL
TWA: 5 ppm, 19 mg/m³
Ceiling: 15.6 ppm, 60 mg/m³

1985-86 Toxicity Data*
Mammal, inhalation, LC_{50}: 74 mg/m³
Rat, oral, LD_{50}: 317 mg/kg; toxic effects include behavorial changes (convulsions or effect on seizure threshold)
Rabbit, eye, TC_{Lo}: 5 mg produces severe irritation

1987 IDLH Level
250 ppm

* See NIOSH, *RTECS* (SJ3325000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 359.15 °F (181.75 °C) at 760 mm Hg
Melting Point: 109.4 °F (43 °C)
Vapor Pressure: 0.3513 mm Hg at 77 °F (25 °C)
Vapor Density (Air = 1): 3.24
pH: 6 (aqueous solution)
Molecular Weight: 94.11
Specific Gravity (20 °C/4 °C): 1.0576
Water Solubility: 1 g dissolves in about 15 ml H_2O
Viscosity: 12.7 centipoise at 64.9 °F (18.3 °C)

Appearance and Odor: White crystalline solid with a characteristic sharp medicinal sweet, tangy odor detectable above 0.05 ppm. Phenol turns pink or red if it contains impurities or is exposed to heat or light.

Section 4. Fire and Explosion Data

Flash Point: 175 °F (79 °C), CC	Autoignition Temperature: 1319 °F (715 °C)	LEL: 1.7% v/v	UEL: 8.6% v/v

Extinguishing Media: Use water spray, carbon dioxide, dry chemical, or alcohol-type foam to extinguish fires involving phenol. Do not use a solid stream of water since the stream scatters and spreads fire. Use water spray to cool fire-exposed tanks/containers.
Unusual Fire or Explosion Hazards: Phenol presents a moderate fire hazard when exposed to heat, flame, or oxidizers. When heated, it emits toxic fumes and vapors that form explosive mixtures with air. Air mixtures containing 3 to 10% phenol are explosive. Solid phenol burns with difficulty, giving off heavy smoke.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective clothing. Be aware of runoff from fire control methods. Water containing phenol can cause severe chemical burns. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Phenol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: In general, phenol is incompatible with strong oxidizing agents and halogens. It coagulates colodion and proteins. A potentially explosive reaction occurs with formaldehyde, peroxydisulfuric acid, peroxymonosulfuric acid, sodium nitrite + heat, and aluminum chloride + nitromethane (at 110 °C/100 bar). A violent reaction occurs with butadiene, sodium nitrite + trifluoroacetic acid, and aluminum chloride + nitrobenzene at 248 °F (120 °C). Combining phenol with mineral oxidizing acids results in fire; with acetaldehyde results in violent condensation; with isocyanates results in heat generation and violent polymerization, with calcium hypochlorite results in an exothermic reaction producing toxic fumes which may ignite; and with nitrides results in heat and flammable gas generation. Hot phenol is corrosive to many metals, including aluminum, lead, magnesium, and zinc. Reaction with these materials causes phenol to discolor.
Conditions to Avoid: Avoid heating phenol above 122 °F (90 °C).
Hazardous Products of Decomposition: Thermal oxidative decomposition of phenol can produce oxides of carbon and water.

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list phenol as a carcinogen. Although no specific evidence of human cancer exists, its carcinogenicity to mice emphasizes the need for precaution when handling this material. Phenol also causes human mutations (genetic changes).
Summary of Risks: Phenol is a general protoplasmic poison that is corrosive to any living tissue it contacts. Toxicity most likely results from dermal (skin) contact or ingestion. Skin absorption occurs readily with a rapid onset of symptoms or death (within 30 min to several hours). Contact with eyes may cause severe damage and blindness. Ingestion of 1 g may be fatal. Although phenol is irritating to the respiratory tract, due to its low volatility and good warning properties, inhalation is typically less of a concern. Chronic toxic effects are uncommon, but may include digestive disturbances, neurological disorders, skin rash (dermatitis), and liver and kidney damage.
Medical Conditions Aggravated by Long-Term Exposure: Individuals with chronic respiratory disorders, pre-existing skin disorders, convulsive disorders, or kidney or liver abnormalities may be at increased risk from phenol exposure.
Target Organs: Liver, kidneys, nervous system, and skin.
Primary Entry Routes: Skin absorption, eye contact, ingestion, and inhalation.
Acute Effects: Skin contact results in white, wrinkled discoloration, followed by a severe burn or systemic poisoning if removed improperly.

Continue on next page

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

Phenol ingestion can cause gangrene and corrosion of lips, mouth, throat, esophagus, and stomach if not properly decontaminated (see First Aid). Although not immediately painful, skin contact can cause serious burns and systemic toxicity. In addition to skin burns and respiratory tract irritation, systemic absorption may cause pallor, anorexia (appetite loss), nausea, vomiting, diarrhea, weakness, muscle aches, darkened urine, headache, tinnitus (ringing in ears), sweating, convulsions, cyanosis (bluish coloration of lips and/or fingertips), shock, unconsciousness, respiratory failure, and death. After ingestion, major percutaneous (skin), or inhalation exposures, collapse and death can be rapid. Ingestion can cause severe tissue corrosion or gangrene affecting lips, mouth, throat, esophagus, and stomach. Eye contact can cause severe corrosive damage to the eye (conjunctival edema, corneal opacification, and hypesthesia) and possible blindness.

Chronic Effects: Chronic phenol poisoning is rarely reported. Symptoms include vomiting, difficulty swallowing, diarrhea, appetite loss, headache, fainting, dizziness, darkened urine, and mental disturbances. Chronic exposure can cause death from liver and kidney damage. Repeated skin contact with phenol or phenol-bearing products can result in dermatitis with dark pigmentation (ochronosis) of skin and whites of eyes (sclerae).

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician immediately.

Skin: Speedy action is critical. Flood exposed area with water and quickly remove contaminated clothing. *As soon as possible*, repeatedly spray or swab with the decontaminating agent polyethyleneglycol-300 (PEG). Immerse extremities in PEG. Rescue personnel should protect themselves from skin contact with phenol. Do not use greases, powders, or ointments to treat phenol burns. *Never* delay phenol removal if PEG is not readily available. Use soap and water instead.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: *Speed is essential in the treatment of oral poisoning.* Immediately consult a physician and poison center. Never give anything by mouth to an unconscious or convulsing person. Administer to that *conscious* person 15 to 30 cc castor oil or another vegetable oil, and be prepared to induce vomiting upon a physician's advice. Vegetable oils slow phenol absorption and reduce local damage.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat ingestion with gastric lavage using 40% aqueous Bacto-Peptone, milk, or water until phenolic odor is eliminated. Then give 15 to 50 cc castor or vegetable oil. Debride necrotic skin. Monitor vital signs, fluid status, electrolytes, BUN, renal and hepatic function, and electrocardiogram. Manage sedation, seizures, renal failure, and fluid electrolyte imbalances symptomatically as indicated.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and skin and eye contact with a self-contained breathing apparatus and full personal protective clothing and equipment. Absorb small spills with some noncombustible inert material and place in a closed metal container for disposal. Dike large spills and allow material to cool and solidify. Using nonsparking tools, shovel solid into steel containers for disposal. Thoroughly flush spill area with water, use caustic soda solution for neutralization, and collect flushings and wash water for disposal. Do not allow phenol to enter sewers, watersheds, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120). Notify proper authorities including the National Response Center (800-424-8802).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33)

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Reportable Quantity (RQ), 1000 lb (454 kg) [* per Clean Water Act, Sec. 311(b)(4), Sec. 307(a), and per RCRA, Sec. 3001]

Listed as a SARA Extremely Hazardous Substance (40 CFR 355): RQ, 1000 lb; Threshold Planning Quantity (TPQ), 500/10,000 lb

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Where potential exists for exposures near or over 19 mg/m³, use a MSHA/NIOSH-approved full facepiece respirator with an organic vapor cartridge/canister and dust/mist prefilter. Increased protection is obtained from full facepiece powered-air purifying respirators. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. ACGIH recommends neoprene or butyl rubber as good-to-excellent protective materials.

Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL and ACGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area away from heated surfaces, open flame, and ignition sources. Outside or detached storage is preferred. Protect containers from physical damage.

Engineering Controls: Enclose all operations, eliminating all possible phenol exposure routes. Educate workers about phenol's hazards and potential dangers. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Provide local exhaust ventilation at the site of chemical release. Practice good personal hygiene and housekeeping procedures.

Medical Surveillance: Provide preplacement or periodic medical examinations that emphasize central nervous system (CNS), hepatic, renal, and skin. Tests should include BUN, creatinine, LFTs, and urinalysis. Phenol can be detected in urine in free or conjugated forms. The ACGIH biological exposure index (BEI) is 250 mg total phenol/g creatinine or 15 mg/hr.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Phenol
DOT Hazard Class: Poison B
ID No.: UN1671
DOT Label: Poison
DOT Packaging Exceptions: 173.364
DOT Packaging Requirements: 173.369

IMO Shipping Name: Phenol
IMO Hazard Class: 6.1
ID No.: UN1671
IMO Label: Poison
IMDG Packaging Group: II

MSDS Collection **References:** 1, 2-12, 15, 19, 23, 24, 26, 31, 34, 37, 38, 59, 73, 79, 84, 85, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138-140, 143, 146, 148, 149

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:
Sheet No. 351
Styrene *monomer*
Issued: 8/79 Revision: D, 6/92

38

Section 1. Material Identification

Styrene *monomer* ($C_6H_5CHCH_2$) **Description:** Produced by catalytic dehydrogenation of ethylbenzene at 932 to 1292 °F (500 to 700 °C) at 30 mm Hg; catalyst is a mixture of zinc oxide (86%), aluminum, calcium, and magnesium. Available in technical (99.2% pure) and polymer (99.6% pure) grades. Occurs naturally in the sap of styracaceous plants, in pyrolysis and cracking products of petroleum derivatives, in bituminous-coal and shale-oil tars, in rubber latexes, and as a product of organic substance pyrolysis. Used in the manufacture of a wide range of polymers including polystyrene and copolymer elastomers such as butadiene-styrene rubber or acrylonitrile-butadiene-styrene (ABS); in production of plastics and insulators, as a resin modifying additive, dental filling component, chemical reaction intermediate, and in agricultural products.
Other Designations: CAS No. 100-42-5, cinnamene, Diarex HF 77, ethenylbenzene, NCI-C02200, phenylethylene, styrol, styropor, vinylbenzene.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.
Cautions: Styrene is extremely flammable and polymerizes easily. The vapor is irritating to eyes, skin, and respiratory system and the liquid may cause burns. Inhalation of high concentrations can lead to central nervous system (CNS) depression.

R 2
I 3
S 2*
K 3
* Skin absorption

NFPA†



HMIS
H 2
F 3
R 2
PPG‡
‡ Sec. 8

† Rating is for *inhibited* monomer

Section 2. Ingredients and Occupational Exposure Limits

Styrene *monomer*, ca 99.6%, containing inhibitors butylcatechol or hydroquinone

1991 OSHA PELs
8-hr TWA: 50 ppm (215 mg/m³)
15-min STEL: 100 ppm (425 mg/m³)

1990 IDLH Level
5000 ppm

1990 NIOSH RELs
TWA: 50 ppm (215 mg/m³)
STEL: 100 ppm (425 mg/m³)

1991-92 ACGIH TLVs (Skin)
TWA: 50 ppm (213 mg/m³)
STEL: 100 ppm (426 mg/m³)

1990 DFG (Germany) MAKs
Ceiling: 20 ppm (85 mg/m³)
Half-life: < 2 hr
Peak Exposure Limit: 40 ppm, 30 min. average value, 4 per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 20 µg/m³ caused eye effects.
Human, skin: 500 mg (non-standard test, *accident*) caused irritation.
Human, HeLa cell: 28 mmol/L caused unscheduled DNA synthesis.
Rat, oral, LD_{50}: 5000 mg/kg; toxic effects not yet reviewed
Rat, inhalation, LC_{50}: 24 g/m³/ 4 hr produced an antipsychotic effect.

* See NIOSH, *RTECS* (WL3675000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 293 °F (145 °C)
Freezing Point: -23 °F (-31 °C)
Vapor Pressure: 5 mm Hg at 68 °F (20 °C)
Viscosity: 0.751 mPa
Refraction Index: 1.5463 at 68 °F (20 °C)
Odor Threshold Range: 0.15 to 25 ppm
Density: 0.9045 at 25/25 °C
Surface Tension: 32.14 dyne/cm at 66.2 °F (19 °C)
Molecular Weight: 104.2
Saturated Vapor Density (air = 1.2 kg/m³): 1.22 kg/m³ or 0.076 lbs/ft³
Water Solubility: Practically insoluble, 0.3 lbs/100 lbs water; floats on water
Other Solubilities: Soluble in benzene, carbon disulfide, carbon tetrachloride, ethanol, ethyl ether and ketones. Dissolves organic substances and polymers.

Appearance and Odor: Colorless to slightly yellow oily liquid with a sweet, pleasant odor at low levels becoming pungent as levels increase.

Section 4. Fire and Explosion Data

Flash Point: 88 °F (31 °C), CC	Autoignition Temperature: 914 °F (490 °C)	LEL: 1.1% v/v	UEL: 7% v/v

Extinguishing Media: A Class 1C flammable liquid. For small fires, use dry chemical, carbon dioxide (CO_2), or regular foam. For large fires, use fog, or regular foam. Water may be ineffective since styrene tends to float on water; use only when other agents are unavailable.
Unusual Fire or Explosion Hazards: Styrene may accumulate static electricity. Hazardous polymerization can occur causing container to rupture due to heat of fire. Vapors may travel to ignition source and flash back. Styrene poses a vapor explosion hazard indoors, outdoors, and in sewers.
Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Use protective clothing specifically recommended by manufacturer. Apply cooling water to container sides until well after fire is out. If possible without risk, remove container from fire area. Stay away from ends of tanks. For massive fire in cargo area use monitor nozzles or unmanned hose holders; if this is impossible, withdraw from area and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Uninhibited styrene monomer is very unstable and even when inhibited (butylcatechol or hydroquinone) polymerization occurs slowly at room temperature and fast at elevated temperatures or in contact with certain initiators. **Chemical Incompatibilities:** Styrene vapor is explosive when exposed to heat or flame; reacts with oxygen above 104 °F (40 °C) to form a heat-sensitive explosive peroxide. Violent polymerization may be initiated by alkali metal-graphite composites, butyllithium, dibenzoyl peroxide, azoisobutyronitrile or di-*tert*-butyl peroxide. Styrene reacts violently with chlorosulfonic acid, oleum, sulfuric acid, chlorine + iron (II) chloride (above 50 °C) and can react vigorously with oxidizing materials. **Conditions to Avoid:** Exposure to heat and ignition sources, light, and contact with incompatibles. **Hazardous Decomposition Products:** Thermal oxidative decomposition of styrene can produce carbon dioxide, acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC(164) lists styrene monomer as a carcinogen; Class 2B (possibly carcinogenic, limited human evidence in the absence of sufficient animal data). **Summary of Risks:** Styrene is irritating to the eyes, skin, and respiratory system. It is absorbed through the skin at 9 to 15 mg/m²/hr (hand and forearm). Inhalation of high concentrations can cause CNS depression but styrene's pungent, irritating odor is usually enough to prevent acute toxic exposures. If heavy exposure occurs, styrene can saturate the body in 30-40 minutes, is distributed throughout the organs and is rapidly eliminated (~85% in 24 hr) either in urine (71%) or expired air (10%). Unexcreted styrene accumulates in adipose tissue (subcutaneous connective tissue containing fat cells). Ovulation and menstrual disorders were observed in women exposed to styrene. In one case, CNS effects were observed in infants whose mother was exposed to chemicals such as styrene during pregnancy. In general, pregnant women may be at elevated risk because styrene crosses the placental barrier. **Target Organs:** CNS, eyes, respiratory system, and skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Medical Conditions Aggravated by Long-term Exposure:** Possibly, liver, kidney, blood, skin, and CNS disorders.
Acute Effects: Inhalation of concentrations as low as 50 ppm causes irritation of the eyes, and respiratory tract.

Continue on next page

Copyright © 1992 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

Symptoms include watering eyes and nose, chest heaviness or pain, difficulty breathing, coughing, bluish face and lips, wheezing, headache, nausea, vomiting, dizziness, fatigue, diarrhea and risk of pulmonary edema (fluid in lungs). Skin contact is irritating, with itching, inflammation and possible blisters. Splashes to the eyes cause irritation, watering, lid inflammation, chemical corneal burns, and possibly, serious lesions. Cases of ingestion have not been reported but by analogy to animal studies it could cause irritation of the lips, mouth, and throat; painful swallowing, abdominal pain, nausea, vomiting, state of shock, possible convulsions and risk of pulmonary edema. **Chronic Effects:** Repeated exposure has caused "styrene sickness" described by nausea, vomiting, appetite loss, and general weakness. Occupational asthma may occur rarely. Functional disorders of the nervous system, irritation of the upper airways, and blood changes particularly leukopenia (abnormally low number of circulating, nucleated white or colorless blood cells) and lymphocytosis (increased number of lymphocytes which are involved in the immune system) have also been observed. Medical exams revealed toxic hepatitis in workers exposed to ~50 mg/m^3 styrene for over 5 yr. Prolonged exposure to < 50 mg/m^3 caused certain liver function disorders (protein, pigment, glycogen). Peripheral neuropathies were observed in chronically exposed workers. Repeated or prolonged skin exposure may cause dermatitis with rough, dry, fissured skin due to defatting.

FIRST AID Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Do *not* allow victim to rub or keep eyes tightly shut. Immediately consult a physician. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not induce vomiting!* Gastric lavage may be indicated if victim is at risk of convulsing but the decision should be carefully weighed since severe esophageal irritation may occur. **Note to Physicians:** For acute exposure, give baseline liver and kidney function tests and obtain urinalysis, CBC, amylase and lipase levels. Monitor arterial blood gases and perform chest X-ray if significant respiratory irritation occurs. Phenylglyoxylic and mandelic acid may be determined in urine.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should protect against inhalation and eye and skin contact. Shut off all ignition sources. Use water spray to cool and disperse vapors (this may not prevent ignition in closed spaces). For small spill, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers. For large spills, dike far ahead of liquid spill for later disposal or reclamation. For spills in water, apply activated carbon at 10 X the spilled amount (at least 10,000 ppm) or use barriers or oil spill booms to limit motion. "Universal" gelling agent injected into spill may aid in solidification. Remove material with suction hoses or mechanical dredges. Follow applicable OSHA regulations (29 CFR 1910.120). Report spills in excess of 1000 lb. **Ecotoxicity Values:** TLm, *Pimephales promelas* (fathead minnow), 53.6 mg/L/48 hr; TLm, *Artemia salina* (brine shrimp), 68 mg/L/24 hr and 52 mg/L/48 hr. **Environmental Degradation:** In water, styrene monomer volatilizes rapidly and may be subjected to biodegradation. It is not expected to hydrolyze. In air, styrene will react rapidly with hydroxyl radicals and ozone with a combined calculated half-life of 2.5 to 9 hr. In soil, styrene will biodegrade and leach to groundwater with low to moderate mobility (depending on soil conditions). **Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations Listed as a RCRA Hazardous Waste (40 CFR 261.21 & 261.23): D001 and D003, Characteristic of ignitability and reactivity
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311(b)(4)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A & Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH/MSHA-approved respirator. For < 500 ppm, use any supplied air respirator (SAR) or SCBA. For < 1250 ppm, use any SAR operated in a continuous flow mode. For < 5000 ppm, use any SAR with a full facepiece in positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol is recommended as suitable material for PPG. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Thoroughly decontaminate PPG. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Styrene is corrosive to copper or copper alloy containers. Store in cool (hazardous above 32 °C), dry, well-ventilated area away from incompatibles (Sec. 5). Store small refrigerated amounts in glass containers and large amounts in vented metal tanks in outside or detached storage under an inert blanket (i.e., nitrogen). Install electrical equipment Class 1, Group D. Inhibit styrene during storage to prevent polymerization. Uninhibited vapor may polymerize in vents and cause blockage. To prevent static sparks, electrically ground and bond all equipment used in styrene manufacture, use, storage, transfer, and shipping. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Continuously monitor workplace air levels of styrene. Make sure ducting, piping, and pipe joints are leak tight. Give preference to continuous rather than batch techniques and mechanize manual operations. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, blood, liver, kidney, and skin. Consider precluding pregnant women from styrene exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Styrene monomer, inhibited
DOT Hazard Class: Flammable liquid
ID No.: UN2055
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Styrene monomer, inhibited
IMO Hazard Class: 3.3
ID No.: UN2055
IMO Label: Flammable liquid
IMDG Packaging Group: II

MSDS Collection **References:** 73, 89, 100, 101, 103, 124, 126, 127, 131, 132, 133, 136, 139, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MPH, MD

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 318
Xylene *(Mixed Isomers)*

Issued: 11/80 Revision: E, 9/92 Errata: 12/94

Section 1. Material Identification

Xylene (Mixed Isomers) (C_8H_{10}) Description: The commercial product is a blend of the three isomers [*ortho*-(*o*-), *meta*-(*m*-), *para*-(*p*-)] with the largest proportion being *m*- xylene. Xylene is obtained from coal tar, toluene by transalkylation, and pseudocumene. Used in the manufacture of dyes, resins, paints, varnishes, and other organics; as a general solvent for adhesives, a cleaning agent in microscope technique; as a solvent for Canada balsam microscopy; as a fuel component; in aviation gasoline, protective coatings, sterilizing catgut, hydrogen peroxide, perfumes, insect repellants, pharmaceuticals, and the leather industry; in the production of phthalic anhydride, isophthalic, and terephthalic acids and their dimethyl esters which are used in the manufacture of polyester fibers; and as an indirect food additive as a component of adhesives. Around the home, xylene is found as vehicles in paints, paint removers, degreasing cleaners, lacquers, glues and cements and as solvent/vehicles for pesticides.

Other Designations: CAS No. 1330-20-7 [95-47-6; 108-38-3; 106-42-3 (*o*-, *m*-, *p*-isomers)], dimethylbenzene, methyltoluene, NCI-C55232, Violet 3, xylol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 2
S 2
K 3

NFPA



HMIS
H 2†
F 3
R 0
PPE ‡

† Chronic Effects
‡ Sec. 8

Cautions: Xylene is an eye, skin, and mucous membrane irritant and may be narcotic in high concentrations. It is a dangerous fire hazard.

Section 2. Ingredients and Occupational Exposure Limits

Xylene (mixed isomers): the commercial product generally contains ~ 40% *m*-xylene; 20% each of *o*-xylene, *p*-xylene, and ethylbenzene; and small quantities of toluene. Unpurified xylene may contain pseudocumene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m^3)
15-min STEL: 150 ppm (655 mg/m^3)

1990 IDLH Level
1000 ppm

1990 NIOSH RELs
TWA: 100 ppm (435 mg/m^3)
STEL: 150 ppm (655 mg/m^3)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m^3)
STEL: 150 ppm (651 mg/m^3)
BEI (Biological Exposure Index): Methylhippuric acids in urine at end of shift: 1.5 g/g creatinine

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m^3)
Category II: Substances with systemic effects
Half-life: < 2 hr
Peak Exposure: 200 ppm, 30 min, average value, 4 peaks per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 200 ppm produced olfaction effects, conjunctiva irritation, and other changes involving the lungs, thorax, or respiration.
Man, inhalation, LC_{Lo}: 10000 ppm/6 hr; toxic effects not yet reviewed.
Human, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted.
Rat, oral, LD_{50}: 4300 mg/kg; toxic effect not yet reviewed.
Rat, inhalation, LC_{50}: 5000 ppm/4 hr; toxic effects not yet reviewed.

* See NIOSH, *RTECS* (XE2100000), for additional toxicity data.

Section 3. Physical Data

Boiling Point Range: 279 to 284 °F (137 to 140 °C)*
Boiling Point: *ortho:* 291 °F (144 °C); *meta:* 281.8 °F (138.8 °C); *para:* 281.3 °F (138.5 °C)
Freezing Point/Melting Point: *ortho:* -13 °F (-25 °C); *meta:* -53.3 °F (- 47.4 °C); *para:* 55 to 57 °F (13 to 14 °C)
Vapor Pressure: 6.72 mm Hg at 70 °F (21 °C)
Saturated Vapor Density (Air = 1.2 kg/m^3): 1.23 kg/m^3, 0.077 lbs/ft^3

Appearance and Odor: Clear, sweet-smelling liquid.

Molecular Weight: 106.16
Specific Gravity: 0.864 at 20 °C/4 °C
Water Solubility: Practically insoluble
Other Solubilities: Miscible with absolute alcohol, ether, and many other organic liquids.
Octanol/Water Partition Coefficient: logKow = 3.12-3.20
Odor Threshold: 1 ppm
Viscosity: <32.6 SUS

* Materials with wider and narrower boiling ranges are commercially available.

Section 4. Fire and Explosion Data

Flash Point: 63 to 77 °F (17 to 25 °C) CC | **Autoignition Temperature:** 982 °F (527 °C) (*m*-) | **LEL:** 1.1 (*m*-, *p*-); 0.9 (*o*-) | **UEL:** 7.0 (*m*-, *p*-); 6.7 (*o*-)

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), water spray or regular foam. For large fires, use water spray, fog or regular foam. Water may be ineffective. Use water spray to cool fire-exposed containers. **Unusual Fire or Explosion Hazards:** Xylene vapors or liquid (which floats on water) may travel to an ignition source and flash back. The heat of fire may cause containers to explode and/or produce irritating or poisonous decomposition products. Xylene may present a vapor explosion hazard indoors, outdoors, or in sewers. Accumulated static electricity may occur from vapor or liquid flow sufficient to cause ignition. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide limited protection. If feasible and without risk, move containers from fire area. Otherwise, cool fire-exposed containers until well after fire is extinguished. Stay clear of tank ends. Use unmanned hose holder or monitor nozzles for massive cargo fires. If impossible, withdraw from area and let fire burn. Withdraw immediately in case of any tank discoloration or rising sound from venting safety device. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Xylene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Xylene is easily chlorinated, sulfonated, or nitrated. **Chemical Incompatibilities:** Incompatibilities include strong acids and oxidizers and 1,3-dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin). Xylene attacks some forms of plastics, rubber, and coatings. **Conditions to Avoid:** Avoid heat and ignition sources and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of xylene can produce carbon dioxide, carbon monoxide, and various hydrocarbon products.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list xylene as a carcinogen. **Summary of Risks:** Xylene is an eye, mucous membrane, and respiratory tract irritant. Irritation starts at 200 ppm; severe breathing difficulties which may be delayed in onset can occur at high concentrations. It is a central nervous system (CNS) depressant and at high concentrations can cause coma. Kidney and liver damage can occur with xylene exposure. With prolonged or repeated cutaneous exposure, xylene produces a defatting dermatitis. Chronic toxicity is not well defined, but it is less toxic than benzene. Prior to the 1950s, benzene was often found as a contaminant of xylene and the effects attributed to xylene such as blood dyscrasias are questionable. Since the late 1950s, xylenes have been virtually benzene-free and blood dyscrasias have not been associated with xylenes. Chronic exposure to high concentrations of xylene in animal studies have demonstrated mild reversible decrease in red and white cell counts as well as increases in platelet counts.

Continue on next page

Copyright © 1992 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

Menstrual irregularity was reported in association with workplace exposure to xylene perhaps due to effects on liver metabolism. Xylene crosses the human placenta, but does not appear to be teratogenic under conditions tested to date. **Medical Conditions Aggravated by Long-Term Exposure:** CNS, respiratory, eye, skin, gastrointestinal (GI) , liver and kidney disorders. **Target Organs:** CNS, eyes, GI tract, liver, kidneys, and skin. **Primary Entry Routes:** Inhalation, skin absorption (slight), eye contact, ingestion. **Acute Effects:** Inhalation of high xylene concentrations may cause dizziness; nausea, vomiting, and abdominal pain; eye, nose, and throat irritation; respiratory tract irritation leading to pulmonary edema (fluid in lung); drowsiness; and unconsciousness. Direct eye contact can result in conjunctivitis and corneal burns. Ingestion may cause a burning sensation in the oropharynx and stomach and transient CNS depression. **Chronic Effects:** Repeated or prolonged skin contact may cause drying and defatting of the skin leading to dermatitis. Repeated eye exposure to high vapor concentrations may cause reversible eye damage, peripheral and central neuropathy, and liver damage. Other symptoms of chronic exposure include headache, fatigue, irritability, chronic bronchitis, and GI disturbances such as nausea, loss of appetite, and gas.

FIRST AID *Emergency personnel should protect against exposure.* **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Carefully dispose of contaminated clothing as it may pose a fire hazard. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. Monitor exposed person for respiratory distress. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, *do not induce vomiting!* If spontaneous vomiting should occur, keep exposed person's head below the hips to prevent aspiration (breathing liquid xylene into the lungs). *Aspiration of a few millimeters of xylene can cause chemical pneumonitis, pulmonary edema, and hemorrhage.* **Note to Physicians:** Hippuric acid or the ether glucuronide of *ortho*-toluic acid may be useful in diagnosis of *meta-*, *para-* and *ortho*-xylene exposure, respectively. Consider gastric lavage if a large quantity of xylene was ingested. Proceed gastric lavage with protection of the airway from aspiration; consider endotracheal intubation with inflated cuff.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and ventilate spill area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If feasible and without undue risk, stop leak. Use appropriate foam to blanket release and suppress vapors. Water spray may reduce vapor, but does not prevent ignition in closed spaces. For small spills, absorb on paper and evaporate in appropriate exhaust hood or absorb with sand or some non-combustible absorbent and place in containers for later disposal. For large spills dike far ahead of liquid to contain. Do not allow xylene to enter a confined space such as sewers or drains. On land, dike to contain or divert to impermeable holding area. Apply water spray to control flammable vapor and remove material with pumps or vacuum equipment. On water, contain material with natural barriers, booms, or weirs; apply universal gelling agent; and use suction hoses to remove spilled material. Report any release in excess of 1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** Little bioconcentration is expected. Biological oxygen demand 5 (after 5 days at 20 °C): 0.64 (no stated isomer). **Ecotoxicity values:** LD_{50}, Goldfish, 13 mg/L/24 hr, conditions of bioassay not specified, no specific isomer. **Environmental Degradation:** In the atmosphere, xylenes degrade by reacting with photochemically produced hydroxyl radicals with a half-life ranging from 1-1.7 hr. in the summer to 10-18 hr in winter or a typical loss of 67-86% per day. Xylenes are resistant to hydrolysis. **Soil Absorption/Mobility:** Xylenes have low to moderate adsorption to soil and when spilled on land, will volatilize and leach into groundwater. **Disposal:** As a hydrocarbon, xylene is a good candidate for controlled incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U239, F003 (spent solvent)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per Clean Water Act, Sec. 311(b)(4); per RCRA, Sec. 3001]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations >1000 ppm, use any chemical cartridge respirator with organic vapor cartridges; any powered, air-purifying respirator with organic vapor cartridges; any supplied-air respirator; or any self-contained breathing apparatus. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.*Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. With breakthrough times > 8 hr, consider polyvinyl alcohol and fluorocarbon rubber (Viton) as materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in clearly labelled, tightly closed, containers in a cool, well-ventilated place, away from strong oxidizing materials and heat and ignition sources. During transferring operations, electrically ground and bond metal containers. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Use hermetically sealed equipment, transfer xylene in enclosed systems, avoid processes associated with open evaporating surfaces, and provide sources of gas release with enclosures and local exhaust ventilation. Use Class I, Group D electrical equipment. **Administrative Controls:** Establish air and biological monitoring programs and evaluate regularly. Consider preplacement and periodic medical examinations including a complete blood count, a routine urinalysis, and liver function tests. Consider hematologic studies if there is any significant contamination of the solvent with benzene. If feasible, consider the replacement of xylene by less toxic solvents such as petrol (motor fuel) or white spirit. Before carrying out maintenance and repair work, steam and flush all equipment to remove any xylene residues.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Xylenes
DOT Hazard Class: 3
ID No.: UN1307
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Nonbulk Packaging : 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: –

***MSDS Collection* References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 176, 180.
Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 683
Polychlorinated Biphenyls (PCBs)

Issued: 11/88 Revision: A, 9/92

Section 1. Material Identification

Polychlorinated Biphenyls [$C_{12}H_{10-n}Cl_n$ (n=3, 4, 5)] Description: A class of nonpolar chlorinated hydrocarbons with a biphenyl nucleus (two benzene nuclei connected by a single C-C bond) in which any or all of the hydrogen atoms have been replaced by chlorine. Commercial PCBs are mixtures of chlorinated biphenyl isomers with varying degrees of chlorination. Prepared industrially by the chlorination of biphenyl with anhydrous chlorine in the presence of a catalyst such as ferric chloride or iron filings. Except for limited research and development applications, PCBs have not been produced in the US since 1977. When large quantities of PCBs were manufactured in the US, they were marketed under the tradename Aroclor (Monsanto) and were characterized by four digit numbers. The first two digits indicating biphenyls (12), triphenyls (54), or both (25, 44); the last two digits indicating the weight percent of chlorine. PCBs' thermal stability, nonflammability, and high dielectric capability made them very useful in electrical equipment. Formerly used as additives in hydraulic fluids, heat transfer systems, lubricants, cutting oils, printer's ink, fire retardants, asphalt, brake linings, automobile body sealants, plasticizers, adhesives, synthetic rubber, floor tile, wax extenders, dedusting agents, pesticide extenders, and carbonless reproducing paper. PCBs are still used in certain existing electrical capacitors and transformers that require enhanced electrical protection to avoid heating from sustained electric faults.

R 1
I 4
S 3*
K 1
* Skin absorption

NFPA



HMIS
H 2‡
F 1
R 0
PPE†
† Sec. 8
‡ Chronic Effects

Other Designations: CAS No. 1336-36-3, Aroclor, Clophen, Chlorextol, chlorinated biphenyls, chlorinated diphenyl, chlorinated diphenylene, chloro biphenyl, chloro-1,1-biphenyl, Dykanol, Fenclor, Inerteen, Kaneclor, Montar, Noflamol, Phenoclor, Pyralene, Pyranol, Santotherm, Sovol, Therminol FR-1

Cautions: PCBs are potent liver toxins that may be absorbed through skin. Potentially, chronic or delayed toxicity is significant because PCBs accumulate in fatty tissue and may reasonably be anticipated to be carcinogens. PCBs are a bioaccumulative environmental hazard. When burned, decomposition products may be more hazardous than the PCBs.

Section 2. Ingredients and Occupational Exposure Limits

PCBs, contain various levels of polychlorinated dibenzofurans and chlorinated naphthalenes as contaminants

1991 OSHA PELs, Skin
8-hr TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m³
8-hr TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m³

1990 DFG (Germany) MAK, Danger of Cutaneous Absorption
TWA (Chlorodiphenyl, 42% chlorine): 0.1 ppm (1 mg/m³)
Category III: Substances with systemic effects, onset of effect > 2 hr., half-life > shift length (strongly cumulative)
Short-term Level: 1 ppm, 30 min., average value, 1 per shift

TWA (Chlorodiphenyl, 54% chlorine): 0.05 ppm (0.5 mg/m³)
Category III: (see above)
Short-term Level: 0.5 ppm, 30 min., average value, 1 per shift

1985-86 Toxicity Data*
Rat, oral, TD: 1250 mg/kg administered intermittently for 25 weeks produced liver tumors.
Mammal, oral, TD_{Lo}: 325 mg/kg administered to female for 30 days prior to mating and from the 1st to the 36th day of gestation produced effects on newborn (stillbirth; live birth index; viability index).

1990 NIOSH REL
TWA (Chlorodiphenyl, 42% chlorine): 0.001 mg/m³
TWA (Chlorodiphenyl, 54% chlorine): 0.001 mg/m³

1992-93 ACGIH TLVs, Skin *
TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m³
TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m³

* These guidelines offer reasonably good protection against systemic intoxication, but may not guarantee that chloroacne won't occur.
† See NIOSH, *RTECS* (TQ1350000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: 644-707 °F (340-375 °C)
Melting Point: 42%: -2.2 °F (-19°C); 54%: 14 °F (-10 °C)
Vapor Pressure: 1 mm Hg at 100 °F (38 °C); 10^{-6} to 10^{-3} mm at 20 °C
Molecular Weight: 188.7 to 398.5

Specific Gravity: 1.3 to 1.8 at 20 °C
Water Solubility: Low solubility (0.007 to 5.9 mg/L)
Other Solubilities: Most common organic solvents, oils, and fats; slightly soluble in glycerol and glycols.

Appearance and Odor: PCBs vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins, depending upon chlorine content.

* Physical and chemical properties vary widely according to degree and to the position of chlorination.

Section 4. Fire and Explosion Data

Flash Point: 286-385 °F (141-196 °C) OC*	Autoignition Temperature: 464 °F (240 °C)	LEL: None reported	UEL: None reported

Extinguishing Media: Use extinguishing media suitable to the surrounding fire. Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water spray may be ineffective. Use water spray to cool fire-exposed containers or transformers. Do not scatter PCBs with high-pressure water streams. **Unusual Fire or Explosion Hazards:** Combustion products (hydrogen chloride, phosgene, polychlorinated dibenzofurans, and furans) are more hazardous than the PCBs themselves. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Approach fire from upwind to avoid highly toxic decomposition products. Structural firefighter's protective clothing will provide *limited* protection. Do not release runoff from fire control methods to sewers or waterways. Dike for later disposal.

* Flash points shown are a range for various PCBs. Some forms do not have flash points.

Section 5. Reactivity Data

Stability/Polymerization: PCBs are very stable materials but are subject to photodechlorination when exposed to sunlight or UV (spectral region above 290 nanometers). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs are chemically inert and resistant to oxidation, acids, and bases. **Conditions to Avoid:** Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition [1112-1202 °F (600-650 °C)] of PCBs can produce highly toxic derivatives, including polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hydrogen chloride, phosgene and other irritants.

Copyright © 1992 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] and NTP[169] list PCBs as an IARC probable carcinogen (overall evaluation is 2A; limited human data; sufficient animal data) and NTP anticipated carcinogen, respectively. **Summary of Risks:** PCBs are potent liver toxins that can be absorbed through unbroken skin in toxic amounts without immediate pain or irritation. PCBs have low acute toxicity, but can accumulate in fatty tissue and severe health effects may develop later. Generally, toxicity increases with a higher chlorine content; PCB-oxides are more toxic. The toxic action on the liver also increases with simultaneous exposure to other liver toxins, e.g. chlorinated solvents, alcohol, and certain drugs. Pathological pregnancies (abnormal pigmentations, abortions, stillbirths, and underweight births) have been associated with increased PCB serum levels in mothers; PCBs can be passed in breast milk. PCBs can affect the reproductive system of adults. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, liver, and respiratory disease. **Target Organs:** Skin, liver, eyes, mucous membranes, and respiratory tract. **Primary Entry Routes:** Inhalation, dermal contact, ingestion. **Acute Effects:** Exposure to PCB vapor or mist is severely irritating to the skin, eyes, nose, throat, and upper respiratory tract. Intense acute exposure to high concentrations may result in eye, lung, and liver injury. Systemic effects include nausea, vomiting, increased blood pressure, fatigue, weight loss, jaundice, edema and abdominal pain. Cognitive, neurobehavior and psychomotor impairment and memory loss have also been seen after acute exposure. **Chronic Effects:** Repeated exposure to PCBs can cause chloroacne; redness, swelling, dryness, thickening and darkening of the skin and nails; swelling and burning of the eyes, and excessive eye discharge; distinctive hair follicles; gastrointestinal disturbances; neurological symptoms including headache, dizziness, depression, nervousness, numbness of the extremities, and joint and muscle pain; liver enlargement; menstrual changes in women; and chronic bronchitis. Cancer, primarily liver, is also a possible result of exposure, but data is inconclusive.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Rinsing eyes with medical oil (olive, mineral) initially may remove PCB and halt irritation better than water rinsing alone. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. *Multiple soap and water washings are necessary.* Avoid the use of organic solvents to clean the skin. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** In most cases, accidental PCB ingestion will not be recognized until long after vomiting would be of any value. Never give anything by mouth to an unconscious or convulsing person. Vomiting of the pure substance may cause aspiration. Consult a physician. **Note to Physicians:** Monitor patients for increased hepatic enzymes, chloroacne, and eye, gastrointestinal, and neurologic symptoms listed above. Diagnostic tests include blood levels of PCBs and altered liver enzymes.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, provide adequate ventilation, and isolate hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. For small spills, take up with sand or other noncombustible material and place into containers for later disposal. For larger spills, dike far ahead of spill to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** PCBs have been shown to bio-concentrate significantly in aquatic organisms. **Ecotoxicity:** Bluegill, TLm: 0.278 ppm/96 hr. Mallard Duck, LD_{50}: 2000 ppm. **Environmental Degradation:** In general, the persistence of PCBs increases with an increase degree of chlorination. **Soil Absorption/Mobility:** PCBs are tightly absorbed in soil and generally do not leach significantly in most aqueous soil systems. However, in the presence of organic solvents, PCBs may leach rapidly through the soil. Volatilization of PCBs from soil may be slow, but over time may be significant. **Disposal:** Approved PCB disposal methods include: incineration with scrubbing, high-efficiency boilers, landfills, and EPA-approved alternative disposal methods. Each disposal method has various criteria. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

RCRA Hazardous Waste (40 CFR 261.33): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1 lb (0.454 kg) [* per CWA, Sec. 311(b)(4) and 307(a)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Minimum respiratory protection should include a combination dust-fume-mist and organic vapor cartridge or canister or air-supplied, depending upon the situation. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Butyl rubber, neoprene, Teflon, and fluorocarbon rubber have break through times greater than 8 hrs. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Segregate contaminated clothing in such a manner so that there is no direct contact by laundry personnel. Implement quality assurance to ascertain the completeness of the cleaning procedures. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a closed, labelled, container in a ventilated area with appropriate air pollution control equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Inform employees of the adverse health effects associated with PCBs. Limit access to PCB work areas to authorized personnel. Consider preplacement and periodic medical examinations with emphasis on the skin, liver, lung, and reproductive system. Monitor PCB blood levels. Consider possible effects on the fetus. Keep medical records for the entire length of employment and for the following 30 yrs.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Polychlorinated biphenyls
DOT Hazard Class: 9
ID No.: UN2315
DOT Packing Group: II
DOT Label: CLASS 9
Special Provisions (172.102): 9, N81

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 100 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 34

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 163, 164, 168, 169, 174, 175, 180
Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy MPH, CIH; **Medical Review:** AC Darlington, MD

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

2, 3, 7, 8-Tetrachlorodibenzo-*p*-dioxin (TCDD)

MSDS No. 906 Date of Preparation: 6/94

Section 1 - Chemical Product and Company Identification 44

Product/Chemical Name: 2, 3, 7, 8-Tetrachlorodibenzo-*p*-dioxin (TCDD)
Chemical Formula: $C_{12}H_4Cl_4O_2$
CAS No.: 1746-01-6
Synonyms: dioxin; dioxine; NCI-C03714; tetrachlorodibenzodioxin; 2, 3, 7, 8-tetrachlorodibenzo(b, e)(1, 4)dioxin; 2, 3, 7, 8-tetrachlorodibenzo-1, 4-dioxin; TCDBD; TCDD; 2, 3, 7, 8-TCDD; tetradioxin
Derivation: TCDD is not manufactured, but is formed as a by-product of chlorobenzenes, chlorophenols, and the herbicides 2, 4, 5-trichlorophenoxyacetic acid (2, 4, 5-T) and 2-(2, 4, 5-trichlorophenoxy)propionic acid (Silvex) which are produced from 2, 4, 5-trichlorophenol (TCP). 2, 4, 5-T, commonly known as Agent Orange, was the defoliant used during the Vietnam War. TCP, 2, 4, 5-T and Silvex are no longer commercially produced in the U.S. As a chemical and toxicological standard, TCDD can be prepared by catalytic condensation of potassium 2, 4, 5-trichlorophenate. TCDD has been released to the environment during the incineration of chemical wastes including chlorinated benzenes, chlorophenols, and biphenyl ethers, from the improper disposal of certain chlorinated chemical wastes, in emissions from wood burning in the presence of chlorine, in accidental fires involving transformers containing PCBs, and from the use of the herbicides 2, 4, 5-T and Silvex.
General Use: TCDD is an extremely toxic, unwanted by-product and essentially has no beneficial uses. It may be used as a research chemical. **Vendors:** Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

2, 3, 7, 8-Tetrachlorodibenzo-*p*-dioxin, ca 100 %wt. TCDD normally persists as a contaminant in TCP in variable amounts (0.07-6.2 mg/kg). Consequently, the concentrations of TCDD in different batches of Agent Orange varied greatly with an average concentration of about 2 ppm.

OSHA PEL*
None established

NIOSH REL
Carcinogen, lowest feasible concentration.

DFG (Germany) MAK
None established

ACGIH TLV
None established

* A preliminary occupational exposure limit of 0.2 ng/m^3 (200 pg/m^3) is recommended. It provides an ample margin of safety to prevent chloracne and takes into consideration the chronic effects of animal studies and accidental human exposure. [Leung HW et al; *American Industrial Hygiene Association Journal*, 49 (9): 466-74 b(1988)]

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

TCDD is a colorless, crystalline solid at room temperature. It is highly toxic and a potential human carcinogen. Exposure to TCDD-contaminated materials may cause a severe and disabling acne-like rash that may persist for years (chloracne), metabolic disorders, and nervous system and liver damage. In animals, TCDD causes teratogenesis, tumorigenesis, and immunological dysfunction. Findings in humans are inconclusive, but human toxicology is under continuing investigation. Workers may be exposed to TCDD from residues from prior production or use of 2, 4, 5-T or Silvex, waste materials contaminated by TCDD, or contamination resulting from transformer fires. Take every precaution to avoid any exposure to TCDD.

Wilson Risk Scale	
R	1
I	4
S	4*
K	1

*Skin absorption

HMIS	
H	4†
F	1
R	0

†Chronic Effects
PPE‡
‡Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation (dust),* skin contact, ingestion.
Target Organs: Skin, liver, and nervous system.
Acute Effects
Inhalation: Shortness of breath, headaches, fatigue, severe muscle pains, weakness, and digestive disturbance. Most symptoms develop slowly, over many days.
Eye: Conjunctivitis and chemical burns.
Skin: Chemical burns. In most cases, chloracne appears within 2 to 4 weeks after initial exposure. It consists of blackheads with small, pale-yellow cysts. In severe cases, there may be papules (red spots) or even pustules (pus-filled spots). This acne-like rash appears on the cheekbones under the eyes and behind the ears in very mild cases. With increasing severity, the rest of the face and neck are affected and the outer upper arms, chest, back, abdomen, outer thighs and genitalia may be involved in varying degrees in the worst cases. In the worst cases, lesions may be active 15 or more years after the contact has ceased. Chloracne may also appear after ingestion or inhalation. Skin fragility, hirsutism (excessive growth of hair of normal or abnormal distribution), and photosensitivity may also occur.
Ingestion: Nausea, vomiting, and possible pancreatitis.

Copyright © 1994 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Carcinogenicity: The IARC, NTP, MAK , and NIOSH list TCDD as an IARC-2B (possibly carcinogenic to humans: inadequate evidence of carcinogenicity in humans but there is sufficient evidence of carcinogenicity in experimental animals), an NTP-2 (reasonably anticipated to be a carcinogen: limited evidence from studies in humans or sufficient evidence from studies in experimental animals), an MAK-A2 (unmistakably carcinogenic in animal experimentation only), and a NIOSH-X (carcinogen defined with no further categorization). OSHA does not list TCDD as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: Skin, liver, nervous and endocrine system disorders.
Chronic Effects: Lack of energy, loss of sex drive, personality and mood changes, numbness, weakness and pain in the legs, liver damage, chloracne, and elevated blood lipids. TCDD increased the incidence of a variety of tumors in animals, but human data is inconclusive. Little is known of the human health effects (if any) as a result of long-term exposures to low concentrations.
Comments: The observed health effects from clinical or epidemiological studies of populations who were occupationally and non-occupationally exposed cannot be solely attributed to TCDD because of the concurrent exposure to 2, 4, 5-T and TCP and to other herbicides as well. There is no report of human exposure to TCDD alone.
* Vapor inhalation is unlikely because TCDD has a low vapor pressure.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin Contact: *Quickly* remove contaminated clothing. Flush with water to remove solid particles; follow with a soap and water wash of exposed areas. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: For an acute exposure, obtain liver function tests, CBC, prothrombin time, serum lipids, and uroporphyrins. EMG may be useful in detecting subclinical neuropathy. Current analytical techniques to detect dioxins in human tissue specimens involve gas chromatography and mass spectrometry. Chloracne may respond to topical retinoic acid, and oral tetracyclines may help secondary pustular follicles. Resistant cases may require dermabrasion or acne surgery. Isotretinoin may be tried.
Special Precautions/Procedures: Emergency personnel should protect against contamination.

Section 5 - Fire-Fighting Measures

Genium



Flash Point: None reported.
Autoignition Temperature: None reported.
LEL: None reported.
UEL: None reported.
Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam extinguisher.
Unusual Fire or Explosion Hazards: None reported.
Hazardous Combustion Products: Toxic fumes of chlorine.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel of spill, evacuate all unnecessary personnel, remove heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against skin and eye contact and dust inhalation.
Small Spills: Carefully collect and place in sealed containers for disposal.
Large Spills
Containment: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways.
Cleanup: Avoid generating dust. *Do not* sweep! Provide an organized procedure of containment, collection, and disposal of contaminated solutions and residues generated during cleanup. Provide separate facilities for decontamination of large equipment. Conduct repetitive wash/rinse cycles separately, either by using different locations or by spacing in time.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120). For specific recommendations, contact your Department of Environmental Protection or your regional EPA office.

Section 7 - Handling and Storage

Handling Precautions: Handle with extreme caution. Take all the necessary precautions to avoid any exposure.
Storage Requirements: Store in tightly closed and properly labeled containers in a cool, well-ventilated area.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Isolate work areas involving TCDD or TCDD-contaminated materials.

Copyright © 1994 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Administrative Controls:** Consider preplacement and periodic medical examinations with emphasis on the skin, liver, nervous and endocrine systems. Regularly monitor glassware, bench tops, instruments, and tools with wipe tests (wipe with filter paper and measure amount of TCDD). **Respiratory Protection:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For situations where TCDD contamination is low (e.g., exposure to dust contaminated with low levels of TCDD), wear an air-purifying respirator until the extent and characterization of the exposure can be determined. For materials highly contaminated with TCDD, wear respirators that consist of self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive pressure mode. An alternate method utilizes a combination Type C supplied-air respirator, with full facepiece, operated in a pressure-demand mode and equipped with auxiliary positive pressure self-contained air supply. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Protective Clothing/Equipment:** Consider disposable clothing due to the uncertainty of adequate decontamination. Wear protective clothing consisting of both outer (zippered coverall with attached hood and draw string or elastic sleeves, gloves and closure boots) and inner (cotton overalls, undershirts, undershorts, gloves, and socks) garments. For dust or particulate exposure, wear coveralls of a non-woven fabric such as Tyvek or spun bonded polyethylene. For exposure to liquids, wear coveralls, gloves, and boots made of chemically resistant materials such as Saranax coated Tyvek or butyl, nitrile, or neoprene rubber. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area. **Contaminated Equipment:** Shower and change clothes after potential exposures or at the end of the work day. Separate contaminated work clothes from street clothes. Launder before reuse. Place disposable clothing in marked and approved containers for disposal. Remove this material from your shoes and clean personal protective equipment. To prevent cross-contact, provide segregated decontamination locations with separate, controlled, and well-marked entry/exit routes and locations. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: Colorless needles
Water Solubility: 19.3 ng/L
Other Solubilities: *o*-dichlorobenzene (1.4 g/L); chlorobenzene (0.72 g/L); benzene (0.57 g/L); chloroform (0.37 g/L); acetone (0.11 g/L); *n*-octanol (0.05 g/L); methanol (0.01 g/L); lard oil (0.04 g/L)

Vapor Pressure: 7.4×10^{-10} mm Hg at 77 °F (25 °C)
Formula Weight: 322
Melting Point: 581-583 °F (305-306 °C)
Octanol/Water Partition Coefficient: log Kow= 7.02
Henry's Law Constant: 1.62×10^{-5} atm m^3/mole at 25 °C (estimated)

Section 10 - Stability and Reactivity

Stability: TCDD is relatively stable toward heat, acids, and alkalis. It is changed chemically when exposed in isooctane or *n*-octanol to UV light. **Polymerization:** Hazardous polymerization cannot occur. **Chemical Incompatibilities:** None reported. **Conditions to Avoid:** Avoid heat and ignition sources. **Hazardous Decomposition Products:** Thermal oxidative decomposition of TCDD can produce toxic fumes of chlorine. Decomposition begins at 932 °F (500 °C) and complete decomposition occurs within 21 sec at 1472 °F (800 °C).

Section 11- Toxicological Information

Toxicity Data:*

Eye Effects:
Rabbit, eye: 2 mg caused moderate irritation.
Acute Effects:
Human, skin, TD_{Lo}: 107 µg/kg produced dermatitis and allergic reaction.
Mammal, oral, LD_{50}: 4200 ng/kg produced changes of the liver, kidney, ureter, bladder, and spleen.
Rat, oral, LD_{50}: 20 µg/kg
Reproductive Effects:
Monkey, oral, TD_{Lo}: 92 ng/kg (46 weeks prior to mating, on each day during gestation, and for 17 weeks following birth) caused effects on the newborn (behavioral; delayed effects).
Genetic Effects:
Human cell: 100 pmol/L caused unscheduled DNA synthesis.

Copyright © 1994 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genetic Effects *(continued)*:
Human cell: 10 nmol/L caused DNA inhibition.
Tumorigenic Effects:
Rat, oral: 52 µg/kg/2 yr (intermittent) caused liver and thyroid tumors.
Rat, oral: 27 µg/kg/65 weeks (continuous) caused liver and kidney tumors.
Multiple Dose:
Rat, oral: 6500 ng/kg/13 weeks (intermittent) caused changes in liver and thymus weight and pigmented or nucleated red blood cells.
Mouse, skin: 97 µg/kg/13 weeks (intermittent) caused diffuse hepatitis (hepatocellular necrosis); changes in spleen; and death.
* See NIOSH, *RTECS* (HP3500000), for additional toxicity data.

Section 12 - Ecological Information

Environmental Transport: Bioconcentration will occur in aquatic organisms. Due to TCDD's low solubility in water and lipids as well as its low partition coefficient in lipids, TCDD is not likely to accumulate in as many biological systems as DDT.
Environmental Degradation: When released to the atmosphere, gas-phase TCDD is degraded by reaction with hydroxyl radicals and direct photolysis (half-life =8.3 days). Particulate-phase TCDD may be physically removed from air by wet and dry deposition. TCDD may be transported long distances through the atmosphere with surface water sediments being an ultimate environmental sink of airborne particulates. TCDD will absorb to sediment and limit the overall rate by which TCDD is removed from water. TCDD near the water's surface may experience significant photodegradation. 1.5 yr is the persistence half-life of TCDD in lakes. TCDD is generally resistant to biodegradation. Photodegradation on terrestrial surfaces may be an important transformation process. During warm conditions, volatilization from soil surfaces may be a major removal mechanism. Volatilization of TCDD from dry soil surfaces is likely to be faster than from wet soil surfaces. TCDD that has been mixed into soil depths beneath the upper surface boundary will volatilize extremely slowly. On soil surfaces, persistence half-life of TCDD on soil surfaces varies from less than 1 yr to 3 yr. Half-lives in soil interiors may be as long as 12 yr.
Soil Absorption/Mobility: TCDD is immobile in soil and is not expected to leach. Lateral movement due to surface erosion may occur.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Environmentally hazardous substances, solid, n.o.s.*
Shipping Symbols: —
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9
Special Provisions (172.102): 8, B54, N50

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: None
b) Cargo Aircraft Only: None

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: —

* If it is in a quantity, in one package which equals or exceeds the RQ of 1 lb (0.454 kg).

Section 15 - Regulatory Information

EPA Regulations: RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per CWA, Sec. 307(a)
CERCLA Reportable Quantity (RQ), 1 lb (0.454 kg)
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations: Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): Not listed

Section 16 - Other Information

References: 73, 103, 124, 132, 136, 139, 184, 187, 189, 190, 193
Prepared By MJ Wurth, BS **Industrial Hygiene Review** PA Roy, MPH, CIH **Medical Review** T Thoburn, MD, MPH
Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1994 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:
Sheet No. 317
Toluene
Issued: 8/79 Revision: E, 9/92 Errata: 2/94

Section 1. Material Identification

Toluene ($C_6H_5CH_3$) Description: Derived from petroleum i.e., dehydrogenation of cycloparaffin fractions followed by the aromatization of saturated aromatic hydrocarbons or by fractional distillation of coal-tar light oil and purified by rectification. Used widely as a solvent (replacing benzene in many cases) for oils, resins, adhesives, natural rubber, coal tar, asphalt, pitch, acetyl celluloses, cellulose paints and varnishes; a diluent for photogravure inks, raw material for organic synthesis (benzoyl & benzilidene chlorides, saccharine, TNT, toluene diisocyanate, and many dyestuffs), in aviation and high octane automobile gasoline, as a nonclinical thermometer liquid and suspension solution for navigational instruments.
Other Designations: CAS No. 108-88-3, Methacide, methylbenzene, methylbenzol, phenylmethane, toluol, Tolu-sol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 3
S 2*
K 3
* Skin absorption

NFPA



HMIS
H 2- Chronic effects
F 3
R 0
PPE-Sec. 8

Cautions: Toluene is an eye, skin, and respiratory tract irritant becoming narcotic at high centrations. Liver and kidney damage has occurred. Pregnant women chronically exposed to toluene have shown teratogenic effects. Toluene is highly flammable.

Section 2. Ingredients and Occupational Exposure Limits

Toluene, < 100%; may contain a small amount of benzene (~ 1%), xylene, and nonaromatic hydrocarbons.

1991 OSHA PELs
8-hr TWA: 100 ppm (375 mg/m³)
15-min STEL: 150 ppm (560 mg/m³)

1990 IDLH Level
2000 ppm

1990 NIOSH RELs
TWA: 100 ppm (375 mg/m³)
STEL: 150 ppm (560 mg/m³)

1992-93 ACGIH TLV (Skin)
TWA: 50 ppm (188 mg/m³)

1990 DFG (Germany) MAK*
TWA: 100 ppm (380 mg/m³)
Half-life: 2 hr to end of shift
Category II: Substances with systemic effects
Peak Exposure Limit: 500 ppm, 30 min average value, 2/shift

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: 100 ppm caused hallucinations, and changes in motor activity and changes in psychophysiological tests.
Human, oral, LD_{Lo}: 50 mg/kg; toxic effects not yet reviewed
Human, eye: 300 ppm caused irritation.
Rat, oral, LD_{50}: 5000 mg/kg
Rat, liver: 30 µmol/L caused DNA damage.

* Available information suggests damage to the developing fetus is probable.
†See NIOSH, *RTECS* (XS5250000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 232 °F (110.6 °C)
Melting Point: -139 °F (-95 °C)
Molecular Weight: 92.15
Density: 0.866 at 68 °F (20/4 °C)
Surface Tension: 29 dyne/cm at 68 °F (20 °C)
Viscosity: 0.59 cP at 68 °F (20 °C)
Refraction Index: 1.4967 at 20 °C/D

Water Solubility: Very slightly soluble, 0.6 mg/L at 68 °F (20 °C)
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, chloroform, glacial acetic acid, petroleum ether, and carbon disulfide.
Vapor Pressure: 22 mm Hg at 68 °F (20 °C); 36.7 mm Hg at 86 °F (30 °C)
Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.0797 lb/ft³ or 1.2755 kg/m³
Odor Threshold (range of all referenced values): 0.021 to 69 ppm

Appearance and Odor: Colorless liquid with a sickly sweet odor.

Section 4. Fire and Explosion Data

Flash Point: 40 °F (4.4 °C) CC	**Autoignition Temperature:** 896 °F (480 °C)	**LEL:** 1.27% v/v	**UEL:** 7.0% v/v

Extinguishing Media: Toluene is a Class 1B flammable liquid. To fight fire, use dry chemical carbon dioxide, or 'alcohol-resistant' foam. Water spray may be ineffective as toluene floats on water and may actually spread fire. **Unusual Fire or Explosion Hazards:** Concentrated vapors are heavier than air and may travel to an ignition source and flash back. Container may explode in heat of fire. Toluenes' burning rate = 5.7 mm/min and its flame speed = 37 cm/sec. Vapor poses an explosion hazard indoors, outdoors, and in sewers. May accumulate static electricity. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire because a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Toluene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can't occur. **Chemical Incompatibilities:** Strong oxidizers, concentrated nitric acid, nitric acid + sulfuric acid, dinitrogen tetroxide, silver perchlorate, bromine trifluoride, tetranitromethane, and 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione. **Conditions to Avoid:** Contact with heat, ignition sources, or incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of toluene can produce carbon dioxide, and acrid, irritating smoke.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list toluene as a carcinogen. **Summary of Risks:** Toluene is irritating to the eyes, nose, and respiratory tract. Inhalation of high concentrations produces a narcotic effect sometimes leading to coma as well as liver and kidney damage. 93% of inhaled toluene is retained in the body of which 80% is metabolized to benzoic acid, then to hippuric acid and excreted in urine. The remainder is metabolized to *o*-cresol and excreted or exhaled unchanged. Toluene metabolism is inhibited by alcohol ingestion and is synergistic with benzene, asphalt fumes, or chlorinated hydrocarbons (i.e. perchloroethylene). Toluene is readily absorbed through the skin at 14 to 23 mg/cm²/hr. Toluene is absorbed quicker during exercise than at rest and appears to be retained longer in obese versus thin victims; presumably due to its lipid solubility. There is inconsistent data on toluene's ability to damage bone marrow; chronic poisoning has resulted in anemia and leucopenia with biopsy showing bone marrow hypo-plasia. These reports are few and some authorities argue that the effects may have been due to benzene contaminants. Chronic inhalation during pregnancy has been associated with teratogenic effects on the fetus including microcephaly, CNS dysfunction, attentional deficits, developmental delay + language impairment, growth retardation, and physical defects including a small midface, short palpebral fissures, with deep-set eyes, low-set ears, flat nasal bridge with a small nose, micrognathia, and blunt fingertips. There is some evidence that toluene causes an autoimmune illness in which the body produces antibodies that cause inflammation of its own kidney.

Continue on next page

Copyright © 1992 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Alcoholism and CNS, kidney, skin, or liver disease. **Target Organs:** CNS, liver, kidney, skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Acute Effects:** Vapor inhalation causes respiratory tract irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, watering eyes, nervousness, insomnia, parasthesis, and vertigo progressing to narcotic coma. Death may result from cardiac arrest due to ventricular fibrillation with catecholamines loss. Liquid splashed in the eye causes conjunctival irritation, transient corneal damage and possible burns. Prolonged skin contact leads to drying and fissured dermatitis. Ingestion causes GI tract irritation and symptoms associated with inhalation. **Chronic Effects:** Symptoms include mucous membrane irritation, headache, vertigo, nausea, appetite loss and alcohol intolerance. Repeated heavy exposure may result in encephalopathies (cerebellar ataxia and cognitive dysfunction), liver enlargement, and kidney dystrophy (wasting away). Symptoms usually appear at workdays end, worsen at weeks end and decrease or disappear over the weekend. **FIRST AID Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of danger of aspiration into the lungs. Gastric lavage may be indicated if large amounts are swallowed; potential toxicity needs to be weighed against aspiration risk when deciding for or against gastric lavage. **Note to Physicians:** Monitor cardiac function. If indicated, use epinephrine and other catecholamines carefully, because of the possibility of a lowered myocardial threshold to the arrhythmogenic effects of such substances. Obtain CBC, electrolytes, and urinalysis. Monitor arterial blood gases. If toluene has > 0.02% (200 ppm) benzene, evaluate for potential benzene toxicity. BEI: hippuric acid in urine, sample at shift end (2.5 g/g creatinine); Toluene in venous blood, sample at shift end (1.0 mg/L).

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel protect against inhalation and skin/eye contact. Use water spray to cool and disperse vapors but it may not prevent ignition in closed spaces. Cellosolve, hycar absorbent materials, and fluorocarbon water can also be used for vapor suppression/containment. Take up small spill with earth, sand, vermiculite, or other absorbent, noncombustible material. Dike far ahead of large spills for later reclamation or disposal. For water spills, (10 ppm or greater) apply activated carbon at 10X the spilled amount and remove trapped material with suction hoses or use mechanical dredges/lifts to remove immobilized masses of pollutants and precipitates. Toluene can undergo fluidized bed incineration at 842 to 1796 °F (450 to 980 °C), rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C), or liquid injection incineration at 1202 to 2912 °F (650 to 1600 °C). Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Blue gill, LC_{50} = 17 mg/L/24 hr; shrimp (*Crangonfracis coron*), LC_{50} = 4.3 ppm/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 36.2 mg/L/96 hr. **Environmental Degradation:** If released to land, toluene evaporates and undergoes microbial degradation. In water, toluene volatilizes and biodegrades with a half-life of days to several weeks. In air, toluene degrades by reaction with photochemically produced hydroxyl radicals. **Disposal:** Treat contaminated water by gravity separation of solids, followed by skimming of surface. Pass through dual media filtration and carbon absorption units (carbon ratio 1 kg to 10 kg soluble material). Return waste water from backwash to gravity separator. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U220
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
[* per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307 (a)]
Listed as a SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses with shatter-resistant glass and side-shields or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator (SAR), or SCBA. For < 2000 ppm, use any SAR operated in continuous-flow mode, any SAR or SCBA with a full facepiece, or any air-purifying respirator with a full facepiece having a chin-style, front or back mounted organic vapor canister. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol with a breakthrough time of > 8 hr, Teflon and Viton are recommended as suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove toluene from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incompatibles. Outside or detached storage is preferred. If stored inside, use a standard flammable liquids warehouse, room, or cabinet. To prevent static sparks, electrically ground and bond all equipment used with toluene. Do not use open lights in toluene areas. Install Class 1, Group D electrical equipment. Check that toluene is free of or contains < 1% benzene before use. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Adopt controls for confined spaces (29 CFR 1910.146) if entering areas of unknown toluene levels (holes, wells, storage tanks). Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, liver, kidney, and skin. Include hemocytometric and thrombocyte count in cases where benzene is a contaminant of toluene. Monitor air at regular intervals to ensure effective ventilation.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Toluene
DOT Hazard Class: 3
ID No.: UN1294
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 150
b) Non-bulk Packaging: 202
c) Bulk Packaging: 242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
Vessel Stowage: B
Other: --

CSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 140, 148, 153, 159, 163, 164, 167, 169, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, CIH, MPH; **Medical Review:** AC Darlington, MD, MPH

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 7
Nitric Acid

Issued: 10/88 Revision: D, 9/92

Section 1. Material Identification

Nitric Acid (HNO_3) Description: A solution of nitrogen dioxide in water commercially available in many concentrations. Derived by oxidation of ammonia by catalytic process (heated platinum catalyst); or by direct synthesis, combining atmospheric nitrogen and oxygen in an electric arc (an expensive process, thus largely abandoned). HNO_3 is usually found in conjunction with nitrogen dioxide, which is considered more hazardous. Used in fertilizer production (ammonium nitrate), in photoengraving, steel etching, explosives (TNT, nitroglycerin, trinitrophenol); manufacture of metallic nitrates, sulfuric acid, aqua regia and oxalic acid, jewelry, various dyes and dyestuffs, pharmaceuticals; as a laboratory reagant, in metallurgy (*mainly* as a pickling agent) and the printing industy.
Other Designations: CAS No. 7697-37-2, aqua fortis, aqua regia, azotic acid, engravers nitrate, hydrogen nitrate, red fuming nitric acid (RFNA), white fuming nitric acid (WFNA).
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for suppliers list.

Cautions: Nitric acid is a corrosive, strong oxidizer that causes irritation or severe burns to the skin, eyes, and respiratory tract. Exposures to high levels of the concentrated acid can be fatal. Increases the flammability of combustibles. Use extreme caution when handling HNO_3.

	HMIS		NFPA
R 2	H 3*	*Fuming* nitric acid	
I 4	F 0		
S 4	R 1		
K 0	PPE**		
R 2	H 3*	*> 40%* nitric acid	
I 4	F 0		
S 4	R 1		
K 0	PPE**		
R 2	H 3*	*≤ 40%* nitric acid	
I 3	F 0		
S 3	R 0		
K 0	PPE**		

* Chronic effects ** See Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Nitric acid, various %. Commercially available in nearly all concentrations; most common are 56 and 68%. RFNA (85%), WFNA (97.5%).

1991 OSHA PELs
8-hr TWA: 2 ppm (5 mg/m³)
15-min STEL: 4 ppm (10 mg/m³)

1990 IDLH Level
100 ppm

1990 NIOSH REL
8-hr TWA: 2 ppm (5 mg/m³)
15-min STEL: 4 ppm (10 mg/m³)

1992-93 ACGIH TLVs
TWA: 2 ppm (5.2 mg/m³)
STEL: 4 ppm (10 mg/m³)

1990 DFG (Germany) MAK
2 ppm (5 mg/m³)
Category I: local irritants
Peak Exposure Limit: 2 ppm
5 min momentary value, 8 per shift

1985-86 Toxicity Data*
Man, unreported route, LD_{Lo}: 110 mg/kg; toxic effects not yet reviewed
Rat, oral, TD_{Lo}: 5275 g/kg administered from 1 to 21 days of pregnancy caused post-implantation mortality and specific developmental abnormalities of the musculoskeletal system.
Rat, inhalation, LC_{50}: 67 ppm (NO_2)/4 hr; toxic effects not yet reviewed

* See NIOSH, *RTECS* [QU5775000 (nitric acid), QU5900000 (RFNA), QU6000000 (WFNA)] , for additional reproductive and toxicity data.

Section 3. Physical Data

Boiling Point: 186.8 °F (86 °C)
Melting Point: -43.6 °F (-42 °C)
Vapor Pressure: 67% HNO_3 = 6.8 mm Hg at 68 °F (20 °C); 95 to 98% = 113 at 100.4 °F (38 °C)
Saturated Vapor Density (Air = 1.2 kg/m³): 1.212 kg/m³ or 0.0757 lb/ft³ (67 % HNO_3)
pH: 1

Molecular Weight: 63.02
Density: 1.50269 at 77/39.2 °F (25/4 °C)
Water Solubility: Soluble (releases heat)
Ionization Potential: 11.95 eV

Appearance and Odor: Transparent, clear to yellow, fuming liquid with an acrid, suffocating odor which darkens to a brownish color on aging and exposure to light. "Fuming" nitric acid is red-brown in color.

Section 4. Fire and Explosion Data

Flash Point: Noncombustible	Autoignition Temperature: Noncombustible	LEL: None reported	UEL: None reported

Extinguishing Media: For small fires (< 40% HNO_3), use dry chemical, carbon dioxide (CO_2), water spray, or regular foam. For large fires, use water spray, fog, or regular foam. For small fires (> 40% HNO_3), use water spray, dry chemical, or soda ash. For large fires, flood area with water (*do not* get inside HNO_3 containers). Apply water from as far a distance as possible.
Unusual Fire or Explosion Hazards: HNO_3 is noncombustible but is an oxidizer which increases fire involving combustibles and can initiate an explosion. It releases flammable hydrogen gas in contact with many metals.
Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is not effective for fires involving nitric acid. Acid-resistant clothing is needed. Apply cooling water to sides of containers until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. *Do not* release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Nitric acid decomposes in air and in contact with light and organic matter. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Nitric acid reacts explosively with combustibles, organics or readily oxidizable materials such as wood, turpentine, metal powder and hydrogen sulfide, carbides, cyanides, and alkalies; causes spattering with strong bases; is corrosive to paper, cloth and most metals (except aluminum, gold, platinum, thorium, and tantalum. Will also attack some forms of plastics, rubber, and coatings. There are at least 150 chemicals and chemical combinations which are incompatible with nitric acid. HNO_3 reacts with water to produce heat and toxic corrosive fumes. Refer to *Genium* references 126 and 159 for further detail. **Conditions to Avoid:** Avoid exposure to moisture, heat, and incompatibles.
Hazardous Decomposition Products: Thermal oxidative decomposition of HNO_3 produces nitrogen peroxide and toxic, irritating nitrogen oxides.

Section 6. Health Hazards Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list nitric acid as a carcinogen.
Summary of Risks: Nitric acid is very corrosive to the skin, eyes, digestive and respiratory tract or any tissue it comes in contact with. 58 to 68% (nitric acid) vapors are moderately irritating and can't be tolerated at high concentrations. 95% (nitric acid) vapors cause severe irritation at very low levels and the liquid causes 2nd and 3rd degree burns on short contact with skin or eyes. Vapor inhalation may cause pulmonary edema (fluid in lungs) leading to death. HNO_3 vapor or mist can slowly corrode teeth when chronically exposed. **Medical Conditions Aggravated by Long-Term Exposure:** Chronic respiratory diseases. **Target Organs:** Eyes, skin, respiratory tract, teeth.

Continue on next page

Copyright © 1992 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, continued

Primary Entry Routes: Inhalation, ingestion, skin and eye contact. **Acute Effects:** Inhalation symptoms may take several hours and include throat and nose irritation, cough, chest pain, difficulty breathing, salivation, giddiness, nausea, muscular weakness, ulceration of nasal mucous membranes, pulmonary edema, and chemical pneumonia. Skin contact is moderately irritating to severely corrosive depending on % of nitric acid. Burns may penetrate deeply causing ulcers. Skin may be stained yellowish brown. Dilute solutions cause irritation and tend to harden the epithelium (outer skin layer) without destroying it. HNO_3 liquid causes yellow discoloration of the eyes and severe burns which may result in permanent damage, i.e., sight loss. Ingestion produces immediate pain and digestive tract burns followed by throat swelling, convulsions, risk of stomach perforation (causing a rigid abdomen) and possible coma. **Chronic Effects:** Repeated inhalation of low concentrations may cause chronic bronchitis, tooth erosion, and/or appetite loss. Repeated exposure to $NO_{(x)}$ such as produced by thermal decomposition of HNO_3 is implicated in chronic lung diseases.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing (*do not force removal if stuck to skin*). Rinse with flooding amounts of water for at least 15 min. Apply a 5% triethanolamine solution to affected area. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute followed by lime milk or milk of magnesia. Do not induce vomiting. *Do not* give sodium bicarbonate or attempt to neutralize the acid.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Observe for several hours since symptoms such as pulmonary edema may be delayed.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should wear fully-encapsulating vapor-protective clothing. Use water spray to cool and disperse vapor. Keep combustibles away from spilled material. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in dry containers for disposal. For large spill, flush with water to containment area and neutralize with agricultural (slaked) lime, sodium bicarbonate, crushed limestone, soda ash, or lime. Report any release in excess of 1000 lb. Control runoff and dike for disposal. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a SARA Toxic Chemical (40 CFR 372.65)

Listed as a SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 1000 lb

Listed as a RCRA Hazardous Waste (40 CFR 261.22): No. D001, Characteristic of corrosivity

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311(b)(4)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Listed as a Process Safety Hazardous Chemical (29 CFR 1910.119), TQ: 500 lb

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For < 50 ppm, use any supplied-air respirator operated in a continuous-flow mode. For < 100 ppm, use any supplied-air respirator or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear acid-proof gloves, boots, aprons, and gauntlets to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in aluminum, stainless steel, or glass containers on a cement floor in a cool, dry, well-ventilated area away from incompatibles (Sec. 5). Dike around storage tanks with large kirbs or stills to retain the acid in event of leakage. Keep neutralization agents on hand and install a fire hydrant in storage area. (See NFPA Code 43A). **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the eyes, skin, respiratory tract and teeth. Pulmonary function tests (FEV< FVC) are helpful. Educate workers about the hazardous properties of nitric acid.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: *, †, ‡, §, ¥, ψ, ϕ

DOT Hazard Class: 8

ID No.: UN1826 (*†), UN1796 (‡§), UN2031 (¥ψ), UN2032 (ϕ)

DOT Packing Group: I (†§¥ϕ), II (*‡ψ)

DOT Packaging Label: Corrosive (*‡¥ψ), Corrosive, Oxidizer (†§), Corrosive, Oxidizer, Poison (ϕ)

Special Provisions (172.102): B2, T12, T27 (*); T12, T27 (†); B2, T12, T27 (‡); T12, T27 (§); B12, B53, T9, T27 (¥); B2, B12, B53, T9, T27(ψ); 2, B9, B32, B74, T38, T43, T45(ϕ)

Packaging Authorizations

a) Exceptions: None

b) Non-bulk Packaging: 173.158 (*†‡§¥ψ), 173.227 (ϕ)

c) Bulk Packaging: 173.242 (*‡ψ), 173.243 (†§¥), 173.244(ϕ)

Quantity limitations

a) Passenger Aircraft or Railcar: Forbidden

b) Cargo Aircraft Only: 30L (*‡ψ), 2.5L (†§¥), Forbidden (ϕ)

Vessel Stowage Requirements

a) Vessel stowage: D

b) Other: 40(*); 40, 66, 89 (†); 40 (‡); 40, 66, 89 (§); 110, 111 (¥); 110, 111 (ψ); 40, 66, 74, 89, 90, 95 (ϕ)

* Nitrating acid mixtures spent, < 50% HNO_3

† Nitrating acid mixtures spent, > 50% HNO_3

‡ Nitrating acid mixtures, < 50% HNO_3

§ Nitrating acid mixtures, > 50% HNO_3

¥ Nitric acid other than red fuming, > 70% HNO_3

ψ Nitric acid other than red fuming, < 70% HNO_3

ϕ Nitric acid, red fuming.

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 136, 139, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171, 174, 175

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Coal Tar Creosote

MSDS No. 757

Date of Preparation: 7/91 Revision: A, 9/97

Section 1 - Chemical Product and Company Identification 50

Product/Chemical Name: Coal tar creosote
Chemical Formula: Not found; consists of many compounds and the composition depends on the coal used to make the tar and the design and operating conditions of the coke oven and still.
CAS Number: 8001-58-9
Synonyms: AWPA #1; brick oil; Caswell No. 225; coal tar oil; creosote; creosote oil; creosote P1; creosotum; cresylic creosote; heavy oil; liquid pitch oil; naphthalene oil; Preserv-o-sote; Sakresote; tar oil; wash oil
Derivation: By distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking.
General Use: Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, tap hole refractory cement, and lubricant for die molds. Used only in limited quantities as an animal and bird repellent, animal dip, and insecticide (ovicide).
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Coal tar creosote consists of aromatic hydrocarbons, anthracene, naphthalene, and phenanthrene derivatives; some tar acids; and tar bases. Polycylic aromatic hydrocarbons make up at least 75%.* (198)

OSHA PEL†
8-hr TWA: 0.2 mg/m^3

NIOSH REL†
0.1 mg/m^3 (cyclohexane-extractable fraction)
Carcinogen

DFG (Germany) MAK
None established

ACGIH TLV†
TWA: 0.2 mg/m^3

IDLH Level†
80 mg/m^3

* Creosote contains several carcinogenic polycyclic aromatic hydrocarbons including benz[a]anthracene, benzo[a]pyrene, and dibenz[a,h]anthracene.
† Coal tar pitch volatiles, as benzene solubles (CAS No. 65996-93-20)

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Coal tar creosote is a colorless (pure) or yellow to black (industrial) liquid with an aromatic smoky smell. It is irritating to the eyes, skin and respiratory tract and can be corrosive, causing severe burns. Coal tar creosote is a probable human carcinogen. It is a combustible liquid that is a moderate fire hazard when exposed to an ignition source.

Wilson Risk Scale
R 1
I 3
S 3
K 2
* Skin absorption

HMIS
H 3†
F 2
R 0
PPE‡
†Chronic effects
‡Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, skin absorption, and skin and/or eye contact
Target Organs: Eyes, skin, bladder, kidneys, and respiratory system
Acute Effects *Note! Phenol and phenolic derivatives of various aromatic hydrocarbons (tar acids), present in low concentrations, are the constituents most likely to be responsible for acute toxicity.*
Inhalation: Inhalation of vapors causes moderate irritation to the nose, throat, and upper respiratory tract.
Eye: Contact with liquid causes conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. May cause loss of vision.
Skin: Contact causes irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and bumps), or burns. Photosensitization (worsening of rash with exposure to sunlight) may occur.
Ingestion: Causes salivation, nausea; vomiting; gastrointestinal tract irritation or bleeding; abdominal pain; rapid, thready pulse; vertigo; headaches; loss of pupillary reflexes; hypothermia; cyanosis; respiratory distress; shock and mild convulsions. Large doses may be fatal.
Carcinogenicity: IARC classifies coal tar creosote as Group 2A: probably carcinogenic to humans: limited human evidence, sufficient animal evidence. NTP classifies coal tar creosote as Group 2B: sufficient evidence of carcinogenicity from studies in experimental animals. OSHA does not specifically classify coal tar creosote as a carcinogen. NIOSH classifies coal tar pitch volatiles, as benzene solubles, as a carcinogen defined with no further categorization.
Medical Conditions Aggravated by Long-Term Exposure: Skin disorders.
Chronic Effects: Include dermatitis and, possibly, skin cancer or other forms of cancer. An increased risk of scrotal cancer for creosote-exposed brick makers was indicated in a worker mortality analysis. Epidemiological studies of coke oven workers reveal increased incidences of lung, bladder, prostate, pancreas, and intestinal cancer.

Copyright © 1997 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air, monitor for respiratory distress, and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician or ophthalmologist immediately.
Skin Contact: *Quickly* remove contaminated clothing. Prior to washing and if readily available, use undiluted polyethylene glycol 300 to 400. Wash affected area with soap and flooding amounts of water for at least 15 min. *Do not* rub or apply pressure to the affected skin, apply any oily substance or use hot water to rinse. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Rinse the mouth several times with cold water. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water. *Do not induce vomiting!* Keep victim warm and at rest.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Creosote may be detected in urine.
Special Precautions/Procedures: An exposed person should examine their skin periodically for growths, changes in warts or moles, and sores that do not heal.

Section 5 - Fire-Fighting Measures



Flash Point: 165.2 °F (74 °C)
Flash Point Method: CC
Autoignition Temperature: 637 °F (336 °C)
LEL: None reported.
UEL: None reported.
Flammability Classification: OSHA IIIA combustible liquid
Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or regular foam. For large fires, use water spray, fog or regular foam.
Unusual Fire or Explosion Hazards: Coal tar creosote may present a vapor explosion hazard indoors, outdoors, and in sewers. Vapors may travel to an ignition source and flash back.
Hazardous Combustion Products: Include carbon oxides.
Fire-Fighting Instructions: If feasible and without undue risk, remove containers from fire hazard area. Otherwise use water spray to cool fire-exposed containers until well after they are extinguished. *Do not* release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Immediately leave area if you hear a rising sound from venting safety device or notice any fire-caused tank discoloration as a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Isolate area for 1/2 mile in all directions if fire involves tank, rail car or tank truck. Fully decontaminate or properly dispose of personal protective clothing.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind of spills. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin and eye contact.
Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for later disposal.
Large Spills
Containment: Consider initial downwind evacuation for at least 300 meters (1000 feet). For large spills, dike far ahead of liquid spill for later disposal. Water spray may reduce vapor. *Do not* release into sewers or waterways.
Cleanup: Use nonsparking tools.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor inhalation and skin and eye contact. Use ventilation sufficient to reduce airborne exposures to nonhazardous levels (Sec. 2). Wear protective gloves, goggles, and clothing to avoid contact. Wear respiratory protection when necessary (Sec. 8). Consult your industrial hygienist. Practice good personal hygiene procedures to avoid inadvertently ingesting this material. Keep away from ignition sources.
Storage Requirements: Store in a cool, dry, well-ventilated area away from heat and ignition sources. Store coal tar creosote as close to area of use as possible to minimize transporting distance. Avoid physical damage to containers.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose all operations and/or ventilate at the site of release to avoid vapor dispersion into the work area. To prevent static sparks, electrically ground and bond all containers and equipment.

Copyright © 1997 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Ventilation: Provide general or local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source. (103)

Administrative Controls: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney disorders, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the attending physician considers appropriate. Educate workers about the health and safety hazards associated with coal tar creosote.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. (The following respirator recommendations are for coal tar pitch volatiles.) For concentrations above the NIOSH REL or at any detectable concentrations, wear a SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent any skin contact. With breakthrough times of >8 hr, butyl rubber, Teflon™, and Viton™ are recommended materials. Frequent change of protective garments is an additional protective measure. Wear protective eyeglasses or chemical safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Oily liquid

Appearance and Odor: Colorless (pure) or yellow to black (industrial); aromatic smoky smell

Specific Gravity (H_2O=1, at 4 °C): 1.07 to 1.08 at 68 °F (20 °C)

Water Solubility: Slightly soluble

Other Solubilities: Soluble in alcohol; ether; glycerin; dimethyl sulfate; fixed or volatile oils; in solution of fixed alkali hydroxides.

Boiling Point Range: 381 to 752 °F (194 to 400 °C)

Octanol/Water Partition Coefficient: log K_{ow} = 1.0

Heat of Combustion: -12,500 Btu/lb; -6,900 cal/g

Section 10 - Stability and Reactivity

Stability: Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.

Conditions to Avoid: Avoid excessive heat and contact with chlorosulfonic acid.

Hazardous Decomposition Products: Thermal oxidative decomposition of coal tar creosote can produce carbon oxides and thick, black, acrid smoke.

Section 11 - Toxicological Information

Toxicity Data:*

Genetic Effects:

S. typhimurium: 20 µg/plate (-S9) produced mutations.

Hamster, ovary cell: 10 mg/L induced sister chromatid exchange.

Reproductive Effects:

Mouse, oral: 2 g/kg administered on gestational days 5-9 produced maternal effects and fetotoxicity.

Acute Oral Effects:

Rat, oral, LD_{50}: 725 mg/kg

Mouse, oral, LD_{50}: 433 mg/kg

Tumorigenicity: Mouse, skin, 99 g/kg/33 weeks administered intermittently produced tumors on skin and appendages (carcinogenic by RTECS criteria).

* See NIOSH, *RTECS* (GF8615000), for additional toxicity data.

Copyright © 1997 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 12 - Ecological Information

Ecotoxicity: TL_{50}, goldfish (*Carassius auratus*), 3.51 ppm/24 hr (60:40) mixture of creosote and coal tar; TL_{50}, rainbow trout (*Salmo gairdneri*), 3.72 ppm/24 hr (60:40) mixture of creosote and coal tar; LD_{50}, bob white quail (*Colinus virginianus*), 1,260 ppm/8 days (60:40) mixture of creosote and coal tar.
Environmental Fate: Data not found.

Section 13 - Disposal Considerations

Disposal: Coal tar creosote is a good candidate for rotary kiln and fluidized bed incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
Container Cleaning and Disposal: Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Corrosive liquids, n.o.s.
Shipping Symbols: Not listed.
Hazard Class: 8
ID No.: UN1760
Packing Group: I, II, or III*
Label: CORROSIVE
Special Provisions: A7, B10, T42†; B2, T14 ‡; T7 §

Packaging Authorizations
a) Exceptions: None †; 173.154 ‡ §
b) Non-bulk Packaging: 173.201†; 173.202‡; 173.203§
c) Bulk Packaging: 173.243†; 173.242‡; 173.241§

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 0.5 L†; 1 L‡; 5 L§
b) Cargo Aircraft Only: 2.5 L†; 30 L‡; 60 L§

Vessel Stowage Requirements
a) Vessel Stowage: B†; B‡; A§
b) Other: 40†‡§

* See 49 CFR 173.137 to assign Packing Group. Data was not available for Genium to make this determination.
† Packing Group I
‡ Packing Group II
§ Packing Group III

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Material No. U051
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) listed specific per RCRA, Sec. 3001
CERCLA Final Reportable Quantity (RQ), 1 lb (0.454 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Listed (as coal tar pitch volatiles) as an Air Contaminant (29 CFR 1910.1000, Table Z-1)
Listed as an OSHA Specifically Regulated Substance (29 CFR 1910.1002; interpretation of term)

Section 16 - Other Information

References: 73, 103, 124, 136, 139, 184, 196, 197, 198, 200, 209 W5-MAC

Prepared By ..... J Sawyer, MS/MJ Wurth, BS
Industrial Hygiene Review ..... DJ Wilson, CIH
Medical Review ..... G Kelafant, MD

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1997 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 789
Cyanide

Issued: 11/91

Section 1. Material Identification

Cyanide (CN^-) Description: Derived by combining a carbon ion with a nitride ion. Used in rat and pest poisons, silver and metal polishes, photographic solutions, fumigating products, and electroplating solutions. Cyanide may also be liberated in burning of plastics, natural fabrics (wool or silk), polyurethane bedding or furniture, acrylic baths, nylon carpets, and melamine resin insulation.

R 1
I 4
S 2
K 1

Genium



Other Designations: CAS No. 57-12-5, carbon nitride ion, cyanide anion, isocyanide.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*™ for a suppliers list.

HMIS
H 4
F 1
R 1
PPG*
* Sec. 8

Cautions: Cyanide is severely toxic by all routes of entry and its lethal dose is an estimated 1 µg/ml. Take necessary precautions to avoid all possible exposure to this material.

Section 2. Ingredients and Occupational Exposure Limits

Cyanide, ca 100%

1990 OSHA PEL (Skin)
STEL: 4.7 ppm, 5 mg/m³, as hydrogen cyanide (gas)

1991-92 ACGIH TLV (Skin)
Ceiling: 10 ppm, 11 mg/m³, as hydrogen cyanide (gas)

1990 DFG (Germany) MAK (*Danger of cutaneous absorption*)
TWA: 10 ppm, 11mg/m³ as hydrogen cyanide (gas)

1985-86 Toxicity Data*
Mouse, intraperitoneal, LD_{50}: 3 mg/kg; toxic effects not yet reviewed

1990 IDLH Level
50 mg/m³

1990 NIOSH REL (Skin)
STEL: 4.7 ppm, 5 mg/m³ as hydrogen cyanide (gas)

* See NIOSH, *RTECS* (GS7175000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: Varies with specific CN^- compound
Melting Point: Varies with specific CN^- compound
Molecular Weight: 26.02
Density: Varies with specific CN^- compound
Water Solubility: Varies with specific CN^- compound

Appearance and Odor: Varies with specific CN^- compound, but usually has an almond odor.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Cyanide is combustible. For small fires, use dry chemical, water spray or foam. *Do not use carbon dioxide (CO_2)!* For large fires, use water spray, fog, or regular foam. *Do not scatter* material with more water than needed to extinguish fire.

Unusual Fire or Explosion Hazards: Combustible by chemical reaction with heat, moisture, or acid. Many cyanides readily evolve hydrogen cyanide (HCN), a toxic flammable gas.

Special Fire-fighting Procedures: Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing *is ineffective* for fires involving cyanide. Wear chemical protective clothing that the shipper or manufacturer specifically recommends. If possible without risk, remove container from fire area. Fight fire from maximum distance. Stay away from ends of tanks. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Remove and isolate contaminated clothing at the site.

Section 5. Reactivity Data

Stability/Polymerization: Cyanide is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Cyanide may react violently with hypochlorite solutions at pH 10 to 10.3, is explosive with nitrites if heated above 450 °C, and is incompatible with chlorates, fluorine, magnesium, nitrates, and all inorganic acids.

Conditions to Avoid: Avoid exposure to heat and contact with incompatibles.

Hazardous Products of Decomposition: Thermal oxidative decomposition of cyanide can produce carbon dioxide and toxic, flammable vapors of CN^-.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list cyanide as a carcinogen.

Summary of Risks: Cyanide is a potent, fast-acting, chemical asphyxiant (material which causes pulse and breathing obstruction) that prevents tissue utilization of oxygen by inhibiting the enzyme involved (cytochrome oxidase). Death can occur within seconds to minutes after inhalation of some cyanide gases, and may take as long as an hour after ingestion of a large amount of a cyanide salt due to a slower absorption. Toxicity is dependent on the form of cyanide the victim is exposed to. Mortality from acute exposures is high, but recovery is generally complete in nonfatal cases.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Continue next page

Copyright © 1991 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

Target Organs: Brain, heart, lungs, skin, blood.
Primary Entry Routes: Inhalation, ingestion, skin absorption.
Acute Effects: Inhalation of cyanide gases may cause rapid toxicity where the victim may only have time to utter a warning cry before succumbing to unconsciousness caused by asphyxiation. If exposure is small there may be a weak, rapid, irregular heartbeat with bright-pink coloration of the skin due to high oxyhemoglobin content in the veins before person loses consciousness. A telltale sign of inhalation or ingestion is the odor of bitter almonds on the breath, however up to half the population is genetically unable to detect this smell. Dialated pupils are common in severe poisonings. Contact with broken skin can cause cyanide absorption into the bloodstream. Cyanide ingestion can cause a bitter, burning taste, salivation, nausea, vomiting, anxiety, confusion, vertigo (dizziness), giddiness, sensation of stiffness in the lower jaw, and dyspnea (difficult respiration). In severe cases symptoms could progress to convulsions, paralysis, coma, cardiac arrhythmias, followed by death due to respiratory failure.
Chronic Effects: Chronic skin contact may cause cyanide rash, characterized by itching, and macular (blotches), papular (small, solid, conical, elevation of the skin), and vesicular (blister-like) eruptions. Chronic cyanide inhalation may cause appetite loss, headache, weakness, nausea, dizziness, and symptoms of irritation of the upper respiratory tract and eyes. Other symptoms of chronic exposure include goiter, B12 and folate abnormalities, chest discomfort, epistaxis (nose bleed), poor appetite and sleeping, and functional changes in hearing.
FIRST AID: *Emergency personnel should protect against contamination!*
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Speed is extremely important. Rinse with flooding amounts of water for at least 15 min. Wash exposed area *extremely thoroughly* with soap and water. If irritation and pain persist, consult a physician.
Inhalation: Remove exposed person to fresh air and immediately begin administering 100% oxygen. Avoid mouth-to-mouth resuscitaton during CPR to prevent self-poisonings.
Ingestion: Obtain and prepare the Lilly cyanide antidote kit [Eli Lilly Co. (Stock No. M76)] for use in symptomatic patients. Never give anything by mouth to an unconscious or convulsing person. Do not induce vomiting with Ipecac syrup. Consider gastric lavage. Activated charcoal is said to be ineffective.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: If the victim is unconscious, bradycardia and absence of cyanosis may be key diagnostic signs. Consider administration of amyl nitrite followed by sodium nitrite and sodium thiosulfate (antidote kit). Consider use of 100% oxygen.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate area, deny entry, and stay upwind. Shut off all ignition sources—no flames, flares, or smoking in hazard area. Cleanup personnel should wear fully encapsulating, vapor-protective clothing for spills or leaks without fire. For small dry spills, carefully scoop into clean, dry, suitable container and cover loosely. For small solution spill, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers. For large spills, dike far ahead of solution spills for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): Hazardous Waste No. P030
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity: *An RQ is not being assigned to the general class* [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Select the respirator based on its suitability provide adequate worker protection for the given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA with a full facepiece operated in pressure-demand or other positive-pressure mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent repeated or prolonged skin contact.
Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics. Cyanide detoxifying kits and instructions should be available in use areas. Instruct employees working in these areas on how and when to use these kits.

Section 9. Special Precautions and Comments

Storage Requirements: Avoid physical damage to containers. Store in tightly closed and properly labeled containers in cool, dry, well-ventilated area away from heat and incompatibles.
Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control hazardous airborne contaminants and to maintain concentrations at the lowest practical level.
Other Precautions: If respirators are used, implement a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Consider preplacement and periodic medical examinations of exposed workers that emphasize the heart, blood, and respiratory system.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Cyanide *or* cyanide mixture, dry
DOT Hazard Class: Poison B
ID No.: UN1588
DOT Label: Poison
DOT Packaging Exceptions: 173.364
DOT Packaging Requirements: 173.370

IMO Shipping Name: Cyanides, inorganic, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN1588
IMO Label: Poison
IMDG Packaging Group: I/II; Stow 'away from' acids

MSDS Collection **References:** 73, 101, 103, 126, 127, 136, 143, 146, 148, 153, 159, 161, 163
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MPH, MD; **Edited by:** JR Stuart, MS

Copyright © 1991 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

MATERIAL SAFETY DATA SHEET: CRYSTAL SIMPLE GREEN®

I. PRODUCT & COMPANY INFORMATION

PRODUCT NAME: **CRYSTAL SIMPLE GREEN®**

OTHER NAMES: **CRYSTAL SIMPLE GREEN® - SPECIALIZED CLEANER / DEGREASER**
SIMPLE GREEN SAFETY TOWELS (fluid only)

COMPANY NAME: **SUNSHINE MAKERS, INC.**
15922 Pacific Coast Highway
Huntington Harbour, CA 92649 USA
Telephone: 800-228-0709 • 562-795-6000
Fax: 562-592-3034
Website: www.simplegreen.com

Version No. 4006
Issue Date: January 2002

For 24-hour emergency, call Chem-Tel, Inc.: 800-255-3924

USE OF PRODUCT: A specialized cleaner and degreaser for use in the industrial and institutional workplace..

II. INGREDIENT INFORMATION

The only ingredient of Crystal Simple Green® with established exposure limits is undiluted 2-butoxyethanol (<6%) (Butyl Cellosolve; CAS No. 111-76-2): the OSHA PEL and ACGIH TLV is 25 ppm (skin). Note, however, that Butyl Cellosolve is only one of the raw material ingredients that undergo processing and dilution during the manufacture of Crystal Simple Green®. Upon completion of the manufacturing process, Crystal Simple Green® does not possess the occupational health risks associated with exposure to undiluted Butyl Cellosolve. Verification of this is contained in the independent test results detailed under "Toxicological Information" on Page 3 of this MSDS.

The Butyl Cellosolve in Crystal Simple Green® is part of a chemical category (glycol ethers) regulated by the Emergency Planning and Community Right-to-Know Act (SARA, Title III, section 313); therefore, a reporting requirement exists. Based upon chemical analysis, Crystal Simple Green® contains no known EPA priority pollutants, heavy metals, or chemicals listed under RCRA, CERCLA, or CWA. Analysis by TCLP (Toxicity Characteristic Leaching Procedure) according to RCRA revealed no toxic organic or inorganic constituents.

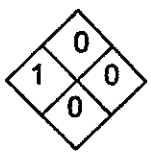
All components of Crystal Simple Green® are listed on the TSCA Chemical Substance Inventory.

III. HAZARDS IDENTIFICATION

UN Number: Not required
Dangerous Goods Class: Nonhazardous

Hazard Rating (NFPA/HMIS)

Health = 1* Reactivity = 0
Fire = 0 Special = 0



Rating Scale

0 = minimal 1 = slight
2 = moderate 3 = serious
4 = severe

*Mild eye irritant, non-mutagenic and non-carcinogenic. **None of the ingredients in Crystal Simple Green® are regulated or listed as potential cancer agents by Federal OSHA, NTP, or IARC.**

IV. FIRST AID MEASURES

SYMPTOMS OF OVEREXPOSURE AND FIRST AID TREATMENT

Eye contact: Reddening may develop. Immediately rinse the eye with large quantities of cool water; continue 10-15 minutes or until the material has been removed; be sure to remove contact lenses, if present, and to lift upper and lower lids during rinsing. Get medical attention if irritation persists.

Skin contact: Minimal effects, if any; rinse skin with water, rinse shoes and launder clothing before reuse. Reversible reddening may occur in some dermal-sensitive users; thoroughly rinse area and get medical attention if reaction persists.

Swallowing: Essentially non-toxic. Give several glasses of water to dilute; do not induce vomiting. If stomach upset occurs, consult physician.

Inhalation: Non-toxic. Exposures to concentrate-mist may cause mild irritation of nasal passages or throat; remove to fresh air. Get medical attention if irritation persists.

V. FIRE FIGHTING MEASURES

Crystal Simple Green® is stable, not flammable, and will not burn.

Flash Point/Auto-Ignition:	Not flammable.
Flammability Limits:	Not flammable.
Extinguishing Media:	Not flammable/nonexplosive. No special procedures required.
Special Fire Fighting Procedures:	None required.

VI. ACCIDENTAL RELEASE MEASURES

Recover usable material by convenient method; residual may be removed by wipe or wet mop. If necessary, unrecoverable material may be washed to drain with large quantities of water.

VII. HANDLING, STORAGE & TRANSPORT INFORMATION

No special precautions are required. **This product is non-hazardous for storage and transport according to the U.S. Department of Transportation Regulations.** Crystal Simple Green® requires no special labeling or placarding to meet U.S. Department of Transportation requirements.

UN Number:	Not required
Dangerous Goods Class:	Nonhazardous

VIII. EXPOSURE CONTROLS

Exposure Limits: The Crystal Simple Green® formulation presents no health hazards to the user when used according to label directions for its intended purposes. Mild skin and eye irritation is possible (please see Eye contact and Skin contact in Section IV.).

Ventilation: No special ventilation is required during use. Large-scale uses indoors should provide an increased rate of air exchange.

Human Health Effects or Risks from Exposure: Adverse effects on human health are not expected from Crystal Simple Green®, based upon twenty years of use of Simple Green without reported adverse health incidence in diverse population groups, including extensive use by inmates of U.S. Federal prisons in cleaning operations.

Crystal Simple Green® is a mild eye irritant; mucous membranes may become irritated by concentrate-mist.

Crystal Simple Green® is not likely to irritate the skin in the majority of users. Repeated daily application to the skin without rinsing, or continuous contact of Crystal Simple Green® on the skin may lead to temporary, but reversible, irritation.

Medical Conditions Aggravated by Exposure: No aggravation of existing medical conditions is expected; dermal-sensitive users may react to dermal contact by Crystal Simple Green®.

IX. PERSONAL PROTECTION

Precautionary Measures: No special requirements under normal use conditions.
Eye Protection: Caution, including reasonable eye protection, should always be used to avoid eye contact where splashing may occur.
Skin Protection: No special precautions required; rinse completely from skin after contact.
Respiratory Protection: No special precautions required except during large-scale spray applications where spray mist levels are high.
Work and Hygienic Practices: Wash or rinse hands before touching eyes or contact lenses. Follow standard hygienic practices for handling cleaning agents.

X. PHYSICAL AND CHEMICAL PROPERTIES

Appearance/odor::	Clear liquid	Vapor Pressure:	18 mm Hg @ 20 °C; 23.5 mm Hg @ 26 °C
Specific Gravity:	1.020	Vapor Density:	1.3 (air = 1)
pH of concentrate:	9.35	Density:	8.5 lbs./gallon
Evaporation:	>1 (butyl acetate = 1)		
Boiling Point:	100.6 °C (212 °F)		
Freezing Point:	-9 °C (16 °F) If product freezes, it will reconstitute without loss of efficacy when brought back to room temperature and agitated.		

VOC Composite Partial Pressure: 0 mm Hg @ 20 °C
Volatile Organic Compounds (VOCs): 0 g/L per ASTM Method D-2369. Per California AQMD's VOC test method, product must be diluted at least 2 parts of water to 1 part Crystal Simple Green® in order to meet SCAQMD Rule 1171 & Rule 1122 and BAAQMD Regulation 8-16 VOC requirements for solvent cleaning operations.
Water Solubility: Completely soluble in water.
Detection: Crystal Simple Green® has a characteristic odor that is not indicative of any hazardous situation.

XI. STABILITY AND REACTIVITY INFORMATION

Nonreactive. Crystal Simple Green® is stable, even under fire conditions, and will not react with water or oxidizers. Hazardous polymerization will not occur.

XII. TOXICOLOGICAL INFORMATION

The information and conclusions cited in this section are based on data and testing of Simple Green®. The data are directly applicable to Crystal Simple Green® because, except for the fragrance and dyes which have been removed, it contains the same ingredients as Simple Green®.

Nonhuman Toxicity

Acute Mortality Studies:
Oral LD_{50} (rat): >5.0 g/kg body weight // Dermal LD_{50} (rabbit): >2.0 g/kg body weight

Dermal Irritation: Only mild, but reversible, irritation was found in a standard 72-hr test on rabbits. A value of 0.2 (non-irritating) was found on a scale of 8.

Eye Irritation: With or without rinsing with water, the irritation scores in rabbits at 24 hours did not exceed 15 (mild irritant) on a scale of 110.

Subchronic dermal effects: No adverse effects, except reversible dermal irritation, were found in rabbits exposed to Simple Green® (up to 2.0 g/kg/day for 13 weeks) applied to the skin of 25 males and 25 females. Only female body weight gain was affected. Detailed microscopic examination of all major tissues showed no adverse changes.

Fertility Assessment by Continuous Breeding: The Simple Green® formulation had no adverse effect on fertility and reproduction in CD-1 mice with continuous administration for 18 weeks, and had no adverse effect on the reproductive performance of their offspring.

XIII. BIODEGRADABILITY AND ENVIRONMENTAL TOXICITY INFORMATION

Biodegradability:
Like Simple Green®, Crystal Simple Green® is readily decomposed by naturally occurring microorganisms. The biological oxygen demand (BOD), as a percentage of the chemical oxygen demand (COD), after 4, 7, and 11 days was 56%, 60%, and 70%, respectively. Per OECD Closed Bottle Test, Crystal Simple Green® meets OECD and EPA recommendations for ready biodegradability.

In a standard biodegradation test with soils from three different countries, Butyl Cellosolve reached 50% degradation in 6 to 23 days, depending upon soil type, and exceeded the rate of degradation for glucose, which was used as a control for comparison.

Environmental Toxicity Information:
Crystal Simple Green® is considered practically non-toxic per EPA's aquatic toxicity scale.

XIV. DISPOSAL CONSIDERATIONS

Crystal Simple Green® is fully water soluble and biodegradable and will not harm sewage-treatment microorganisms if disposal by sewer or drain is necessary. Dispose of in accordance with all applicable local, state, and federal laws.

XV. OTHER INFORMATION

Containers:	Crystal Simple Green® residues can be completely removed by rinsing with water; the container may be recycled or applied to other uses.
Contact Point:	Sunshine Makers, Inc., Research and Development Division: 562-795-6000.

***** NOTICE *****

All information appearing herein is based upon data obtained by the manufacturer and recognized technical sources. Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of this information, Sunshine Makers, Inc. or its distributors extends no warranties, makes no representations and assumes no responsibility as to the suitability of such information for application to purchaser's intended purposes or for consequences of its use.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Fuel Oil No. 4

MSDS No. 886

Date of Preparation: 10/93

Section 1 - Chemical Product and Company Identification 42

Product/Chemical Name: Fuel Oil No. 4
Chemical Formula: Not given
CAS No.: 68476-31-3
Synonyms: heating oil
Derivation: A petroleum fraction consisting of heavier straight-run or cracked distillates.
General Use: Used in commercial or industrial burner installations not equipped with preheating facilities.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Fuel Oil No. 4, ca 100 % vol
Trace Impurities: All petroleum fractions contain appreciable amounts of aromatics (toluene, xylene) and saturated rings (cycloparaffins, naphthenes).

OSHA PEL
None established

NIOSH REL
None established

DFG (Germany) MAK
None established

ACGIH TLV
None established

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Fuel oil no. 4 is a moderately dark, viscous liquid. It is flammable when exposed to heat or flame. Prolonged or repeated skin contact may cause dermatitis. It is a DOT flammable liquid.

Wilson Risk Scale
R 1
I -
S 1
K 2

HMIS
H 1
F 2
R 0

PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion.
Target Organs: Skin, CNS (severe exposure).
Acute Effects
Inhalation: Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, increased rate of respiration, tachycardia (excessively rapid heart beat), stupor, convulsions, cyanosis (dark purplish coloration of the skin and mucous membranes caused by deficient blood oxygenation), or unconsciousness, depending on concentration and length of exposure.
Eye: None reported.
Skin: Prolonged or repeated skin contact may cause irritation of the hair follicles and may block the sebaceous glands, producing a rash of acne pimples and spots, usually on arms and legs.
Ingestion: Ingestion may cause nausea, vomiting, diarrhea, and abdominal pain; occasionally, mild CNS depression or excitement occur after ingestion.
Carcinogenicity: IARC lists fuel oils, residual heavy as a possible carcinogen (2B; limited animal data). OSHA and NTP do not list fuel oil no. 4 as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: Dermatitis.
Chronic Effects: Repeated skin contact may cause defatting and dermatitis.
Comments: Fuel oil no. 4 may be a synergist to pesticides.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of tepid water for at least 15 min. If pain and irritation persist, consult an ophthalmologist.
Skin Contact: Remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, *do not* induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Comments: Following ingestion of hydrocarbons, the primary concern is aspiration into the lungs. Hydrocarbons with the lowest viscosity and surface tension have the greatest risk for aspiration. Fuel oil no. 4 is a viscous liquid and therefore, has a lesser risk for aspiration. Risk for vapor inhalation of fuel oil no. 4 is less than other hydrocarbons such as gasoline or kerosene because fuel oil no. 4 is less volatile. In general, fuel oil no. 4 is more viscous and less toxic than kerosene.

Copyright © 1993 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 5 - Fire-Fighting Measures

Flash Point: 142-240 °F (61-116 °C): reported by NFPA; 129 °F (54 °C)

NFPA



Autoignition Temperature: 505 °F (263 °C)
LEL: None reported.
UEL: None reported.
Flammability Classification: Depending on the flash point, fuel oil no. 4 is classified as an OSHA Class II, Class IIIA or IIIB Combustible Liquid.*
Extinguishing Media: For small fires, use dry chemical, CO_2, water spray, or regular foam. For large fires, use water spray, fog, or regular foam.
Unusual Fire or Explosion Hazards: Containers may explode in the heat of fire.
Hazardous Combustion Products: Acrid smoke and irritating fumes.
Fire-Fighting Instructions: If feasible and without undue risk, move containers from fire hazard area. Otherwise, apply cooling water to containers until well after fire is extinguished. Withdraw immediately in case of any tank discoloration or rising sound from venting safety device due to fire. For massive fires, use monitor nozzles or unmanned hose holders. Do not release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide limited protection.
* You will notice that there is a difference in classifications of a flammable and combustible liquid between OSHA and the DOT. The DOT classifies fuel oil (no. 1, 2, 4, 5, 6) as flammable liquids (See Sec. 14).

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel of large spills, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation and skin or eye contact. Clean up spills promptly to reduce fire hazards. Use nonsparking tools.
Small Spills: Use an inert, noncombustible, absorbent material to pick up small spills or residues.
Large Spills
Containment: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways.
Cleanup: Consider using straw, polyurethane foam, activated carbon, or peat to soak up oil. There is a wide variety of sorbents, dispersants, sinking agents, combustion promoters, and mechanical systems to treat oil spills.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor or mist inhalation or prolonged skin contact.
Storage Requirements: Store in closed containers in a well-ventilated area away from heat and ignition sources. No smoking in storage or use areas.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Administrative Controls: Practice good personal hygiene and housekeeping procedures. Do not wear oil contaminated clothing.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Barrier creams may be helpful. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Copyright © 1993 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance and Odor: Moderately dark, viscous.
Medium Odor Threshold: 0.5 ppm
Water Solubility: Insoluble
Melting Point: -51 °F (-46 °C)

Section 10 - Stability and Reactivity

Stability: Fuel oil no. 4 is stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization: Hazardous polymerization cannot occur.
Chemical Incompatibilities: Oxidizing materials.
Conditions to Avoid: Heat and ignition sources.
Hazardous Decomposition Products: Thermal oxidative decomposition of fuel oil no. 4 can produce various hydrocarbons and hydrocarbon derivatives and partial oxidation products including carbon oxides.

Section 11- Toxicological Information

Toxicity Data: None reported*

* Monitor NIOSH, *RTECS* (LS8965000), for future toxicity data.

Section 12 - Ecological Information

Aquatic Toxicity:
Striped bass, LC_{50}, 96 hr: 25.1 ppm (static test environment)
Carp, LC_{50}, 24 hr: 50 ppm (static test environment)
Striped bass, LC_{50}, 96 hr: 0.62 ppm (static test environment with 1.5 mg/L LAS)
Carp, LC_{50}, 24 hr: 5.1 ppm (static with 1.5 mg/L LAS)

Section 13 - Disposal Considerations

Disposal: Consider incineration (permit-approved facilities only). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Fuel oil (No. 1, 2, 4, 5, or 6)
Shipping Symbols: D
Hazard Class: 3
ID No.: NA1993
Packing Group: III
Label: Flammable Liquid*
Special Provisions (172.102): B1

* DOT defines a flammable liquid as a liquid having a flash point at or above 100 °F (37.8 °C) and not more than 141 °F (60.5 °C). OSHA defines a flammable liquid as any liquid having a flash point below 100 °F.

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 60 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: —

Section 15 - Regulatory Information

EPA Regulations:
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Classified as a RCRA Hazardous Waste (40 CFR 261.21): Characteristic of Ignitability [if flash point <140 °F (60 °C)]
CERCLA Hazardous Substance (40 CFR 302.4): Listed if classified as a RCRA Hazardous Waste, Characteristic of Ignitability
CERCLA Reportable Quantity (RQ), 100 lb (45.4 kg)
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): Not listed

Copyright © 1993 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 16 - Other Information

References: 73, 101, 103, 126, 132, 136, 164

Prepared by ..... MJ Wurth, BS
Industrial Hygiene Review ..... DJ Wilson, CIH
Medical Review ..... J Brent, MD, PhD
Revision Notes:

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1993 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 467
Automotive Gasoline, Lead-free

Issued: 10/81 Revision: A, 9/91

Section 1. Material Identification

35

Automotive Gasoline, Lead-free, Description: A mixture of volatile hydrocarbons composed mainly of branched-chain paraffins, cycloparaffins, olefins, naphthenes, and aromatics. In general, gasoline is produced from petroleum, shale oil, Athabasca tar sands, and coal. Motor gasolines are made chiefly by cracking processes, which convert heavier petroleum fractions into more volatile fractions by thermal or catalytic decomposition. Widely used as fuel in internal combustion engines of the spark-ignited, reciprocating type. Automotive gasoline has an octane number of approximately 90. A high content of aromatic hydrocarbons and a consequent high toxicity are also associated with a high octane rating. Some gasolines sold in the US contain a minor proportion of tetraethyllead, which is added in concentrations not exceeding 3 ml per gallon to prevent engine "knock." However, methyl-tert-butyl ether (MTBE) has almost completely replaced tetraethyllead.

R 1
I 2
S 2*
K 4
* Skin absorption

NFPA



HMIS
H 2
F 3
R 1
PPG†
† Sec. 8

Other Designations: CAS No. 8006-61-9, benzin, gasoline, gasolene, motor spirits, natural gasoline, petrol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Inhalation of automotive gasoline vapors can cause intense burning in throat and lungs, central nervous system (CNS) depression, and possible fatal pulmonary edema. Gasoline is a dangerous fire and explosion hazard when exposed to heat and flames.

Section 2. Ingredients and Occupational Exposure Limits

Automotive gasoline, lead-free*

1990 OSHA PELs
8-hr TWA: 300 ppm, 900 mg/m³
15-min STEL: 500 ppm, 1500 mg/m³

1990-91 ACGIH TLVs
TWA: 300 ppm, 890 mg/m³
STEL: 500 ppm, 1480 mg/m³

1990 NIOSH REL
None established

1985-86 Toxicity Data*
Man, inhalation, TC_{Lo}: 900 ppm/1 hr; toxic effects include sense organs and special senses (conjunctiva irritation), behavioral (hallucinations, distorted perceptions), lungs, thorax, or respiration (cough)
Human, eye: 140 ppm/8 hr; toxic effects include mild irritation
Rat, inhalation, LC_{50}: 300 g/m³/5 min

* A typical modern gasoline composition is 80% paraffins, 14% aromatics, and 6% olefins. The mean benzene content is approximately 1%. Other additives include sulfur, phosphorus, and MTBE.
† See NIOSH, *RTECS* (LX3300000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: Initially, 102 °F (39 °C); after 10% distilled, 140 °F (60 °C); after 50% distilled, 230 °F (110 °C); after 90% distilled, 338 °F (170 °C); final boiling point, 399 °F (204 °C)
Vapor Density (air = 1): 3.0 to 4.0
Density/Specific Gravity: 0.72 to 0.76 at 60 °F (15.6 °C)
Water Solubility: Insoluble

Appearance and Odor: A clear (gasoline may be colored with dye), mobile liquid with a characteristic odor recognizable at about 10 ppm in air.

Section 4. Fire and Explosion Data

Flash Point: -45 °F (-43 °C)	Autoignition Temperature: 536 to 853 °F (280 to 456 °C)	LEL: 1.3% v/v	UEL: 6.0% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or alcohol foam as extinguishing media. Use of water may be ineffective to extinguish fire, but use water spray to knock down vapors and to cool fire-exposed drums and tanks to prevent pressure rupture. Do not use a solid stream of water since it may spread the fuel.
Unusual Fire or Explosion Hazards: Automobile gasoline is an OSHA Class IB flammable liquid and a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow to an ignition source and flash back. Automobile gasoline can also react violently with oxidizing agents.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective clothing. When the fire is extinguished, use nonsparking tools for cleanup. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Automotive gasoline is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Automotive gasoline can react with oxidizing materials such as peroxides, nitric acid, and perchlorates.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of automotive gasoline can produce oxides of carbon and partially oxidized hydrocarbons.

Copyright © 1991 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC list gasoline as a possible human carcinogen (Group 2B). Although the IARC has assigned an overall evaluation to gasoline, it has not assigned an overall evaluation to specific substances within this group (inadequate human evidence).
Summary of Risks: Gasoline vapors are considered moderately poisonous. Vapor inhalation can cause central nervous system (CNS) depression and mucous membrane and respiratory tract irritation. Brief inhalations of high concentrations can cause a fatal pulmonary edema. Reported responses to gasoline vapor concentrations are: 160 to 270 ppm causes eye and throat irritation in several hours; 500 to 900 ppm causes eye, nose, and throat irritation, and dizziness in 1 hr; and 2000 ppm produces mild anesthesia in 30 min. Higher concentrations are intoxicating in 4 to 10 minutes. If large areas of skin are exposed to gasoline, toxic amounts may be absorbed. Repeated or prolonged skin exposure causes dermatitis. Certain individuals may develop hypersensitivity. Ingestion can cause CNS depression. Pulmonary aspiration after ingestion can cause severe pneumonitis. In adults, ingestion of 20 to 50 g gasoline may produce severe symptoms of poisoning.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eye, respiratory and central nervous systems.
Primary Entry Routes: Inhalation, ingestion, skin contact.
Acute Effects: Acute inhalation produces intense nose, throat, and lung irritation; headaches; blurred vision; conjunctivitis; flushing of the face; mental confusion; staggering gait; slurred speech; and unconsciousness, sometimes with convulsions. Ingestion causes inebriation (drunkenness), vomiting, dizziness, fever, drowsiness, confusion, and cyanosis (a blue to dark purplish coloration of skin and mucous membrane caused by lack of oxygen). Aspiration causes choking, cough, shortness of breath, increased rate of respiration, excessively rapid heartbeat, fever, bronchitis, and pneumonitis. Other symptoms following acute exposure include acute hemorrhage of the pancreas, fatty degeneration of the liver and kidneys, and passive congestion of spleen.
Chronic Effects: Chronic inhalation results in appetite loss, nausea, weight loss, insomnia, and unusual sensitivity (hyperesthesia) of the distal extremities followed by motor weakness, muscular degeneration, and diminished tendon reflexes and coordination. Repeated skin exposure can cause blistering, drying, and lesions.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Give conscious victim a mixture of 2 tablespoons of activated charcoal mixed in 8 oz of water to drink. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Use nonsparking tools. Take up small spills with sand or other noncombustible adsorbent. Dike storage areas to control leaks and spills. Follow applicable OSHA regulations (29 CFR 1910.120).
Aquatic Toxicity: Bluegill, freshwater, LC_{50}, 8 ppm/96 hr.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.21): Characteristic of ignitability
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. There are no specific NIOSH recommendations. However, for vapor concentrations not immediately dangerous to life or health, use chemical cartridge respirator equipped with organic vapor cartridge(s), or a supplied-air respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Materials such as neoprene or polyvinyl alcohol provide excellent/good resistance for protective clothing. **Note:** Resistance of specific materials can vary from product to product.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IB liquid. Outside or detached storage preferred.
Engineering Controls: Avoid vapor inhalation and skin or eye contact. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Indoor use of this material requires explosion-proof exhaust ventilation to remove vapors. Only use gasoline as a fuel source due to its volatility and flammable/explosive nature. Practice good personal hygiene and housekeeping procedures. Wear clean work clothing daily.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Gasoline (*including casing-head and natural*)
DOT Hazard Class: Flammable liquid
ID No.: UN1203
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Gasoline
IMO Hazard Class: 3.1
ID No.: UN1203
IMO Label: Flammable liquid
IMDG Packaging Group: II

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 140, 143, 146, 153, 159
Prepared by: M Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

Copyright © 1991 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Fuel Oil No. 2 **MSDS No. 469**

Date of Preparation: 10/81 Revision: B, 3/98

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Fuel oil no. 2
Chemical Formula: Unspecified or Variable
CAS Number: 68476-30-2
Synonyms: #2 home heating oil; API no. 2 fuel oil; diesel oil; gas oil; home heating oil no. 2; number 2 burner fuel; number 2 fuel oil
Derivation: Residue from distillation (straight run or cracked) of crude oil.
General Use: Used as a fuel in atomizing burners for domestic and industrial heating, in engines of heavy units (ships, trucks, trains), as a source of synthesis gas, in drilling muds, and for mosquito control (coats breeding waters).
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Fuel oil no. 2, ca 100% vol (complex mixture (< 95%) of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons)
Trace Impurities: water and sediment (< 0.05% vol), carbon residue (< 0.35%), ash (< 0.01% wt), sulfur (< 0.7% wt) and benzene (< 100 ppm).

OSHA PEL
As petroleum distillates
8-hr TWA: 500 ppm (2000 mg/m^3)

ACGIH TLV
As diesel fuel
Notice of impending change (1997):
TWA: 100 mg/m^3, *Skin*

NIOSH REL
As petroleum distillates
10-hr TWA: 350 mg/m^3
Ceiling (15 min): 1800 mg/m^3

IDLH Level
As petroleum distillates
1,100 ppm

DFG (Germany) MAK
None established

Section 3 - Hazards Identification

ANSI Signal Word: Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Fuel oil no. 2 is an amber to brown, slighty viscous liquid with a petroleum odor. It can be irritating to the skin and respiratory tract. This low viscosity fuel oil presents a significant aspiration hazard following ingestion, which can result in chemical pneumonitis and respiratory failure. Also Causes: vomiting, diarrhea, central nervous system (CNS) depression, increased rate of respiration, rapid heart beat, and cyanosis (blue coloration of the skin caused by oxygen deficiency). Fuel oil no. 2 can be an environmental hazard if spilled. This flammable liquid is a moderate fire hazard. When heated to decomposition, it will emit acrid smoke and irritating fumes.

Wilson Risk Scale	
R	1
I	2
S	2
K	2

HMIS	
H	1*
F	2
R	0
PPE†	

*Chronic effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion
Target Organs: Skin, CNS, cardiovascular system (CVS), respiratory system, mucous membranes
Acute Effects

Inhalation: Respiratory tract irritation, headache, dizziness, euphoria, nausea, increased respiration rate, tachycardia (excessively rapid heart beat), cyanosis, stupor, convulsions, and unconsciousness can result from inhalation of fuel oil no. 2 mist.

Eye: Contact may result in irritation.

Skin: Contact may cause irritation.

Ingestion: Gastrointestinal irritation, vomiting, diarrhea, and in severe cases, CNS depression, progressing to coma and death, can result. Since intestinal absorption of longer chain hydrocarbons is minimal, aspiration into lungs following ingestion is a more significant exposure route; it may result in transient CNS depression, hemorrhaging and pulmonary edema, progressing to renal (kidney) involvement, chemical pneumonitis, and respiratory failure.

Carcinogenicity: IARC lists distillate (light) fuel oils as Group 3 (not classifiable as to carcinogenicity to humans). ACGIH lists a notice of impending change for diesel fuels as TLV-A3 (Animal carcinogen). NTP and OSHA do not list fuel oil no. 2 as a carcinogen.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Copyright © 1998 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgements as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Chronic Effects: Prolonged and repeated skin contact can cause dermatitis, irritate the hair follicles and may block the (oil) sebaceous glands, producing a rash of acne pimples, usually on the arms and legs. Repeated exposures producing CNS effects may lead to permanent nervous system damage.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain and/or irritation develop.

Skin Contact: Quickly remove contaminated clothing. Rinse with flooding amounts of water followed by washing the exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. *Do not* induce vomiting unless the poison control center advises otherwise.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Gastric lavage for treatment of ingestion is contraindicated due to aspiration hazard. Administer charcoal slurry cathartic (30 g/240 mL diluent). In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases and obtain chest x-ray.

Section 5 - Fire-Fighting Measures

Flash Point: 136 °F (57.78 °C)

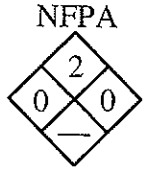
Flash Point Method: CC

Autoignition Temperature: 494 °F (257 °C)

LEL: 0.6% v/v

UEL: 7.5% v/v

NFPA



Flammability Classification: OSHA Class II Combustible Liquid.

Extinguishing Media: Use dry chemical, carbon dioxide, foam, water fog or spray. Water may be ineffective in putting out a fire involving fuel oil no. 2, and a solid water stream may spread the flames; however, a water spray may be used to cool fire-exposed containers, and flush spills away from ignition sources.

Unusual Fire or Explosion Hazards: Can form explosive mixtures in air. In still air, the heavier-than-air vapors of fuel oil no. 2 may travel along low-lying surfaces to distant sources of ignition and flash back to the material source. Containers may explode in heat of fire.

Hazardous Combustion Products: Heating fuel oil no. 2 to decomposition can produce thick acrid smoke and irritating fumes.

Fire-Fighting Instructions: If tank, rail car or tank truck is involved in fire isolate for 1/2 mile (800 m). *Do not* release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. *Do not* touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Isolate area for at least 80-160 ft (25-50 m) in all directions. Water spray or fire fighting foam may suppress vapor, but may not prevent ignition in closed spaces. Use natural barriers or oil spill control booms to confine oil slicks on surface water.

Small Spills: Absorb fuel oil no. 2 with vermiculite, earth, sand or similar material.

Large Spills

Containment: For large spills, consider downwind evacuation of at least 1000 ft (300 m). Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.

Cleanup: Ground all equipment. Spills can be absorbed with materials such as peat, activated carbon, polyurethane foam, or straw. Sinking agents, gelling agents, dispersants, and mechanical systems can also be used to treat oil spills. Use clean non-sparking tools to collect absorbed material.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor or mist inhalation, and skin and eye contact. Use only with ventilation sufficient to reduce airborne concentrations as low as possible. Wear protective gloves (or use barrier cream) and clothing (see Sec. 8). Keep away from heat and ignition sources. Ground and bond all containers during transfers to prevent static sparks. Use non-sparking tools to open and close containers.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Storage Requirements: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (See Sec. 10). Periodically inspect stored materials. Equip drums with self-closing valves, pressure vacuum bungs, and flame arrestors.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.106) for a Class II Combustible Liquid.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Enclose operations and/or provide local exhaust ventilation at the site of chemical release designed for flammable vapors/mists. Where possible, transfer fuel oil no. 2 from drums or other storage containers to process containers. Minimize sources of ignition in surrounding low-lying areas.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), use an SCBA.
Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets of Viton™ or nitrile rubber, if possible, or alternatively, polyvinyl chloride, chlorinated polyethylene or neoprene to prevent skin contact. Butyl rubber may degrade after contact and is not recommended. Wear protective eyeglasses per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Liquid

Appearance and Odor: Amber to brown, slightly viscous; petroleum odor

Odor Threshold: 0.082 ppm

Formula Weight: N/A

Specific Gravity (H_2O=1, at 4 °C): 0.8654 at 59 °F (15 °C)

Water Solubility: Slightly soluble

Boiling Point: 450 °F (232 °C)

Freezing Point: -50.8 °F (-46 °C)

Viscosity: 268 centistoke at 100 °F (37.8 °C)

Surface Tension: 25 dynes/cm, estimated

Henry's Law Constant (H): 29 to 68 atm-m^3/mole at 77 °F (25 °C), estimated

Octanol/Water Partition Coefficient: log K_{ow} = 8.2 to 9.7

Soil Sorption Coefficient (K_{oc}): $1x10^4$, estimated

Section 10 - Stability and Reactivity

Stability: Fuel oil no. 2 is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include strong oxidizing agents.

Conditions to Avoid: Heat and ignition sources.

Hazardous Decomposition Products: Thermal oxidative decomposition of fuel oil no. 2 can produce various hydrocarbons, hydrocarbon derivatives, partial oxidation products (carbon dioxide (CO_2), carbon monoxide (CO), sulfur dioxide (SO_2)).

Section 11- Toxicological Information

Toxicity Data:*

Skin Effects:
Rabbit, skin, standard Draize test: 500 mg/24 hr, resulted in moderate irritation.

Acute Dermal Effects:
Rabbit, skin, LD: > 5 g/kg

Acute Oral Effects:
Rat, oral, LD_{50}: 12 g/kg

Eye Effects:
Rabbit, eye, standard Draize test: 100 mg/30 seconds, resulted in mild irritation.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 11- Toxicological Information - *continued*

Toxicity Data:*

Tumorigenicity:
Mouse, skin: 243 g/kg/97 weeks, administered intermittently, caused skin and appendage tumors (carcinogenic by RTECS criteria).

Multiple Dose Toxicity Data:
Rabbit, skin: 100 mL/kg/12 days, continuously, caused irritative dermatitis, weight loss or decreased weight gain, and death.

* See NIOSH, *RTECS* (LS8930000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Juvenile American shad, TLm/24 hr: 200 ppm; bluegill, LC_{50} = 95 mg/L/96 hr; carp, LC_{50} = 8.2 mg/L/24 hr; pumpkin seed, LC_{50} = 1.9 mg/L/24 hr. Through its coating action, this material can pose a hazard to aquatic biota including water birds, plankton, algae and fish.

Environmental Fate: Based on a calculated BCF ($1.02x10^4$ to $1.4x10^4$), bioconcentration could be an important environmental fate process; however, it may be limited for the chief components of fuel oil no. 2 due to metabolism.

Environmental Degradation: It may biodegrade in water and soil, or volatilize from water (half-life of 4.4- 4.8 hours from a model river) and moist soil surfaces, but adsorption may attenuate the rate of these processes. In the atmosphere, fuel oil no. 2 will rapidly degrade by reaction with photochemically produced hydroxyl radicals (estimated half-life 1 day or less).

Soil Adsorption/Mobility: A high Koc indicates significant sorption and low mobility in the soil column.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Material may be sprayed into an incinerator. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Fuel oil (1, 2, 4, 5 or 6)
Shipping Symbols: D
Hazard Class: 3
ID No.: NA1993
Packing Group: III
Label: Flammable Liquid
Special Provisions (172.102): B1

Packaging Authorizations
a) **Exceptions:** 173.150
b) **Non-bulk Packaging:** 173.203
c) **Bulk Packaging:** 173.242

Quantity Limitations
a) **Passenger, Aircraft, or Railcar:** 60 L
b) **Cargo Aircraft Only:** 220 L

Vessel Stowage Requirements
a) **Vessel Stowage:** A
b) **Other:** –

Section 15 - Regulatory Information

EPA Regulations:
Classified as a RCRA Hazardous Waste (40 CFR 261.21), Characteristic of Ignitability
RCRA Hazardous Waste Number: D001
Listed as a CERCLA Hazardous Substance (40 CFR 302.4), Unlisted Hazardous Waste, Characteristic of Ignitability, per RCRA Section 3001
CERCLA Final Reportable Quantity (RQ), 100 lb (45.4 kg)
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, as petroleum distillates)

Section 16 - Other Information

References: 1, 73, 103, 136, 190, 223, 230, 231

Prepared By..... HM Spliethoff, MS
Industrial Hygiene Review..... PA Roy, MPH, CIH
Medical Review..... T Thoburn, MD, MPH

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Diesel Fuel Oil No. 2-D

MSDS No. 470

Date of Preparation: 10/81 Revision: B, 3/98

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Diesel fuel oil no. 2-D
Chemical Formula: Unspecified or variable
CAS Number: 68334-30-5
Synonyms: automotive diesel oil; diesel fuel; diesel oil (medium); diesel oil no. 2; diesel oil (petroleum); diesel oils; diesel test fuel; fuels, diesel; no. 2 diesel oil; olej napeldowy III (Polish)
Derivation: Fuel oil may be a distilled fraction of petroleum, a residuum from refinery operations, a crude petroleum or a blend of two or more of these.
General Use: This medium viscosity residual fuel oil has both light and heavy grades, and is used in furnaces and boilers of utility and industrial power plants, ships, locomotives, and metallurgical operations.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Diesel fuel oil no. 2-D, ca 100% vol; diesel fuels consist primarily of aliphatic (64% vol), aromatic (35% vol), and olefinic (1-2% vol) hydrocarbons.
Trace Impurities: May contain sulfur (< 0.5), benzene (<100 ppm), and additives such as sulfurized esters.

OSHA PEL
As petroleum distillates
8-hr TWA: 500 ppm (2000 mg/m^3)

ACGIH TLV
As diesel fuel
Notice of impending change (1997):
TWA: 100 mg/m^3, *Skin*

NIOSH REL
As petroleum distillates
10-hr TWA: 350 mg/m^3
Ceiling (15 min): 1800 mg/m^3

IDLH Level
As petroleum distillates
1,100 ppm

DFG (Germany) MAK
None established

Section 3 - Hazards Identification

ANSI Signal Word: Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Diesel fuel oil no. 2-D is a brown, slightly viscous liquid with a kerosene-like odor. It is irritating to the skin and respiratory tract. Inhalation of mist or vapor may result in headache, nausea, vomiting, diarrhea, central nervous system (CNS) depression, tachycardia (rapid heart beat), cyanosis (blue coloration of skin due to oxygen deficiency), pulmonary edema (fluid in the lungs), and liver or kidney injury. Diesel fuel oil no. 2-D is an environmental hazard when spilled. When exposed to heat or flame, this flammable liquid is a fire hazard. When heated to decomposition, diesel fuel oil no. 2-D will emit acrid smoke and irritating vapors.

Wilson Risk Scale	
R	1
I	2
S	2*
K	2

*Skin absorption

HMIS	
H	1*
F	2
R	0
PPE†	

*Chronic effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin contact/absorption
Target Organs: Skin, CNS, cardiovascular system (CVS), respiratory system, liver, kidneys
Acute Effects
Inhalation: Euphoria, respiratory irritation, cardiac dysrhythmia, increased respiration rates, cyanosis, pulmonary edema, hemoptysis (spitting up blood from the respiratory tract), respiratory arrest, renal (kidney) and liver injury, and CNS toxicity can result from inhalation of diesel fuel oil no. 2-D mist or vapor.
Eye: Contact may result in irritation.
Skin: Contact may cause irritation, systemic effects (see Inhalation), and block the sebaceous (oil) glands, resulting in a rash of acne-like pimples and spots, usually on the arms and legs.
Ingestion: Gastrointestinal irritation, vomiting, diarrhea, and in severe cases, CNS depression progressing to coma and death and other systemic effects (see Inhalation) can result. Aspiration can result in transient CNS depression or excitement, hypoxia, infection, pneumatocele (abnormal cavities in lungs) formation, and chronic lung dysfunction.
Carcinogenicity: IARC lists occupational exposure in petroleum refining as Group 2A (Probable human carcinogen) and distillate light (diesel) fuels as Group 3 (Not classifiable as to carcinogenicity to humans). ACGIH lists a notice of impending change for diesel fuels as TLV-A3 (Animal carcinogen). NTP and OSHA do not list diesel fuel oil no. 2-D as a carcinogen.

Copyright © 1998 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Prolonged or repeated skin contact causes dermatitis and possible systemic toxicity. Prolonged or repeated inhalation can cause CNS and peripheral nervous system damage.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain and/or irritation develops.

Skin Contact: Quickly remove contaminated clothing. Rinse with flooding amounts of water followed by washing the exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Have the *conscious and alert* person drink 1 to 2 glasses of water. Contact a poison control center. Because of aspiration risk, *do not* induce vomiting unless the poison control center advises otherwise.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Gastric lavage is contraindicated due to aspiration risk. Instead, consider administration of charcoal or milk. If ingestion amount is large, gastric emptying in the alert patient can be accomplished through administration of Syrup of Ipecac. Treat overexposure symptomatically and supportively.

Section 5 - Fire-Fighting Measures

Flash Point: 100.4 °F (38 °C)

Flash Point Method: CC

Autoignition Temperature: 351-624 °F (177-329 °C)

LEL: 1.3% v/v

UEL: 75% v/v

Flammability Classification: OSHA Class II Combustible Liquid



Extinguishing Media: Use dry chemical, carbon dioxide, foam, low velocity water fog or spray. Use a smothering technique to extinguish fire. Water may be ineffective in putting out a fire involving diesel fuel oil no. 2-D, and a solid water stream may spread the flames; however, a water spray may be used to cool fire-exposed containers, and flush spills away from ignition sources.

Unusual Fire or Explosion Hazards: Vapor or mist can form explosive mixtures in air. In still air, the heavier-than-air vapors of diesel fuel oil no. 2-D from a large source may travel along low-lying surfaces to distant sources of ignition and flash back to the material source. Containers may explode in heat of fire.

Hazardous Combustion Products: Heating diesel fuel oil no. 2-D to decomposition can produce acrid smoke and irritating vapors.

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Ground all equipment used when handling this product. *Do not* touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A fire fighting foam may be used to suppress vapors. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Use clean non-sparking tools to collect absorbed material.

Small Spills: Absorb diesel fuel oil no. 2-D with vermiculite, earth, sand or similar material.

Large Spills

Containment: For large spills, consider downwind evacuation of at least 1000 ft (300 m). Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.

Cleanup: Ground all equipment. Use non-sparking tools. Spills can be absorbed with materials such as peat, activated carbon, polyurethane foam, or straw. Sinking agents, gelling agents, dispersants, and mechanical systems can also be use to treat oil spills.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor or mist inhalation, and skin and eye contact. Use only with ventilation sufficient to reduce airborne concentrations to non-hazardous levels (see Sec. 2). Wear protective gloves (or use barrier cream), and clothing (see Sec. 8). Keep away from heat and ignition sources. Ground and bond all containers during transfers to prevent static sparks. Use non-sparking tools to open and close containers.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Storage Requirements: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Periodically inspect stored materials. Equip drums with self-closing valves, pressure vacuum bungs, and flame arrestors.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.106) for Class II Combustible Liquid.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Enclose operations and/or provide local exhaust ventilation appropriately designed for flammable mist and vapor at the site of chemical release. Where possible, transfer diesel fuel oil no. 2-D from drums or other storage containers directly to process containers. Minimize sources of ignition in surrounding low-lying areas.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), use an SCBA.
Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets. Wear protective eyeglasses, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance and Odor: Brown, slightly viscous; kerosene-like odor
Odor Threshold: 0.7 ppm
Vapor Pressure: < 0.1 mm Hg at 68 °F (20 °C)
Vapor Density (Air=1): > 6
Formula Weight: N/A

Specific Gravity (H_2O=1, at 4 °C): < 0.86
Water Solubility: Insoluble
Boiling Point: 340-676 °F (171-358 °C)
Freezing Point: -29.2 °F (-34 °C)
Viscosity: 1.9-4.1 centistoke at 104 °F (40 °C)
Surface Tension: 23-32 dynes/cm at 68 °F (20 °C)

Section 10 - Stability and Reactivity

Stability: Diesel fuel oil no. 2-D is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include strong oxidizing agents.

Conditions to Avoid: Exposure to heat and ignition sources.

Hazardous Decomposition Products: Thermal oxidative decomposition of diesel fuel oil no. 2-D can produce low molecular weight hydrocarbons, hydrocarbon derivatives, carbon oxides (CO_x), and sulfur oxides (SO_x).

Section 11- Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 7500 mg/kg

Acute Dermal Effects:
Rabbit, skin, LD: > 5 mL/kg

Skin Effects:
Rabbit, skin, standard Draize test: 500 µL/24 hr, resulted in severe reaction.

Toxicity Data:*

Other Multiple Dose Toxicity Data:
Rat, inhalation: 2 g/m³/6 hr/3 weeks, intermittently, resulted in changes in blood erythrocyte (RBC) count, and focal fibrosis (pneumonoconiosis) and other changes in the lung, thorax or respiration.
Rat, inhalation: 400 µg/m³/16 hr/2.5 years, intermittently, caused other changes in the blood, and biochemical effects - transaminases.
Rabbit, skin: 80 mL/kg/12 days, continuously, resulted in other changes in the liver, kidney, ureter, and bladder, and death.

* See NIOSH, *RTECS* (HZ1800000), for additional toxicity data.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 12 - Ecological Information

Ecotoxicity: Juvenile American shad, salt water TLm: 204 mg/L/24 hr; mallard duck, LD_{50}=20 mg/kg.

Environmental Fate: Diesel fuel oil no. 2-D will evaporate from water or soil. In surface water, it may partition from the water column to suspended sediments.

Environmental Degradation: Biodegradation may occur in soil and water.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Diesel fuel
Shipping Symbols: D
Hazard Class: 3
ID No.: NA1993
Packing Group: III
Label: None
Special Provisions (172.102): B1

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 60 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: –

Section 15 - Regulatory Information

EPA Regulations:

Classified as RCRA Hazardous Waste (40 CFR 261.21): Characteristic of Ignitability
RCRA Hazardous Waste Number: D001
Listed as a CERCLA Hazardous Substance (40 CFR 302.4), Unlisted Hazardous Waste, Characteristic of Ignitability per RCRA Sec. 3001
CERCLA Final Reportable Quantity (RQ): 100 lb (45.4 kg)
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A, as petroleum distillates)

Section 16 - Other Information

References: 73, 103, 136, 190, 209, 222, 230, 231

Prepared By..... HM Spliethoff, MS
Industrial Hygiene Review..... PA Roy, MPH, CIH
Medical Review..... T Thoburn, MD, MPH

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Thallium **MSDS No. 80**

Date of Preparation: 12/80 Revision: B, 3/98

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Thallium
Chemical Formula: Tl
CAS Number: 7440-28-0
Synonyms: elemental thallium; Ramor; thallium metal
Derivation: Exists in flue dusts from lead and zinc smelters and pyrite burners. Obtained from thallium compounds by electrolysis, precipitation, or reduction.
General Use: Alloyed with mercury for switches and closures which operate at subzero temperatures; used in the manufacture of thallium salts; of mercury alloys and low-melting glasses; used in cardiac imaging; electrodes in dissolved oxygen analyzers; in photoelectric cells, lamps, and electronics; in scintillation counters; as a catalyst in organic synthesis; in magnesium seawater batteries; as a rodenticide (former use).
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Thallium, ca 99.9 - 100%
Trace Impurities (technical grade): lead, zinc, nickel, cadmium, indium, germanium, selenium, tellurium, arsenic

OSHA PEL
Thallium, elemental, and soluble compounds, as Tl
8-hr TWA: 0.1 mg/m^3, *Skin*

ACGIH TLV
Thallium, elemental, and soluble compounds, as Tl
TWA: 0.1 mg/m^3, *Skin*
Excursion Limit: Provided the TLV-TWA is not exceeded, exposure may exceed 0.3 mg/m^3 for no more than 30 min/day, never exceed 0.5 mg/m^3.

NIOSH REL
Thallium, elemental, and soluble compounds, as Tl
10-hr TWA: 0.1 mg/m^3, *Skin*

IDLH Level
15 mg/m^3

DFG (Germany) MAK
Thallium, elemental, and soluble compounds, as Tl
TWA: 0.1 mg/m^3
Category III: Substances with systemic effects, onset of effect >2 hr half-life > shift length (strongly cumulative).
Danger of cutaneous absorption

Peak Exposure Limit:
1.0 mg/m^3, 30 min, average value, frequency per shift: 1

Section 3 - Hazards Identification

ANSI Signal Word: Danger!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Thallium is a bluish-white, odorless soft metal or powder. It is toxic by ingestion and may be absorbed in toxic amounts through skin contact or inhalation. Exposure also causes: skin sensitization, central nervous system (CNS) and gastrointestinal (GI) tract effects, kidney damage, and death. Exposure is cumulative. Thallium dust is flammable.

Wilson Risk Scale
R 2*
I 4
S 3*
K 2
*Powder

HMIS
H 3*
F 2†
R 1
PPE‡
*Chronic effects
†Powder
‡Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin contact
Target Organs: Central nervous system (CNS), peripheral nerves, cardiovascular system (CVS), gastrointestinal (GI) tract, hair, eyes, respiratory system, liver, kidneys

Acute Effects

Inhalation: Irritation and systemic effects including thallium poisoning. Symptoms of thallium poisoning are often delayed 12 to 24 hours and reach a maximum in the second and third week after exposure. Symptoms include severe sudden abdominal pain, nausea, vomiting, diarrhea, headache, chest pain or tightness, excessive salivation, bloody vomit and stools, sensory nerve disorders, painful tingling in extremities, leg pains, insomnia, hypertension (high blood pressure), tachycardia (rapid heart beat), respiratory failure, decreased visual clarity, impaired color vision, weakness, depression, hair loss, green color to urine, kidney damage, and, in severe cases, tremors, delirium, hallucinations, convulsions, paralysis, coma and death, sometimes within 1 to 2 days. Thallium (metal) is not as toxic as some thallium salts.

Eye: Irritation; may cause vision loss.

Copyright © 1998 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Skin: Irritation, acne, hair loss, impaired nail growth ("Mee's lines"); may be absorbed, causing systemic effects.
Ingestion: Sweating, nerve or nerve sheath structural changes, eye muscle changes; may cause systemic effects (see Inhalation).
Carcinogenicity: IARC, NTP, and OSHA do not list thallium as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: Disorders of the CNS, GI tract, kidneys, liver, and eyes may be worsened by exposure to thallium.
Based on animal studies, thallium may cross the placenta to affect an unborn child.
Chronic Effects: Thallium is a cumulative poison. Chronic effects include systemic effects list under Acute Effects, above, but may also include poor appetite, mood changes, irritability, metallic taste in the mouth, pain in extremities (polyneuritis), alopecia (hair loss), loss of vision, tremor or abnormal muscle jerking, nail changes, dry scaly skin, heart, kidney, and endocrine damage. Permanent brain damage is common.

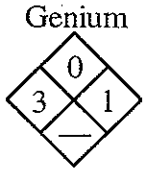
Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, or photophobia persist.
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Monitor for systemic effects.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Seek medical attention.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: If over exposure is suspected, monitor cardiac, renal and hepatic function; medical observation for several days is suggested. The most reliable urine test for thallium is a 24-hour urine quantitative assay. Diethylthiocarbamate has been reported to result in dangerous redistribution of thallium to the CNS and is contraindicated.

Section 5 - Fire-Fighting Measures

Flash Point: Not applicable, probable noncombustible solid
Autoignition Temperature: None reported.
LEL: None reported.
UEL: None reported.
Flammability Classification: Probable noncombustible solid

Genium



Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2) or water spray. For large fires, use water spray, fog, or regular foam. Fire involving tanks or car/trailer loads: fight fire from maximum distance or use unmanned hose holders or monitor nozzles. *Do not* get water inside containers. Cool containers with flooding quantities of water until well after fire is out.
Unusual Fire or Explosion Hazards: Thallium dust is flammable when exposed to heat or flame. Reacts violently with fluorine.
Hazardous Combustion Products: Toxic fumes of thallium.
Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. *Do not* scatter thallium.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Thoroughly decontaminate equipment after use.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Tag container as defective and return to supplier. Use spark-proof tools and explosion proof equipment. Cleanup personnel should protect against exposure.
Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite. Collect in sealed containers for disposal.
Large Spills
Containment: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.
Cleanup: If possible, recover for reuse or recycling.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 7 - Handling and Storage

Handling Precautions: Avoid any exposure to thallium. To avoid dust inhalation, use only with exhaust ventilation sufficient to reduce airborne concentrations to nonhazardous levels (see Sec. 2). Wear personal protective clothing and equipment to prevent contact with skin and eyes, or dust inhalation (see Sec. 8). Remove contaminated clothing and equipment immediately for proper decontamination. Practice good personal hygiene procedures to prevent inadvertently ingesting this material. Wash any areas which might have come in contact with thallium at the end of the work shift. *Do not* attempt to handle broken containers without proper protective equipment. Whenever possible, transfer thallium directly form storage containers to process containers.

Storage Requirements: Store in tightly closed containers in a cool, well-ventilated area away from heat, ignition sources, incompatibles, and food and foodstuffs.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations and exhaust ventilate to avoid dust dispersion into the work area. To prevent static sparks, electrically ground and bond all containers and equipment.

Ventilation: Provide local exhaust ventilation systems equipped with appropriate dust collectors or scrubbers to maintain airborne concentrations below OSHA PEL (see Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices and PPE which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the eyes, nervous and respiratory systems, liver, kidneys, gastrointestinal tract, and hair. Monitor workplace exposures.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Exposure Range: >0.1 to 1 mg/m^3: air purifying, negative pressure, half mask; >1 to 10 mg/m^3: air purifying, negative pressure, full face; >10 to <15 mg/m^3: supplied air, constant flow/pressure demand, full face; 15 to unlimited mg/m^3: SCBA, pressure demand, full face; cartridge color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter). Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent any skin contact. Wear protective eyeglasses or chemical safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice disciplined personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: Bluish white powder; odorless
Vapor Pressure: 1 mm Hg at 1517 °F (825 °C)
Formula Weight: 204.38
Density: 11.85 g/cm^3
pH: Moderately strong base
Water Solubility: Insoluble
Other Solubilities: Slightly soluble in hydrochloric acid, 100 parts nitric acid; soluble in sulfuric acid.
Boiling Point: 2655 °F (1457 °C)
Melting Point: 578.3 °F (303.5 °C)
Ionization Potential (eV): 6.10829

Section 10 - Stability and Reactivity

Stability: Thallium is stable at room temperature in closed containers under normal storage and handling conditions. Exposure to air will result in surface oxidation.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include strong acids and strong oxidizing agents. Reacts violently with fluourine (F_2). Reacts with steam or moist air to produce toxic thallium hydroxide (TlOH), with air to produce thallium (I) oxide (Tl_2O).

Conditions to Avoid: Avoid contact with chemical incompatibles, heat, and sources of ignition.

Hazardous Decomposition Products: Thermal oxidative decomposition of thallium can produce thallium fumes.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 11- Toxicological Information

Toxicity Data:*

Acute Oral Effects:
Man, oral, TD_{Lo}: 5714 µg/kg produced toxic effects: peripheral nerve and sensation - structural change in nerve or sheath; sense organs and special senses - change in extra-ocular muscles; skin and appendages - hair.

Acute Effects:
Man, unreported exposure route, LD_{Lo}: 4412 mg/kg

* See NIOSH, *RTECS* (XG3425000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Freshwater: Atlantic salmon, LD_{50}: 0.03 ppm; *daphnia*, 72 hr threshold: 2-4 ppm; *gammarus*, 72 hr threshold: 4 ppm; perch, 72 hr threshold: 60 ppm. Saltwater: brown shrimp, 96 hr LC_{50}: 10 ppm.

Environmental Fate: May persist indefinitely as cation. Thallium bioaccumulates.

Section 13 - Disposal Considerations

Disposal: If possible, recover for reuse or recycling. Contact your supplier or a licensed contractor for detailed recommendations for disposal. Follow applicable Federal, state, and local regulations.

Container Cleaning and Disposal: Handle empty containers carefully as hazardous residues may still remain. Triple rinse containers and dispose of wash wastewater appropriately.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Thallium compounds, n.o.s.
Shipping Symbols: –
Hazard Class: 6.1
ID No.: UN1707
Packing Group: II
Label: POISON
Special Provisions (172.102): –

Packaging Authorizations
a) Exceptions: None
b) Non-bulk Packaging: 173.212
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 25 kg
b) Cargo Aircraft Only: 100 kg

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: –

Section 15 - Regulatory Information

EPA Regulations:
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per CWA, Sec. 307(a)
CERCLA Final Reportable Quantity (RQ), 1000 lb (454 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

Section 16 - Other Information

References: 1, 73, 99, 103, 124, 136, 149, 176, 190, 209, 216, 222, 223, 224, 227, 230

Prepared By..... S Fleming, BS/HM Spliethoff, MS
Industrial Hygiene Review..... PA Roy MPH, CIH
Medical Review..... T Thoburn, MD, MPH

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Mercury **MSDS No. 26**

Date of Preparation: 1/77 Revision: D, 6/94

Section 1 - Chemical Product and Company Identification 44

Product/Chemical Name: Mercury
Chemical Formula: Hg
CAS No.: 7439-97-6
Synonyms: colloidal mercury, hydrargyrum, liquid silver, Quicksilver
Derivation: Obtained by roasting cinnabar (mercury sulfide) and purified by distillation, or as a by-product of gold mining.
General Use: Used in agricultural poisons, anti-fouling paint, dental amalgams, mining amalgamation (to remove gold and other metals from ore), thermometers, barometers, dry cell batteries, chlorine and caustic soda production, electrical apparatus, and as a neutron absorber in nuclear power plants.
Vendors: Consult the latest *Chemical Week Buyers' Guide*. (73)

Section 2 - Composition / Information on Ingredients

Mercury, ca 100 %wt

OSHA PEL
Ceiling: 0.1mg/m^3 (vapor and inorganic Hg)
8-hr TWA: 0.05 mg/m^3 (vapor), skin; (Vacated 1989 Final Rule Limit)

ACGIH TLVs
TWA: 0.025 mg/m^3 (inorganic compounds), skin

NIOSH REL
10-hr TWA: 0.05 mg/m^3 (vapor), skin

DFG (Germany) MAK
TWA: 0.01 ppm (0.1 mg/m^3)
Category III: Substances with systemic effects
Onset of Effect: > 2 hr
Half-life: > shift length (strongly cumulative)

Peak Exposure Limit:
0.1 ppm (1 mg/m^3), 30 min. average value, 1/shift

IDLH Level
28 mg/m^3

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Mercury exists as a heavy, odorless, silver-white liquid metal. It is highly toxic by both acute and chronic exposure. Exposure can cause corrosion of the eyes, skin, and respiratory tract and may result in irreversible nervous system damage. It readily forms amalgamations with most metals except iron.

Wilson Risk Scale
R 1
I 4
S 2*
K 1
*Skin absorption

HMIS
H 4*
F 0
R 0
*Chronic effects
PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, eye and skin contact/absorption.
Target Organs: Central nervous system, eyes, skin, respiratory system, liver, kidneys.
Acute Effects
Inhalation: Exposure to high vapor concentrations can cause severe respiratory damage. Other symptoms include wakefulness, muscle weakness, anorexia, headache, ringing in the ear, headache, diarrhea, liver changes, fever, gingivitis, chest pain, difficulty breathing, cough, inflammation of the mouth (stomatitis), salivation, bronchitis, and pneumonitis. Acrodynia (pink or Swifts disease), characterized by redness and peeling of the skin on the toes and fingers, was commonly seen in children in the 1950s and is still *infrequently* seen in workers.
Eye: Irritation and corrosion.
Skin: Skin can become severely irritated if allowed to remain in contact with mercury. Skin absorption will occur at 2.2% of the rate of absorption through the lungs.
Ingestion: Mercury generally passes through the digestive tract uneventfully. However, large amounts may get caught up in the intestine and require surgical removal. If an abscess or other perforation is present along the digestive tract, absorption into the blood stream with subsequent mercury poisoning is possible.
Carcinogenicity: IARC, NTP, and OSHA do not list mercury as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: Central nervous system disorders.
Chronic Effects: Chronic exposure appears more common than acute and is primarily associated with central nervous system damage which can be permanent (ex. paresthesia of the hands, lips, feet). Early signs of toxicity include weakness, fatigue, anorexia, weight loss, and gastrointestinal disturbances. If exposure levels are high, characteristic tremors of the fingers, eyelids, and lips occur with progression to generalized tremors of the entire body. Psychic disorders are noticeable and characterized by behavior and personality changes, increased excitability, memory loss, insomnia, and depression. In severe cases, delirium and

Copyright © 1994 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

hallucinations may occur. Kidney damage is observed with oliguria (decreased urine output) progressing to anuria (urine cessation) and may require dialysis. The cornea and lens of the eyes may take on a brownish discoloration and the extraocular muscles may be damaged. This syndrome has been termed *Asthenic-Vegetative Syndrome* or *Micromercurialism.* Chronic symptoms occur increasingly with exposures to 0.1 mg/m^3 or higher. *Mutation:* Aneuploidy and other chromosomal aberrations have been observed in the lymphocytes from whole blood cultures in workers exposed to mercury. *Reproductive:* Mercury has been detected in stillborn babies of women treated with mercury for syphilis. In a study of six men acutely exposed (occupationally) to mercury levels as high as 44 mg/m^3, all suffered impaired sexual function. Repeated skin contact may cause allergic dermatitis in some individuals.

NOTE: Spilled mercury will release sufficient vapor over time to produce chronic poisoning.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water and then wash exposed area with soap. For reddened or blistered skin, consult a physician.

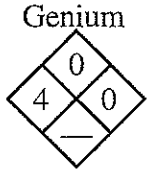
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. In general, mercury will pass through the digestive tract uneventfully.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: BEI: *blood* (15 µg/L), *urine*: (35 µg/g creatinine). Extremely high urine levels of 0.5 to 0.85 mg Hg/L are indicative of polyneuropathy. 0.4 to 22 µg/L is reported to be the human lethal blood level. Obtain urinalysis including at a minimum: albumin, glucose, and a microscopic examination of centrifuged sediment. Use BAL or 2, 3-dimercaptosuccinic acid as chelators. *Do not* use calcium sodium EDTA because of nephrotoxicity. An electromyograph may determine extent of nerve dysfunction. It has been noted that exposure to mercury may predispose persons to development of carpal tunnel syndrome.

Section 5 - Fire-Fighting Measures

Genium



Flash Point: Nonflammable

Autoignition Temperature: Nonflammable

LEL: None reported.

UEL: None reported.

Extinguishing Media: Use agents suitable for surrounding fire.

Unusual Fire or Explosion Hazards: None reported.

Hazardous Combustion Products: Toxic mercury vapor and mercuric oxide.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Keep a mercury spill kit readily available in areas where mercury is used. Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind.

Small and Large Spills: Follow instructions on mercury spill kit. Most kits come with an aspiration-driven vacuum trap with a mercury "sweeper" (copper or copper-plated brush). Wash spill area with a dilute calcium sulfide or nitric acid solution. If spill cannot be taken up readily, dust the top of the spill with flowers of sulfur or preferably, calcium polysulfide. This will produce a surface coating of mercury sulfide which will reduce mercury vapor dispersion into the air.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use appropriate PPE when working with mercury. *Do not* use on porous work surfaces (wood, unsealed concrete, etc.) to prevent spills from lodging in cracks.

Storage Requirements: Store in a cool, dry, well-ventilated area away from heat and incompatibles (Sec. 10). Store on non-porous floors and wash them regularly with a dilute calcium sulfide solution. Because mercury will form amalgamations with most metals except iron, metal shelves should be painted with a sufficiently thick coating to prevent this from happening.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Wherever possible, enclose processes to prevent mercury vapor dispersion into work area.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)

Administrative Controls: Consider pre-placement and periodic medical exams of exposed workers with emphasis on the skin, eyes, central nervous system, liver, and kidneys.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For $\leq$ 0.5 mg/m^3, use any chemical cartridge

Copyright © 1994 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

respirator with cartridges providing protection against mercury and equipped with an ESLI (end of service life indicator), any SCBA, or any SAR (supplied-air respirator). For ≤ 1.25 mg/m^3, use any SAR operated in continuous-flow mode, any PAPR (powered, air-purifying respirator) with an ESLI. For ≤ 2.5 mg/m^3, use any SCBA or SAR with a full facepiece, any SAR with a tight-fitting facepiece and operated in continuous-flow mode, or any chemical cartridge respirator with a full facepiece, chemical cartridges providing protection against mercury, and equipped with an ESLI. For ≤28 mg/m^3, use any SAR operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA with full facepiece and operated in pressure-demand or other positive pressure mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets made of butyl rubber, nitrile rubber, fluorocarbon rubber, neoprene rubber, polyvinyl chloride, chlorinated polyethylene, or polycarbonate to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Liquid metal
Appearance and Odor: Silvery-white, odorless
Vapor Pressure: 0.0018 mm Hg at 77 °F (25 °C)
Formula Weight: 200.59
Density (H_2O=1): 13.534 g/cm^3 at 77 °F (25 °C)
Boiling Point: 674.09 °F (356.72 °C)
Freezing Point: -37.97 °F (-38.87 °C)
Viscosity: 15.5 mP at 77 °F (25 °C)
Electrical Resistivity: 95.76 µohm at 68 °F (20 °C)

Water Solubility: 0.28 µmol/L at 77 °F (25 °C)
Other Solubilities: Soluble in boiling sulfuric acid, nitric acid (reacts); slightly in lipids, and 2.7 mg/L in pentane. Insoluble in alcohol, ether, cold sulfuric acid, hydrogen bromide, and hydrogen iodide.
Surface Tension: 484 dyne/cm at 77 °F (25 °C)
Critical Temperature: 2664 °F (1462 °C)
Critical Pressure: 1587 atm

Section 10 - Stability and Reactivity

Stability: Mercury does not tarnish at ordinary temperatures but when heated to near its boiling point, it slowly oxidizes to mercuric oxide.

Polymerization: Hazardous polymerization does not occur.

Chemical Incompatibilities: Mercury forms alloys (amalgamates) with most metals except iron. It is incompatible with oxidizers such as bromine, 3-bromopropyne, methylsilane + oxygen, chlorine, chlorine dioxide, nitric acid, or peroxyformic acid; tetracarbonyl nickel + oxygen, alkynes + silver perchlorate, ethylene oxide, acetylenic compounds (explosive), ammonia (explosive), boron phosphodiiodide, methyl azide, nitromethane, and ground sodium carbide.

Conditions to Avoid: Exposure to high temperatures, metal surfaces or incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of mercury can produce mercuric oxide.

Section 11- Toxicological Information

Toxicity Data:*

Reproductive:
Rat, inhalation: 890 ng/m^3/24 hr for 16 weeks prior to mating had an effect on spermatogenesis.

Acute Dermal Toxicity:
Man, skin, TD_{Lo}: 129 mg/kg for 5 continuous hours caused ringing in the ears, headache, and allergic dermatitis.

Acute Oral Toxicity:
Man, oral, TD_{Lo}: 43 mg/kg caused tremor and jaundice or other liver changes.

Acute Inhalation Effects:
Woman, inhalation, TC_{Lo}: 150 µg/m^3/46 days caused anorexia, diarrhea, and wakefulness.
Man, inhalation, TC_{Lo}: 44300 µg/m^3/8 hr caused muscle weakness, liver changes, and increased body temperature.

Chronic Effects:
Rat, inhalation: 1 mg/m^3/ 24 hr for 5 continuous weeks caused proteinuria.

* See NIOSH, *RTECS* (OV4550000), for additional toxicity data.

Copyright © 1994 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 12 - Ecological Information

Ecotoxicity: Catfish, LC_{50} = 0.35 mg/L/96 hr; mollusk (*Modiolus carvalhoi*), LC_{50} = 0.19 ppm/96 hr: tadpole (*Rana hexadactyla*), LC_{50} = 0.051 ppm/96 hr. Mercury is transformed to methyl mercury by bacteria in the environment and undergoes bioaccumulation readily. BCF for freshwater fish = 63,000; for saltwater fish = 10,000; and for marine and freshwater invertebrates = 100,000.

Environmental Degradation: Mercury is expected to volatilize rapidly when deposited on soil surfaces. Once in the air, it can be transported long distances before being redeposited on soil or in water. In water, mercury appears to bind to particulates where it eventually becomes deposited on the bed sediment. In general, mercury entering the environment can be deposited and revolatilized several times.

Section 13 - Disposal Considerations

Disposal: Incineration is *not* an appropriate disposal method. Wastewater may be treated by addition of chlorine to oxidize the mercury to its ionic state. The water can then be passed through an absorbent (an activated charcoal concentrate with a sulfur coating or peanut shell charcoal) to collect the ionic mercury, followed by distillation to recover the mercury. Sodium borohydride, a reducing agent, can be used to precipitate mercury from waste solutions. Bioremediation, using *Pseudomonas putida*, has also been suggested. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Mercury
Shipping Symbols: A, W
Hazard Class: 8
ID No.: UN2809
Packing Group: III
Label: Corrosive
Special Provisions (172.102): --

Packaging Authorizations
a) Exceptions: 173.164
b) Non-bulk Packaging: 173.164
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 35 kg
b) Cargo Aircraft Only: 35 kg

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: 40, 97

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste (40 CFR 261.33): U151
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per RCRA, Sec. 3001; CWA, Sec. 307(a), CAA, Sec. 112
CERCLA Reportable Quantity (RQ), 1 lb (0.454 kg)
SARA 311/312 Codes: 1, 2
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 73, 103, 124, 132, 136, 148, 149, 159, 167, 176, 187, 189

Prepared By ..... M Gannon, BA
Industrial Hygiene Review ..... RE Langford, PhD, CIH
Medical Review ..... T Thoburn, MD, MPH

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1994 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Asbestos **MSDS No. 15**

Date of Preparation: 11/90 Revision: A, 9/97

Section 1 - Chemical Product and Company Identification 50

Product/Chemical Name: Asbestos

Chemical Formula: actinolite, $Ca_2(Fe^{2+}, Mg)_5Si_8O_{22}(OH)_2$; amosite, $(Fe^{2+},Mg)_7Si_8O_{22}(OH)_2$; anthophyllite, $(Mg, Fe^{2+})_7Si_8O_{22}(OH)_2$; chrysotile, $Mg_3Si_2O_5(OH)_4$; crocidolite, $Na_2(Fe^{2+}, Mg)_3Fe^{3+}{}_2Si_8O_{22}(OH)_2$; tremolite, $Ca_2Mg_5Si_8O_{22}(OH)_2$;

CAS Number: CAS No. 1332-21-4, asbestos; CAS No. 12172-73-5, amosite, brown asbestos; CAS No. 12001-29-5, chrysotile, white asbestos; CAS No. 12001-28-4, crocidolite, blue asbestos; CAS No. 17068-78-9, anthophyllite; CAS No. 13768-00-8, actinolite

Synonyms: actinolite; ascarite; amosite; anthophyllite; chrysotile; crocidolite; earth flax; mountain cork; stone flax; tremolite

Derivation: Asbestos is a generic term applied to many naturally occurring, hydrated silicates (minerals) found in rock which separate into flexible fibers when crushed or processed. Commercially important forms are amosite, anthophyllite (mined and used only in Finland), chrysotile, and crocidolite. Other types include tremolite and actinolite.

General Use: Chrysotile was most widely used in US industry. Since asbestos is insensitive to chemical attack and incombustible, asbestos has been used in more than 5,000 products including thermal and electrical insulation, roofing, cement pipe and sheet flooring, friction materials, gaskets, coatings, plastics, textiles, and paper products. However, due to its health hazards, other materials are now replacing it wherever possible. Under TSCA, EPA proposed to prohibit or phase out the manufacture and use of asbestos in certain products. EPA issued a final rule banning the manufacture, importation, processing, and distribution of most asbestos-containing products. Between 1950 and 1972 asbestos was used as spray insulation in buildings, but OSHA now prohibits spray application of actinolite, anthophyllite, asbestos, or tremolite (29 CFR 1910.1001).

Section 2 - Composition / Information on Ingredients

Asbestos, ca 100 %wt

Trace Impurities: Metals including nickel, cobalt, chromium, manganese, beryllium, cadmium, copper, and thallium; other fibrous materials including tremolite and brucite; and oils and waxes.

OSHA PELs*
8-hr TWA: 0.1 f/cc
30-min STEL: 1 f/cc
Carcinogen - See 29 CFR 1910.1001

NIOSH REL*
10-hr TWA: 0.1 f/cc
Carcinogen - Use 29 CFR 1910.1001

DFG (Germany) MAK
None established

ACGIH TLVs†
Amosite (12172-73-5): TWA: 0.5 f/cc ‡
Chrysotile (12001-29-5): TWA: 2 f/cc
Crocidolite (12001-28-4): TWA: 0.2 f/cc
Asbestos, other forms: TWA: 2 f/cc

IDLH Level
Not determined

* The following limits are applicable for amosite (12172-73-5), chrysotile (12001-29-5), crocidolite (12001-28-4), and asbestos, other forms.
† Notice of Intended Change: 0.1 f/cc
‡ Fibers longer than 5 µm; aspect ratio ≥ 3:1 as determined by the membrane filter method at 400-450X magnification (4-mm objective) phase contrast illumination.

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White or greenish (chrysotile), blue (crocidolite), or gray-green (amosite) fibrous, odorless solids. Asbestos causes three specific diseases: asbestosis (fibrous lung scarring), lung cancer, and mesothelioma (cancer of the chest lining and abdominal cavities). These diseases typically develop decades (20 to 40 yr) after exposure begins, but may occur sooner. Prevent or minimize asbestos exposure.

Wilson Risk Scale
R 0
I 4
S 1
K 0

HMIS
H 1*
F 0
R 0
PPE†

* Chronic Effects: Cancer Hazard
† Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact

Target Organs: Respiratory system, eyes; possibly digestive system

Acute Effects

Inhalation: Nose and throat irritation are possible with high exposure.

Eye: Irritation.

Skin: Irritation with exposure to high concentrations.

Ingestion: Gastrointestinal tract irritation is possible.

Carcinogenicity: IARC, NTP, OSHA, ACGIH, NIOSH, EPA, and MAK list asbestos as IARC-1 (carcinogenic to humans), NTP-1 (known to be a carcinogen), OSHA-X (carcinogen defined with no further categorization),

Copyright © 1997 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

ACGIH-TLV-A1 (confirmed human carcinogen), EPA-A (human carcinogen), and MAK-A1 (capable of inducing malignant tumors as shown by human experience).

Medical Conditions Aggravated by Long-Term Exposure: Long-term, high-level exposure may aggravate any chronic lung (asthma, emphysema, bronchitis) or heart condition.

Chronic Effects: Asbestos may cause 1) asbestosis, 2) lung cancer, 3) mesothelioma, 4) pleural plaques, and 5) several other forms of cancer. *Asbestosis* is fibrosis (scarring) of lung tissue after many years of high-level occupational exposure. Scarring may be progressive even after exposure ceases. Even though detectable in lungs of a high proportion of adults in industrialized areas, asbestosis does not result from lower level environmental exposure. Its symptoms range from mild shortness of breath and dry cough to severe disabling breathlessness, heart failure, and ultimately death. Lung scarring can be seen on X-ray and alterations in lung function can be detected with spirometry (a medical test). Examination typically detects rales (crackling sounds in lungs). Severe cases may have cyanosis (bluish skin discoloration) and clubbing of fingertips. *Lung cancer* can result from lower exposure levels than asbestosis, but also takes many years to develop. Smokers exposed to asbestos are at 5 to 10X higher risk than exposed nonsmokers. *Mesothelioma* is a very aggressive cancer of the pleura (lining around the lungs) or peritoneum (lining of the abdomen), and develops after decades of (sometimes low level) exposure. Symptoms may include chest and abdominal pain, weight loss, and/or shortness of breath, with death within 2 years of diagnosis. *Pleural plaques* are thickenings, sometimes with calcium deposits, of the lung's lining and may be seen on X-ray. While not associated specifically with health effects, they indicate significant exposure. *Other sites of cancer* include larynx (vocal cords), portions of digestive tract, and possibly the kidney. Asbestos's toxicity depends on fiber type (crocidolite > amosite > chrysotile), size (longer > shorter), shape (long, thin needle-like > curly), and solubility. Health effects depend on dose (exposure concentration and duration), smoking habits, and individual susceptibility.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air. Clean any fibers from nose and mouth. Encourage victim to cough, spit, and blow nose to remove fibers.

Eye Contact: Do not rub. Gently lift eyelids and flush with flooding amounts of water.

Skin Contact: Shower with water and soap. Wet contaminated clothing prior to removal and seal in a plastic bag for disposal as hazardous waste. If rash develops, consult physician.

Ingestion: Induce vomiting *only* if awake and alert. Consult a physician.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Asbestosis diagnosis is based on chest X-ray with an abnormal ILO "B" reading (small irregular opacities), rales, restrictive pattern spirometry, adequate exposure history, and symptoms. Consider pneumovax, annual flu shot, and other supportive treatment as needed. See Sec. 8, Administrative Controls for specific recommendations for medical surveillance.

Special Precautions/Procedures: Emergency personnel should protect against any exposure when aiding victims.

Section 5 - Fire-Fighting Measures

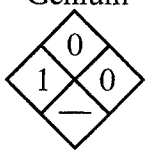
Flash Point: Not applicable (NA); noncombustible solid.

Autoignition Temperature: NA

LEL: NA

UEL: NA

Genium



Extinguishing Media: Use extinguishing media appropriate for surrounding fire. Wet asbestos fibers with water spray to prevent dust generation. *Do not* scatter spilled asbestos with high-pressure water streams.

Unusual Fire or Explosion Hazards: None reported.

Hazardous Combustion Products: None; noncombustible solid.

Fire-Fighting Instructions: Isolate hazard area and deny entry. Avoid asbestos dust generation and inhalation; it may have damaging effects on the lungs. *Do not* release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because there may be airborne asbestos fibers, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel and evacuate all unnecessary personnel. Cleanup personnel should protect against dust inhalation and skin or eye contact. Avoid dust generation, blowing, dry brushing, and dry mopping. Provide HEPA-filtered (high-efficiency particulate air) portable ventilation systems. Use wet cleaning methods or approved HEPA vacuum cleaning system to pick up spills. The techniques used must collect particulate without dispersing dust into air. Place waste in *properly labeled* dust-tight containers or sealed, heavy-gauge, impervious plastic bags for disposal.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid any exposure to asbestos. Work with asbestos only in a sufficient wet state to prevent emission of airborne fibers. Practice good personal hygiene and housekeeping procedures. Use only with ventilation sufficient to reduce airborne concentrations to the lowest feasible level. Wear personal protective clothing and equipment and respiratory protection. Inhaling or ingesting asbestos fibers from contaminated clothing or skin can be hazardous. *Do not* allow dusts and asbestos-containing wastes to accumulate.

Copyright © 1997 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Storage Requirements: Store in closed (dust-tight) containers or heavy-gauge impervious plastic bags in a clean, secure area protected from physical damage. *Do not* open containers that can release asbestos dust without providing proper enclosure or control measure.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose all operations and provide local exhaust ventilation and dust collection systems at the site of release to prevent airborne dispersion.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)

Administrative Controls: Educate workers about asbestos and asbestos-containing materials' hazards. Inform employees of asbestos standard (29 CFR 1910.1001). Exposure to asbestos, tremolite, anthophyllite, and actinolite in construction work is covered by 29 CFR 1926.58. Instruct employees in proper practices for handling asbestos-containing materials and correct use of protective equipment. Prevent or minimize asbestos exposure. Regulate areas where exposure in excess of the PEL is likely. Post warning signs in all regulated areas. Do not substitute personal protective equipment for proper handling and engineering controls. If exposures exceed the PEL, ensure employees wear appropriate protective clothing. Monitor work areas that expose employees to airborne concentrations at or above the action level (Sec. 2). Whenever production, process, control equipment, personnel, or work practices change, institute new monitoring. Medical surveillance is required for all employees possibly exposed at or above the action level. Provide preplacement medical examination that includes complete medical and work history, complete physical examination that emphasizes respiratory and cardiovascular systems and digestive tract, the respiratory disease standardized questionnaire, a posterior-anterior 14" x 17" chest roentgenogram, and pulmonary function tests [FVC and FEV(1)]. Annual periodic medical examinations shall include all these elements and an abbreviated questionnaire. Encourage smoking cessation due to synergistic effects of smoking and asbestos exposure. If it is 10+ years since first asbestos exposure, an individual should have a chest roentgenogram: every 5 years (ages 15 to 35), every 2 years (ages 35 to 45), every year (age 45+). Within 30 days of employment termination, an individual should receive a periodic medical examination with the elements listed above. Keep medical surveillance records for duration of employment, plus 30 years.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. At concentrations above the NIOSH REL or at any detectable concentration, wear any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode (assigned protection factor = 10,000); or any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA or other positive-pressure mode (assigned protection factor = 10,000). For escape wear an air-purifying, full-facepiece respirator with a high-efficiency particulate filter; or any appropriate escape-type, SCBA. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear coveralls or gauntlets made of cotton polyester material; head-coverings; and foot coverings such as canvas booties, rubber galoshes or safety shoes. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Place contaminated protective devices or work clothing in labeled, impermeable, and sealed containers or bags. Separate contaminated work clothes from street clothes. *Do not* remove asbestos from clothing by blowing or shaking. Launder contaminated clothing before wearing. Inform laundering service of asbestos-contaminated clothing and of asbestos' potential harmful effects (29 CFR 1910.1001). A vacuum with HEPA filter may be used to remove asbestos fibers.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid

Appearance and Odor: White or greenish (chrysotile), blue (crocidolite), or gray-green (amosite) fibrous, odorless solids

Formula Weight: Varies with asbestos form (See Sec. 1)

Water Solubility: Insoluble

Melting Point: Decomposes

Section 10 - Stability and Reactivity

Stability: Asbestos is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization does not occur.

Chemical Incompatibilities: Strong acids can attack chrysotile and rapidly extract its MgO and H_2O content; glacial acetic acid can decompose it. Hot water slowly breaks down chrysotile. Like other asbestos forms, it resists strong alkali [(5M NaOH at least up to 212 °F (100 °C)].

Conditions to Avoid: Airborne dispersion of asbestos fibers.

Hazardous Decomposition Products: It is heat resistant, but decomposes and alters its microscopic fiber structure above 1112 °F (600 °C). Chrysotile dehydroxylates at 1112 to 1436 °F (600 to 780 °C); the "asbestos anhydride" in turn breaks down to a mixture of silica (SiO_2) and fosterite (Mg_2SiO_4) at 1472 to 1562 °F (800 to 850 °C). Above 1832 °F (1000 °C), magnesium pyroxenes form and melt at ~2642 °F (1450 °C).

Copyright © 1997 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 11 - Toxicological Information

Toxicity Data:*

Acute Inhalation Effects:
Human, inhalation, TC_{Lo}: 1.2 fb/cc/19 yr/continuous; toxic effects: pleural effusion, dyspnea, and sputum.
Genetic Effects:
E. coli: 10 mg/plate (+/-S9) produced mutations.
Tumorigenicity:
Rat, implant: 750 mg/kg; toxic effects: equivocal tumorigenic agent by RTECS criteria; tumors at site of application.
Mouse, intraperitoneal: 80 mg/kg; toxic effects: equivocal tumorigenic agent by RTECS criteria; tumors at site of application.
* NIOSH, *RTECS* (CI6475000; CAS No.: 1332-21-4)

Section 12 - Ecological Information

Environmental Fate: As a mineral asbestos is not affected by photolytic processes. It is considered to be nonbiodegradable by aquatic organisms; no evidence was found regarding bioaccumulation in aquatic organisms.
Soil Adsorption/Mobility: Although some trace metals and organic compounds have an affinity for asbestos minerals, asbestos itself does not have an adsorptive affinity for the solids normally found in natural water systems.

Section 13 - Disposal Considerations

Disposal: Asbestos is a poor candidate for incineration. Place asbestos and asbestos-containing wastes into good quality plastic bags and bury in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Asbestos
Shipping Symbols: D
Hazard Class: 9
ID No.: NA2212
Packing Group: III
Label: CLASS 9
Special Provisions (172.102): None listed

Packaging Authorizations
a) **Exceptions:** 173.155
b) **Non-bulk Packaging:** 173.216
c) **Bulk Packaging:** 173.240

Quantity Limitations
a) **Passenger, Aircraft, or Railcar:** 200 kg
b) **Cargo Aircraft Only:** 200 kg

Vessel Stowage Requirements
a) **Vessel Stowage:** A
b) **Other:** 34, 40

Section 15 - Regulatory Information

EPA Regulations:
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per CWA, Sec. 307(a) and CAA, Sec. 112.
CERCLA Final Reportable Quantity (RQ), 1 lb (0.454 kg); the RQ is limited to friable forms only
Listed as a SARA Toxic Chemical (40 CFR 372.65), as asbestos (friable); effective date 1/1/87.
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)
Listed as an OSHA Specifically Regulated Substance (29 CFR 1910.1001)

Section 16 - Other Information

References: 73, 103, 124, 136, 139, 147, 167, 184, 190, 197, 198, 209, 223 W5-Mac

Prepared By ..... MJ Wurth, BS
Industrial Hygiene Review ..... DJ Wilson, CIH
Medical Review ..... G Kelafant, MD

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1997 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 296
Arsenic and Compounds

Issued: 4/90

Section 1. Material Identification

Arsenic Description: Obtained from flue dust of copper and lead smelters as white arsenic (arsenic trioxide). Reduction with charcoal and sublimation in an N_2 current yields pure arsenic. Metallic arsenic is used for hardening copper, lead, and alloys; as a doping agent in germanium and silicon solid-state products, special solders, and medicine; and to make gallium arsenide for dipoles and other electronic devices. Arsenic compounds are used in manufacturing certain types of glass; in textile printing, tanning, taxidermy, pharmaceuticals, insecticides and fungicides, pigment production, and antifouling paints; and to control sludge formation in lubricating oils. Arsenic trioxide is the source for 97% of all arsenic products.

Other Designations: CAS No. 7440-38-2; arsen; arsenic black; As; gray arsenic; metallic arsenic.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R 1
I 4
S 2
K 0

Genium



HMIS
H 3
F 2
R 2
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Arsenic and soluble compounds, as As

OSHA PEL
8-hr TWA: 0.5 mg/m³,* 0.01 mg/m³†

ACGIH TLV, 1989-90
TLV-TWA: 0.2 mg/m³

NIOSH REL, 1987
Ceiling: 0.002 mg/m³

Toxicity Data‡
Man, oral, TD_{Lo}: 76 mg/kg administered intermittently over a 12-year period affects the liver (tumors) and blood (hemorrhage)
Man, oral: 7857 mg/kg administered over 55 years produces gastrointestinal (in the structure or function of the esophagus), blood (hemorrhage), and skin and appendage (dermatitis) changes
Rat, oral, TC_{Lo}: 605 µg/kg administered to a 35-week pregnant rat affects fertility (pre- and post-implantation mortality)

* Organic compounds.
† Inorganic compounds.
‡ See NIOSH, *RTECS* (CG0525000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: sublimes at 1134 °F/612 °C
Melting Point: 1497 °F/814 °C
Vapor Pressure: 1 mm at 702 °F/372 °C (sublimes)
Atomic Weight: 74.92
Density: 5.724 at 57 °F/14 °C
Water Solubility: Insoluble†

Appearance and Odor: A brittle, crystalline, silvery to black metalloid. Odorless.

* This data pertains to arsenic only.
† Arsenic is soluble in nitric acid (HNO_3).

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use dry chemical, CO_2, water spray, or foam to fight fires.
Unusual Fire or Explosion Hazards: Flammable and slightly explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Arsenic is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Arsenic can react vigorously on contact with powerful oxidizers such as bromates, peroxides, chlorates, iodates, lithium, silver nitrate, potassium nitrate, potassium permanganate, and chromium (VI) oxide. This material is also incompatible with halogens, bromine azide, palladium, dirubidium acetylide, zinc, and platinum.
Hazardous Products of Decomposition: Thermal oxidative decomposition of arsenic and its compounds produces irritating or poisonous gases.

Copyright © 1990 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data

Carcinogenicity: The IARC, NTP, and OSHA list arsenic as a human carcinogen (Group 1). This evaluation applies to arsenic and arsenic compounds as a whole, and not necessarily to all individual chemicals within the group. Studies report that both the trivalent and pentavalent compounds are strongly implicated as causes of skin, lung, and lymphatic cancers. Experimental studies have shown that arsenic has tumorigenic and teratogenic effects in laboratory animals.
Summary of Risks: Arsenic compounds are irritants of the skin, mucous membranes, and eyes. The moist mucous membranes are most sensitive to irritation. Prolonged contact results in local hyperemia (blood congestion) and later vesicular or pustular eruption. Epidermal carcinoma is a reported risk of exposure. Peripheral neuropathy (degenerative state of the nervous system) is common after acute or chronic arsenic poisoning. Symptoms include decreased sensation to touch, pinprick, and temperature; loss of vibration sense; and profound muscle weakness and wasting. Other complications of acute and chronic arsenic poisoning are encephalopathy (alterations of brain structure) and toxic delirium.
Medical Conditions Aggravated by Long-Term Exposure: Damage to the liver, nervous, and hematopoietic (responsible for the formation of blood or blood cells in the body) system may be permanent. Pulmonary and lymphatic cancer may also occur.
Target Organs: Liver, kidneys, skin, lungs, lymphatic system.
Primary Entry Routes: Inhalation, ingestion of dust and fumes, via skin absorption.
Acute Effects: Acute industrial intoxication is more likely to arise from inhalation of arsine. However, with corrosive arsenical vapors, conjunctivitis, eyelid edema, and even corneal erosion may result. Inhalation may result in nasal irritation with perforation of the septum, cough, chest pain, hoarseness, pharyngitis, and inflammation of the mouth. If ingested, metallic or garlic taste, intense thirst, nausea, vomiting, abdominal pain, diarrhea, and cardiovascular arrhythmias (heartbeat irregularities) may occur. Symptoms generally occur within 30 minutes, but may be delayed for several hours if ingested with food. Acute poisoning may result in acute hemolysis (breakdown of red blood cells).
Chronic Effects: Chronic symptoms include weight loss, hair loss, nausea, and diarrhea alternating with constipation, palmar and plantar hyperkeratoses (thickening of the corneous layer of skin on palms and soles of feet), and skin eruptions, and peripheral neuritis (inflammation of the nerves). Leukemia, bone marrow depression, or aplastic anemia (dysfunctioning of blood-forming organs) may occur after chronic exposure.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: If emesis is unsuccessful after two doses of ipecac, consider gastric lavage. Monitor urine arsenic level. Alkalinization of urine may help prevent disposition of red cell breakdown products in renal tubular cells. If acute exposure is significant, maintain high urine output and monitor volume status, preferably with central venous pressure line. Abdominal X-rays should be done routinely for all ingestions. Chelation therapy with BAL, followed by n-penicillamine is recommended, but specific dosing guidelines are not clearly established.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and contact with skin and eyes. Use nonsparking tools. With a clean shovel, scoop material into a clean, dry container and cover. Absorb liquid material with sand or noncombustible inert material and place in disposal containers. Do not release to sewers, drains, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations*
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance† (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [† per Clean Water Act, Sec. 307(a); per Clean Air Act, Sec. 112]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations‡
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

* Designations for arsenic only.
‡ Listed as arsenic organic compounds (as As).

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PELs, ACGIH TLVs, and NIOSH REL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed, properly labeled, containers in a cool, well-ventilated area away from all incompatible materials (Sec. 5) and heat and ignition sources. Protect containers from physical damage.

Engineering Controls: Avoid inhalation or ingestion of dust and fumes, and skin or eye contact. Practice good personal hygiene and housekeeping procedures. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program with training, maintenance, inspection, and evaluation. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Provide preplacement and annual physical examination with emphasis on the skin, respiratory system, and blood.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Arsenic, solid
DOT Hazard Class: Poison B
ID No.: UN1558
DOT Label: Poison
DOT Packaging Requirements: 173.366
DOT Packaging Exceptions: 173.364

IMO Shipping Name: Arsenic, metallic
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II
ID No.: UN1558

***MSDS Collection* References:** 7, 26, 38, 53, 73, 85, 87, 88, 89, 100, 103, 109, 123, 124, 126, 127, 130, 136, 138
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD M4

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 5
Chromic Acid and Chromates

Issued: 10/77 Revision: C, 7/91 Errata: 12/94

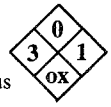
Section 1. Material Identification

45

Chromic Acid (CrO_3) Description: Produced by roasting chromite ore with alkali or lime, leaching with calcium oxide, crystallizing the chromate or dichromate, and then treating it with an excess of sulfuric acid. Used in ceramic glazes, colored glass, dyes, batteries, explosives, water treatment, wood treatment and preservatives, refractories, copper stripping, aluminum anodizing, photomechanical processing, chromium metal plating, purifying oil and acetylene, hardening microscopic preparations, and manufacturing chromated copper arsenate; and as a corrosion inhibitor, a catalyst, an oxidizing agent in organic chemistry, and an etchant for plastics.

R 1
I 4
S 3*
K 0
* Percutaneous (broken skin)

NFPA



HMIS
H 3
F 0
R 1
PPG†
† Sec. 8

Other Designations: CAS No. 1333-82-0; chromic acid; chromic acid, solid (DOT); chromium anhydride; chromium (VI) oxide; chromium trioxide; chromium (6+) trioxide; monochromium trioxide; puratronic chromium trioxide. Chromic acid is the commonly used name, although true chromic acid (CrH_2O_4, CAS No. 7738-94-5) cannot be isolated from solution. Chromic acid and chromates (as CrO_3, CAS No. 7440-47-3).

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Caution: A powerful oxidizer, chromic acid may explode on contact with reducing agents and cause ignition on contact with organic materials. This poison and human carcinogen is corrosive to skin and irritating to mucous membranes. Eye contact may cause permanent blindness.

Section 2. Ingredients and Occupational Exposure Limits

Chromic acid, 99% CrO_3

1990 OSHA PEL
Ceiling: 0.1 mg(CrO_3)/m³

1987 IDLH Level
30 mg/m³

1990-91 ACGIH TLVs
TWA: 0.05 mg(Cr)/m³
Ceiling: 0.1 mg/m³

1990 NIOSH REL
TWA: 0.025 mg(Cr(VI))/m³
Ceiling: 0.05 mg/m³/15 min (Cr(VI))

1985-86 Toxicity Data*
Rat, oral, LD_{50}: 80 mg/kg
Mouse, oral, LD_{50}: 127 mg/kg
Human, inhalation, TC_{Lo}: exposed continuously to 110 µg over 3 years. Toxic effects include tumorigenic (carcinogenic by *RTECS* criteria); sense organs and special senses (olfaction tumors); lungs, thorax, or respiration (tumors).
Dog, subcutaneous, LD_{Lo}: 330 mg/kg

* See NIOSH, *RTECS* (GB6650000), for additional mutative, reproductive, toxicity and tumorigenic data.

Section 3. Physical Data*

Boiling Point: Decomposes at 482 °F (250 °C) to $Cr_2O_3 + O_2$
Melting Point: 385 °F (196 °C)
Molecular Weight: 99.98

Specific Gravity: 2.7
Water Solubility: Soluble
Heat of Fusion: 37.7 cal/g

Appearance and Odor: Dark, purplish-red, prismatic, deliquescent (absorbs all moisture from air) crystals, or a granular powder with no detectable odor.

* These physical data apply only to chromic acid (CAS No. 1333-82-0).

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Chromic acid is noncombustible, but accelerates burning of combustibles (wood, paper, oil). For small fires, *use only water,* not dry chemical, carbon dioxide (CO_2), or halon.

Unusual Fire or Explosion Hazards: A powerful oxidizer, chromic acid ignites on contact with acetic acid and alcohol. It may react rapidly enough with organic materials to cause ignition. Containers may explode if involved in fire.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Cool fire-exposed containers with flooding amounts of water since the decomposing material may form a hot, viscous foam that can cause containers to rupture and explode. *Use caution!* For large fires, flood area from a safe distance, and cool containers from the side with a water spray until after fire is well out. If possible without risk, move containers. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holder. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Chromic acid is generally stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: This material is incompatible with acetic acid, acetic anhydride, acetone, alcohols, alkali metals, ammonia, arsenic, anthracene, benzene, bromine penta fluorine, butyric acid, camphor, chromous sulfide, diethyl ether, glycerol, hydrogen sulfide, methyl alcohol, naphthalene, peroxyformic acid, phosphorus, potassium hexacyanoferrate, pyridine, selenium, sodium, and turpentine. Chromic acid ignites ethyl alcohol and many hydrocarbons.

Conditions to Avoid: Avoid excess heat and contact with combustible or organic materials.

Hazardous Products of Decomposition: Thermal oxidative decomposition of chromic acid can produce carbon dioxide, smoke, and irritating toxic fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC and NTP list chromic acid and other forms of hexavalent (VI) chromium as human carcinogens.

Summary of Risks: Chromic acid is a poison and a powerful irritant to skin, eyes, and respiratory tract. Skin or lung sensitization (allergic reactions) may occur. Exposure can cause dermatitis (skin rash), asthma, pulmonary edema (fluid in lungs), kidney damage, a "chrome hole," or a perforation of the nasal septum (tissue between nostrils).

Medical Conditions Aggravated by Long-Term Exposure: Any chronic lung or skin condition.

Target Organs: Skin, respiratory tract (including nose, throat, airways, and lungs), and kidney.

Primary Entry Routes: Eyes, skin contact, inhalation, and ingestion.

Acute Effects: Inhalation may cause irritation or burning of nose, throat, and air passages, cough, wheezing, and shortness of breath. Higher exposures may cause pulmonary edema (fluid in lungs). Skin exposure may cause dermatitis (skin rash), irritation, burning, itching, redness, and ulceration (skin destruction) which may penetrate. Eye contact can cause irritation, burning, lacrimation (watering), loss of sight and permanent blindness if not removed quickly.

Chronic Effects: Chronic inhalation of excessive levels may cause epistaxis (nosebleed), "chrome holes," nasal congestion, tooth enamel erosion, chest pain, asthma (via allergic sensitization), bronchitis, or respiratory tract cancer. Chronic eye exposure may cause conjunctivitis. Skin contact

Continue on next page

Copyright © 1991 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

can cause irritant or allergic contact dermatitis, or skin ulceration. Chronic systemic absorption could cause liver or kidney damage.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Do not let victim rub eyes or keep them tightly shut. Consult a physician immediately.

Skin: Rinse with flooding amounts of water for at least 15 min, and wash with a gentle soap. Promptly remove contaminated clothing. For redness, blistering, or persistent irritation, consult a physician.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water. *Do not induce vomiting* since this worsens the victim's condition. *Do not* neutralize this acid.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: After decontamination and neutralization, treatment of acid burns is similar to that of thermal burns, although bullae and loose necrotic tissue should be debrided. Update tetanus status. *For severe acid burns,* fluid resuscitation is critical to prevent mortality from hypovolemia and renal failure. Monitor serial vital signs, urine output, electrolytes, blood count, and urinalysis as clinically indicated. Neurovascular compromise distal to a circumferential extremity burn may require escharotomy or fasciotomy. *For inhalation exposures to acids,* a CXR, EKG, ABGs, PFTs, SMA, and CBC may aid in treatment. Evaluate and treat as indicated for reactive airways, upper airway obstruction and noncardiogenic pulmonary edema (possibly delayed onset). Although literature documentation is inadequate, a burst of steroids may help prevent development of sequelae such as reactive airways dysfunction syndrome or bronchilitis obliterans. For ocular exposures to aeids, ensure adequate decontamination. Determination of pH may be helpful. A Morgan Lens© and topical anesthesia may aid in irrigation. Perform fluorescein staining and slit lamp evaluation and consult an opthamalogist. Antibiotic ointments, mydriatic/cycloplegics, topical corticosteroids (after epithelial recovery), patching, and possibly anterior chamber paracentesis may be indicated depending on clinical presentation. Acutely and in follow-up, evaluate as indicated for intraocular pressure, lacrimal and lid function, corneal integrity and infection. Urinary chromium is of questionable value.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel. Cleanup personnel should protect against dust inhalation and eye contact. Do not handle broken packages unless wearing appropriate personal protective equipment. Keep combustibles (wood, paper, etc.) away from spilled material. Whenever possible, use wet cleanup methods; if not, use vacuum cleanup. Remove spills immediately to prevent dust dispersion. For a water spill, neutralize with agricultural lime, crushed limestone, or sodium bicarbonate. For a land spill, dig a pit, pond, or lagoon to contain material. If time permits, seal these with an impermeable, flexible membrane liner. Dike surface flow with soil, sand or foamed concrete. Follow applicable OSHA regulations (29 CFR 1910.120).

Environmental Transport: If allowed contact with soil, chromic acid, solid, lowers pH and may leach into water sources, causing an effect similar to acid rain's on water sources. This material's carcinogenieity makes it hazardous to the environment in its hexavalent state.

Environmental Degradation: The recommended disposal means are reduction, precipitation, or ion exchange. Landfill disposal is not recommended since it raises soil acidity.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.22): Corrosive waste
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 10 lb (4.54 kg) [*per Clean Water Act, Sec. 311(b)(4)]†
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

† Chromic acid (CAS No. 7738-94-5) is listed.

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For 0.5 mg/m^3 concentrations (if not fumes), use any dust and mist respirator except single-use and quarter-mask respirators. For 1.25 mg/m^3 concentrations, use any powered air-purifying respirator with a high-efficiency particulate filter. For 2.5 mg/m^3 concentrations, use any air-purifying full facepiece respirator with a high-efficiency particulate filter. For 30 mg/m^3 concentrations, use any supplied air respirator with a full facepiece and operated in a pressure-demand or other positive-pressure mode. All concentrations may require eye protection. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below occupational exposure levels. Local exhaust ventilation is preferred since it prevents contaminant dispersion into work area by controlling it at its source.[103]

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Contact lenses may minimize or worsen eye injuries. In some cases, soft lenses can actually protect eyes, not worsen corneal damage, due to strong chemicals. In other cases, chemical entrapment is presumed a possible hazard. Since contact lens use in industry is controversial, establish your own poliey. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in glass bottles, cans, or drums. Protect against physical damage. Separate from combustible, organic, or other easily oxidizable materials. Protect from excess moisture which could cause containers to rust. Do not store on wooden floors. Store away from foodstuffs and flammable liquids and solids.

Engineering Controls: Avoid dust inhalation and skin or eye contact. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good housekeeping procedures.

Other Precautions: Institute preplacement and periodic medical exams of exposed workers with attention to the skin and respiratory tract. Consider preplacement and periodic chest radiographs.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Chromic acid, solid
DOT Hazard Class: Oxidizer
ID No.: NA1463
DOT Label: Oxidizer
DOT Packaging Exceptions: 173.153
DOT Packaging Requirements: 173.164

IMO Shipping Name: Chromium trioxide, anhydrous
IMO Hazard Class: 5.1
ID No.: UN1463
IMO Label: Oxidizer, Corrosive
IMDG Packaging Group: II

MSDS Collection **References:** 26, 38, 73, 85, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 139, 140, 143, 142, 145, 148, 159

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Copyright © 1991 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 686
Hydrogen Cyanide

Issued: 8/89

Section 1. Material Identification

29

Hydrogen Cyanide Description: Large-scale preparation by the catalytic oxidation of ammonia-methane mixtures. Used in the fumigation of ships, railroad cars, orchards, buildings, tabacco, and various foods. Can be produced in petroleum refining, electroplating, metallurgy, and photographic development.
Other Designations: Hydrocyanic acid; prussic aeid; anhydrous hydrogen cyanide; HCN; CAS No. 0074-90-8.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide* (Genium ref. 73) for a suppliers list.

R 1
I 4
S -
K 4



NFPA

HMIS
H 4
F 4
R 2
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Hydrogen cyanide, ca 100%

OSHA PEL (Skin*)
Ceiling: 10 ppm, 10 mg/m³

ACGIH TLV (Skin*), 1988-89
TLV Ceiling: 10 ppm, 10 mg/m³

NIOSH REL, 1976
10-min ceiling: 4.7 ppm CN, 5 mg CN/m³

Toxicity Data†
Human, oral, LD_{Lo}: 570 µg/kg
Human, inhalation, LC_{Lo}: 200 mg/m³/10 min
Rat, inhalation, LC_{50}: 484 ppm/5 min

* This material can be absorbed through intact skin, which contributes to overall exposure.
† See NIOSH, *RTECS* (MW6825000), for additional data with references.

Section 3. Physical Data

Boiling Point: 79 °F (29 °C)
Melting Point: 7.88 °F (-13.4 °C)
Vapor Pressure: 620 torr at 68 °F (20 °C)
Vapor Density (Air = 1): 0.941

Molecular Weight: 27 g/mol
Specific Gravity (H_2O = 1): 0.7
Water Solubility: Miscible
% Volatile by Volume: 100

Appearance and Odor: A colorless gas or blue-white liquid; a characteristic faint odor resembling bitter almonds for those individuals able to perceive its presence by smell.

Section 4. Fire and Explosion Data

Flash Point: 0 °F (-17.78 °C) CC	**Autoignition Temperature:** 1000 °F (538 °C)	**LEL:** 5.6% v/v	**UEL:** 40% v/v

Extinguishing Media: Hydrogen cyanide is an extremely toxic, flammable material. In advanced or massive fires, firefighting should be done from a safe, proteeted location. Use carbon dioxide (CO_2), dry chemical, or foams to put out hydrogen cyanide fires. Use water sprays to cool fire-exposed contaimers, protect the personnel attempting to seal the souree of the leaking gas, flush spills away from sensitive exposures (heat, sources of ignition, or incompatible ehemicals), disperse the vapors, and dilute spills to nonflammable mixtures.
Unusual Fire or Explosion Hazards: This gas is extremely poisonous and flammable. Consider evacuation of the incident area in large fires.
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-dcmand or positive-pressure mode. Fire fighters must wear a complete set of personal protective equipment to prevent virtually any contact with this dcadly poison. They must not have exposed skin surfaees since their skin can absorb fatal amounts of hydrogen cyanide.

Section 5. Reactivity Data

Stability/Polymerization: Hydrogen cyanide is stable at room temperature in during routine operations.. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Hydrogen cyanide can react dangerously with acetaldehyde.
Conditions to Avoid: *Specially trained personnel must handle hydrogen cyanide. Never permit inexperienced workers to handle it.* Never expose this material to any heat or ignition sources such as lighted cigarettes or pipes, open flames, or uninsulated heating elements.
Hazardous Products of Decomposition: Thermal oxidative degradation of hydrogcn cyanide can produce carbon dioxide, toxic oxides of nitrogen (N_xO_y) and carbon monoxide (CO). Hydrogen cyanide is a very toxic material even when not decomposed during fires.

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists hydrogen cyanide as a carcinogen.
Summary of Risks: Inhalation of high concentrations of hydrogen cyanide causes tachypnea (rapid breathing) resulting in increased cyanide intake; then dyspnea, paralysis, convulsions, and respiratory arrest. Death may occur withim minutes. Lesser concentrations can cause hcadache, vertigo, nausea, and vomiting. Concentrations of 270 ppm are immediately fatal; 181 ppm in 10 min are fatal; 135 ppm in 30 min are fatal; 110 to 135 ppm in 1 hr are potentially fatal; 45 to 54 ppm are tolerable for 30 to 60 min without immediate or late effects; and 18 to 36 ppm cause slight symptoms after several hours of exposure. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** All body cells. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** Burning sensation in mouth and throat. Initially rapid pulse and high blood pressure followed by decreasing blood pressure and pulse. Cherry-red mucous membranes may be noted. Headache, weakness, mental

Continue on next page

Copyright © 1989 Genium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data (continued)

confusion, nausea, vomiting, shock, convulsions, coma, and possible death. **Chronic Effects:** Enlargement of the thyroid gland, fatique, weakness, headache, changes in taste and smell, irritation of throat, effort dyspnea, nervous instability, lachrymation, abdominal colic, and precordial pain were reported in workers exposed at concentrations between 4 and 12 ppm for approximately 7 years.

FIRST AID

Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min. **Skin:** Immediately remove all contaminated clothing. After rinsing affected area with flooding amounts of water, wash it with soap and water. Avoid contact with this chemical. **Inhalation:** Remove the exposcd person to fresh air and support breathing as needed. Have qualified medical personnel administer oxygen as required. **Ingestion:** Nevcr induce vomiting or perform mouth-to-mouth respiration! Provide 100% oxygen as soon as possible. Institute gastric lavage after endotracheal intubation. **After first aid, get appropriate in-plant, paramedic, or community medical attention and support.** Seek prompt medical assistance for further observation and treatment.

Physician's Note: *Treat all exposures as life-threatening emergencies.* An antidote to hydrogen cyanide is sodium nitrite and sodium thiosulfate. Commereially available cyanide poisoning first-aid kits should be purchased. Competent medical personnel should earefully train appropriately selected workers on how to use these kits in emergencies. Several detailed medical treatments are available for eyanide poisoning. After reviewing the specific uses of hydrogen cyanide in their operation, the safety personnel and/or the industrial hygienists should develop a precise emergency first-aid treatment protocol before an incident occurs. Heart monitorings should be instituted.

Section 7. Spill, Leak, and Disposal Procedures

Spill Leak: *Design and practice a hydrogen cyanide spill control and countermeasure plan (SCCP). Immediately evacuate the incident area and alert the appropriate local officials to the specifics of the hydrogen cyanide release.* When a spill occurs, notify safety personnel, eliminate heat or ignition sources, provide optimum explosion-proof ventilation, and implement the SCCP. Cleanup personnel must wear a complete ensemblc of personal protective equipment (Sec. 8), including self-contained breathing apparatus and total body-covering clothes, to prevent skin contact or inhalation. Use nonsparking tools and equipment. Use water sprays to protect personnel attempting to locate and seal the source of the escaping hydrogen cyanide gas. **Waste Management/ Disposal:** Contact your supplier or a licensed contrator for detailed recommendations. Follow applicable Federal, state, and local regulations.

OSHA Designations

Listed as Air Contaminant (29 CFR 1910.1000, Subpart Z)

EPA Designations

Listed as RCRA Hazardous Waste No. P063 (40 CFR 261.33)

Listed aa a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 10 lb (4.54 kg) [* per CWA, Sec. 311(b)(4) and RCRA, See. 3001]

SARA Extremcly Hazardous Substanee (40 CFR 355), Threshold Planning Quantity (TPQ): 100 lb

SARA Toxic Chemical* (40 CFR 372.65) [* EPA Form R may apply to your facility; see 40 CFR 372.85 for instructions]

Section 8. Special Protection Data

Goggles: Always wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Wear a NIOSH-approved respirator if necessary. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (leaks or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. **Ventilation:** Provide general and local explosion-proof ventilation systems to maintain airborne coneentrations below the OSHA PEL standard (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by eliminating it at its source (Genium rcf. 103). **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Launder contaminated clothing before wearing. Remove this material from your shoes and equipment. **Other:** Use hydrogen cyanide in closed-confinemcnt, pressurized engineering systems. Automatic shutoff valves/sensors to the main feed lincs are recommended in the event of a catastrophic pressure drop from the rupture of a pressurized HCN pipeline. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store hydrogen cyanide in tightly closed, airtight, moisture-proof containers in a cool, dry, well-ventilated, fireproof area away from heat or ignition sources and incompatible chemicals (Sec. 5.) Protect these containers from physical damage; shield them from direct sunlight. Limit access to the storage area to authorized personnel only. **Special Handling/Storage:** Proper stock rotation of hydrogen cyanide is vital for safety. Individual HCN cylinders should not be sored longer than 90 days. Check with your supplier for detailed recommendations concerning proper shelf rotation of stock, and proper dispensing equipment such as valves, flanges, and manifolds. **Engineering Controls:** To prevent static sparks, electrically ground and bond all containers, cylinders, and pipelines used in shipping, receiving, or transferring operations in production and storage areas. **Other Precautions:** Consider installing automatic sensing equipment which alerts workers to airborne concentrations of hydrogen cyanide greater than the 10 ppm ceiling (Sec. 2).

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Hydrocyanic acid solution
DOT Hazard Class: Poison A *or* Poison B
DOT ID No. : UN1613 *or* NA1051
DOT Label: Poison gas and flammable gas

IMO Shipping Name: Hydrogen cyanide
IMO Hazard Class: 6.1
IMO Label: Poison and flammable liquid
IMDG Packaging Group: I

Proper shipping names, hazard classes, labels, and identification numbers vary with the hydrogen cyanide's concentration or strength.

MSDS Collection **References:** 1, 6, 7, 84-94, 100, 116, 117, 119, 120, 122

Prepared by: PJ Igoe, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD

F10

Copyright © 1989 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 52
Hydrogen Sulfide

Issued: 7/79 Revision: B, 9/92

Section 1. Material Identification

Hydrogen Sulfide (H_2S) Description: Formed as a byproduct of many industrial processes (breweries, tanneries, slaughter houses), around oil wells, where petroleum products are used, in decaying organic matter, and naturally occurring in coal, natural gas, oil, volcanic gases, and sulfur springs. Derived commercially by reacting iron sulfide with dilute sulfuric or hydrochloric acid, or by reacting hydrogen with vaporized sulfur. Used in the production of various inorganic sulfides and sulfuric acid, in agriculture as a disinfectant, in the manufacture of heavy water, in precipitating sulfides of metals; as a source of hydrogen and sulfur, and as an analytical reagent.

R 2
I 4
S 3
K 3

NFPA



HMIS
H 3
F 4
R 0
PPE*
* Sec. 8

Other Designations: CAS No. 7783-06-4, dihydrogen monosulfide, hydrosulfuric acid, sewer gas, stink damp, sulfuretted hydrogen, sulfur hydride.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Hydrogen sulfide is a highly flammable gas and reacts vigorously with oxidizing materials. It is highly toxic and can be instantly fatal if inhaled at concentrations of 1000 ppm or greater. Be aware that the sense of smell becomes rapidly fatigued at 50 to 150 ppm, and that its strong rotten-egg odor is not noticeable even at very high concentrations.

Section 2. Ingredients and Occupational Exposure Limits

Hydrogen sulfide: 98.5% *technical*, 99.5% *purified*, and CP *(chemically pure grade)*

1991 OSHA PELs
8-hr TWA: 10 ppm (14 mg/m³)
15-min STEL: 15 ppm (21 mg/m³)

1990 IDLH Level
300 ppm

1990 NIOSH REL
10-min Ceiling: 10 ppm (15 mg/m³)

1992-93 ACGIH TLVs
TWA: 10 ppm (14 mg/m³)
STEL: 15 ppm (21 mg/m³)

1990 DFG (Germany) MAK
TWA: 10 ppm (15 mg/m³)
Category V: Substances having intense odor
Peak exposure limit 20 ppm, 10 min momentary value, 4/shift

1985-86 Toxicity Data*
Human, inhalation, LC_{Lo}: 600 ppm/30 min; toxic effects not yet reviewed
Man, inhalation, LD_{Lo}: 5700 µg/kg caused coma and pulmonary edema or congestion.
Rat, intravenous, LD_{50}: 270 µg/kg; no toxic effect noted

* See NIOSH, *RTECS* (MX1225000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: -76 °F (-60 °C)
Freezing Point: -122 °F (-86 °C)
Vapor Pressure: 18.5 atm at 68 °F (20 °C)
Vapor Density (Air = 1): 1.175
pH: 4.5 (freshly prepared saturated aqueous solution)
Viscosity: 0.01166 cP at 32 °F/0 °C and 1 atm
Liquid Surface Tension (est): 30 dyne/cm at -77.8 °F/-61 °C

Molecular Weight: 34.1
Density: 1.54 g/L at 32 °F (0 °C)
Water Solubility: Soluble*; 1g/187 mL (50 °F/10 °C), 1g/242 mL (68 °F/20 °C), 1g/ 314 mL (86 °F/30 °C)
Other Solubilities: Soluble in ethyl alcohol, gasoline, kerosine, crude oil, and ethylene glycol.
Odor threshold: 0.06 to 1.0 ppm†

Appearance and Odor: Colorless gas with a rotten-egg smell.

* H_2S solutions are not stable. Absorbed oxygen causes turbidity and precipitation of sulfur. In a 50:50 mixture of water and glycerol, H_2S is stable.
† Sense of smell becomes rapidly fatigued and can not be relied upon to warn of continuous H_2S presence.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: 500 °F (260 °C)	LEL: 4.3% v/v	UEL: 46% v/v

Extinguishing Media: Let small fires burn unless leak can be stopped immediately. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** H_2S burns with a blue flame giving off sulfur dioxide. Its burning rate is 2.3 mm/min. Gas may travel to a source of ignition and flash back. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing is not effective for fires involving H_2S. If possible without risk, stop leak. Use unmanned device to cool containers until well after fire is out. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: H_2S is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Hydrogen sulfide attacks metals forming sulfides and is incompatible with 1,1-bis(2-azidoethoxy) ethane + ethanol, 4-bromobenzenediazonium chloride, powdered copper + oxygen, metal oxides, finely divided tungsten or copper, nitrogen trichloride, silver fulminate, rust, soda-lime, and all other oxidants. **Conditions to Avoid:** Exposure to heat and contact with incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of hydrogen sulfide can produce toxic sulfur dioxide .

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list hydrogen sulfide as a carcinogen. **Summary of Risks:** H_2S combines with the alkali present in moist surface tissues to form caustic sodium sulfide, causing irritation of the eyes, nose, and throat at low levels (50 to 100 ppm). Immediate death due to respiratory paralysis occurs at levels greater than 1000 ppm. Heavy exposure has resulted in neurological problems, however recovery is usually complete. H_2S exerts most of it's toxicity on the respiratory system. It inhibits the respiratory enzyme cytochrome oxidase, by binding iron and blocking the necessary oxydo-reduction process. Electrocardiograph changes after over-exposure have suggested direct damage to the cardiac muscle, however some authorities debate this. **Medical Conditions Aggravated by Long-Term Exposure:** Eye and nervous system disorders. **Target Organs:** Eyes, respiratory system and central nervous system. **Primary Entry Routes:** Inhalation, eye and skin contact. **Acute Effects:** Inhalation of low levels can cause headache, dizziness, nausea, cramps, vomiting, diarrhea, sneezing, staggering, excitability, pale

Continued on next page

Copyright © 1992 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

complexion, dry cough, muscular weakness, and drowsiness. Prolonged exposure to 50 ppm, can cause rhinitis, bronchitis, pharyngitis, and pneumonia. High level exposure leads to pulmonary edema (after prolonged exposure to 250 ppm), asphyxia, tremors, weakness and numbing of extremeties, convulsions, unconsciousness, and death due to respiratory paralysis. Concentrations near 100 ppm may be odorless due to olfactory fatigue, thus the victim may have no warning. Lactic acidosis may be noted in survivors. The gas does not affect the skin although the liquid (compressed gas) can cause frostbite. The eyes are very susceptible to H_2S keratoconjunctivitis known as 'gas eye' by sewer and sugar workers. This injury is characterized by palpebral edema, bulbar conjunctivitis, mucous-puss secretions, and possible reduction in visible capacity. **Chronic Effects:** Chronic effects are not well established. Some authorities have reported repeated exposure to cause fatigue, headache, inflammation of the conjunctiva and eyelids, digestive disturbances, weight loss, dizziness, a grayish-green gum line, and irritability. Others say these symptoms result from recurring acute exposures. There is a report of encephalopathy in a 20 month old child after low-level chronic exposure. **FIRST AID Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water. Treat with boric acid or isotonic physiologieal solutions. Serious exposures may require adrenaline drops. Olive oil drops (3 to 4) provides immediate treatment until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing and rinse with flooding amounts of water. For frostbite, rewarm in 107.6°F (42 °C) water until skin temperature is normal. *Do not* use dry heat. **Inhalation:** Remove exposed person to fresh air and administer 100% oxygen. Give hyperbaric oxygen if possible. **Ingestion:** Unlikely since H_2S is a gas above -60 °C. **Note to Physicians:** The efficacy of nitrite therapy is unproven. Normal blood contains < 0.05 mg/L H_2S; reliable tests need to be taken within 2 hr of exposure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. Use water spray to cool, dilute, and disperse vapors. Neutralize runoff with crushed limestone, agricultural (slaked) lime, or sodium bicarbonate. If leak can't be stopped in place, remove cylinder to safe, outside area and repair or let empty. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Bluegill sunfish, TLm = 0.0448 mg/L/96 hr at 71.6 °F/22 °C; fathead minnow, TLm = 0.0071 to 0.55 mg/L/96 hr at 6 to 24 °C. **Environmental Degradation:** In air, hydrogen sulfides residency (1 to 40 days) is affected by temperature, humidity, sunshine, and the presence of other pollutants. It does not undergo photolysis but is oxidated by oxygen containing radicals to sulfur dioxide and sulfates. In water, H_2S converts to clemental sulfur. In soil, due to its low boiling point, much of H_2S evaporates quickly if spilled. Although, if soil is moist or precipitation occurs at time of spill, H_2S becomes slightly mobile due to its water solubility. H_2S does not bioaccumulate but is degraded rapidly by certain soil and water bacteria. **Disposal:** Aerate or oxygenate with compressor. For in situ amelioration, carbon removes some H_2S. Anion exchanges may also be effective. A potential candidate for rotary kiln incineration (1508 to 2912 °F/820 to 1600 °C) or fluidized bed incineration (842 to 1796 °F/450 to 980 °C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U135
SARA Toxic Chemical (40 CFR 372.65): Not listed
Listed as a SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 500 lb
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001 & CWA, Sec. 311 (b)(4)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A & Z-2)
Listed as a Process Safety Hazardous Material (29 CFR 1910.119), TQ: 1500 lb

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 100 ppm, use a supplied-air respirator (SAR) or SCBA. For < 250 ppm, use a SAR operated in continuous-flow mode. For < 300 ppm, use a SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: a written program, medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polycarbonate, butyl rubber, polyvinyl chloride, and neoprene are suitable materials for PPE. **Ventilation:** Provide general & local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in steel cylinders in a cool, dry, well-ventilated area away from incompatibles (Sec. 5). Install electrical equipment of Class 1, Group C. Outside or detached storage is preferred. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to keep levels as low as possible. Enclose processes and continuously monitor H_2S levels in the plant air. Keep pipes clear of rust as H_2S can ignite if passed through rusty pipes. Purge and determine H_2S concentration before entering a confined area that may contain H_2S. The worker entering the confined space should have a safety belt and life line and be observed by a worker from the outside. Follow applicable OSHA regulations (1910.146) for confined spaces. H_2S can be trapped in sludge in sewers or process vessels and may be released during agitation. Calcium chloride or ferrous sulfate should be added to neutralize process wash water each time H_2S formation occurs. Control H_2S emissions with a wet flare stack/scrubbing tower. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers emphasizing the eyes, nervous and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Hydrogen sulfide, liquefied
DOT Hazard Class: 2.3
ID No.: UN1053
DOT Packaging Group: --
DOT Label: Poison Gas, Flammable Gas
Special Provisions (172.102): 2, B9, B14

Packaging Authorizations
Exceptions: --
Non-bulk Packaging: 304
Bulk Packaging: 314, 315

Vessel Stowage Requirements
Vessel Stowage: D
Other: 40

Quantity Limitations
Passenger, Aircraft, or Railcar: Forbidden
Cargo Aircraft Only: Forbidden

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 136, 140, 148, 149, 153, 159, 163, 164, 168, 171, 180
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MPH, MD

Copyright © 1992 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 713
Lead (Inorganic)

Issued: 8/90

Section 1. Material Identification 32

Lead (Inorganic) (Pb) Description: Exists widely throughout the world in a number of ores. Its main commercial souree is galena (lead sulphide). Lead mineral is separated from crude ores by blast-furnace smelting, drossing, or electrolytic refming. Lead is used mostly in manufaeturing storage batteries. Other uses are in manufacturing tetraethyllead and both organic and inorganic lead compounds in ceramics, plastics, and electronic devices; in producing ammunition, solder, cable covering, sheet lead, and other metal products (brass, pipes, caulking); in metallurgy; in weights and as ballast; as a chemical intermediate for lead alkyls and pigments; as a constuction material for the tank linings, piping, and equipment used to handle the corrosive gases and liquids used in sulfuric acid manufacturing, petroleum refining, halogenation, sulfonation, extraction, and condensation; and for x-ray and atomic radiation protection.
Other Designations: CAS No. 7439-92-1, lead oxide; lead salts, inorganic; metallic lead; plumbum.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R	0
I	4
S	-
K	0

Genium



HMIS
H 3
F 1
R 0
PPG*

Cautions: *Inorganic lead is a potent systemic poison.* Organic lead (for example, tetraethyl lead) has severe, but different, health effects. Occupational lead poisoning is due to inhalation of dust and fumes. Major affeeted organ systems are the nervous, blood, and reproductive systems, and kidneys. Health impairment or disease may result from a severe acute short- or long-term exposure. * Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Lead (inorganic) fumes and dusts, as Pb, ca 100%

1989 OSHA PELs (Lead, inorganic compounds)
8-hr TWA: 50 μg/m³
Action Level TWA*: 30 μg/m³

29 CFR 1910.1025 Lead Standard
Blood Lead Level: 40 μg/100 g

1989-90 ACGIH TLV (Lead, inorganic, fumes and dusts)
TLV-TWA: 150 μg/m³

1988 NIOSH REL
10-hr TWA: <100 μg/m³

1985-86 Toxicity Data†
Human, inhalation, TC_{Lo}: 10 μg/m³ affects gastrointestinal tract and liver
Human, oral, TD_{Lo}: 450 mg/kg ingested over 6 yr affects peripheral and central nervous systems
Rat, oral, TD_{Lo}: 790 mg/kg affects multigeneration reproduction

* Action level applies to employee exposure without regard to respirator use.
† See NIOSH, *RTECS* (OF7525000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 3164 °F (1740 °C)
Melting Point: 621.3 °F (327.4 °C)
Vapor Pressure: 1.77 mm Hg at 1832 °F (1000 °C)
Viscosity: 3.2 cp at 621.3 °F (327.4 °C)
Molecular Weight: 207.20
Specifie Gravity (20 °C/4 °C): 11.34
Water Solubility: Relatively insoluble in hot or cold water*

Appearance and Odor: Bluish-white, silvery, gray, very soft metal.

* Lead dissolves more easily at a low pH.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam to extinguish fire.
Unusual Fire or Explosion Hazards: Flammable and moderately explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Lead is stable at room temperature in closed containers under normal storage and handling conditions. It tarnishes on exposure to air. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Lead is ineompatible with sodium azide, zirconium, disodium acetylide, and oxidants. A violent reaction on ignition may occur with concentrated hydrogen peroxide, chlorine trifluoride, sodium acetylide (with powdered lead), ammonium nitrate (below 200 °C with powdered lead). Lead is attacked by pure water and weak organic acids in the presence of oxygen. Lead is resistant to tap water, hydrofluoric acid, brine, and solvents.
Conditions to Avoid: Rubber gloves containing lead may ignite in nitric acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of lead can produce highly toxic fumes of lead.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP and OSHA do not list lead as a carcinogen, the IARC lists it as probably carcinogenic to humans, but having (usually) no human evidence. However, the literature reports instances of lead-induced neoplasms, both benign and malignant, of the kidney and other organs in laboratory rodents. Excessive exposure to lead has resulted in neurologic disorders in infants. Experimental studies show lead has reproductive and teratogenic effects in laboratory animals. Human male and female reproductive effects are also documented.
Summary of Risks: Lead is a potent, systemic poison that affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal (GI) system . The most important way lead enters the body is through inhalation, but it can also be ingested when lead dust or unwashed hands contaminate food, drink, or cigarettes. Much of ingested lead passes through feces without absorption into the body. Adults may absorb only 5 to 15% of ingested lead; children may absorb a much larger fraction. Once in the body, lead enters the bloodstream and circulates to various organs. Lead concentrates and remains in bone for many years. The amount of lead the body stores increases as exposure continues, with possibly cumulative effects. Depending on the dose entering the body, lead ean be deadly within several days or affect health after many years. Very high doses can cause brain damage (encephalopathy).
Medical Conditions Aggravated by Exposure: Lead may aggravate nervous system disorders (e.g., epilepsy, neuropathies), kidney diseases, high blood pressure (hypertension), infertility, and anemia. Lead-induced anemia and its effect on blood presssure can aggravate cardiovascular disease.

Continue on next page

Copyright © 1990 Oenium Publishing Corporation.
Any commercial use or reproduction without the publisher's permission is prohibited.

Section 6. Health Hazard Data, *continued*

Target Organs: Blood, central and peripheral nervous systems, kidneys, and gastrointestinal (GI) tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: An acute, short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposures of this magnitude are rare. Reversible kidney damage can occur from acute exposure, as well as anemia.
Chronic Effects: Symptoms of chronic long-term overexposure include appetite loss, nausea, metallic taste in the mouth, lead line on gingival (gum) tissue, constipation, anxiety, anemia, pallor of the face and the eye grounds, excessive tiredness, weakness, insomnia, headache, nervous irritability, fine tremors, numbness, muscle and joint pain, and colic accompanied by severe abdominal pain. Paralysis of wrist and, less often, ankle extensor muscles may occur after years of increased lead absorption. Kidney disease may also result from chronic overexposure, but few, if any, symptoms appear until severe kidney damage has occurred. Reproductive damage is characterized by decreased sex drive, impotence, and sterility in men; and decreased fertility, abnormal menstrual cycles, and miscarriages in women. Unborn children may suffer neurologic damage or developmental problems due to excessive lead exposure in pregnant women. Lead poisoning's severest result is encephalopathy manifested by severe headache, convulsions, coma, delirium, and possibly death.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Consult a physician if any health complaints develop.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If large amounts of lead were ingested, induce vomiting with Ipecac syrup. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: For diagnosis, obtain blood pressure, blood lead level (PbB), zinc protoporphyrin (ZPP), complete blood count for microcytic anemia and basophilic stippling, urinalysis, and blood urea nitrogen (BUN) of creatinine. Examine peripheral motor neuropathy, pallor, and gingival lead line. Use Ca-EDTA to treat poison, but *never* chelate prophylactically. Consult an occupational physician or toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel immediately. Cleanup personnel should protect against inhalation of dusts or fume and contact with skin or eyes. Avoid creating dusty conditions. Water sprays may be used in large quantities to prevent the formation of dust. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Scoop the spilled material into closed containers for disposal or reclamation. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applieable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33, Appendix II—EP Toxicity Test Proeedures)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Protective clothing made of man-made fibers and lacking turn-ups, pleats, or pockets retain less dust from lead.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially washing hands before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all incompatible materials, direct sunlight, and heat and ignition sources.
Engineering Controls: Educate worker about lead's hazards. Follow and inform employees of the lead standard (29 CFR 1910.1025). Avoid inhalation of lead dust and fumes and ingestion of lead. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Segregate and launder contaminated clothing. Take precautions to protect laundry personnel. Practice good personal hygiene and housekeeping procedures. For a variety of reasons, the lead concentration in workroom air may not correlate with the blood lead levels in individuals.
Other Precautions: Provide preplacement and periodic medical examinations whieh emphasize blood, nervous system, gastrointestinal tract, and kidneys, including a complete blood count and urinalysis. Receive a complete history including previous surgeries and hospitalization, allergies, smoking history, alcohol consumption, proprietary drug intake, and occupational and nonoccupational lead exposure. Maintain records for medical surveillance, airborne exposure monitoring, employee complaints, and physician's written opinions for at least 40 years or duration of employment plus 20 years. Measurement of blood lead level (PbB) and zinc protoporphyrin (ZPP) are useful indicators of your body's lead absorption level. Maintain worker PbBs at or below 40 µg/100 g of whole blood. To minimize adverse reproductive health effects to parents and developing fetus, maintain the PbBs of workers intending to have children below 30 µg/100 g. Elevated PbBs increase your risk of disease, and the longer you have elevated PbBs, the greater your chance of substantial permanent damage.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Lead compounds, soluble, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN2291
IMO Label: St. Andrews Cross (X, Stow away from foodstuffs)
IMDG Packaging Group: III

***MSDS Collection* References:** 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Copyright © 1990 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Selenium **MSDS No. 136**

Date of Preparation: 4/88 Revision: A, 3/98

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Selenium
Chemical Formula: Se
CAS Number: 7782-49-2
Synonyms: C.I. 77805; colloidal selenium; elemental selenium; EPA pesticide chemical code 072001; gray selenium; selen (Polish); selenate; selenium alloy; selenium base; selenium (colloidal); selenium dust; selenium elemental; selenium homopolymer; selenium powder; Vandex
Derivation: Recovered by roasting anode muds from electrolytic eopper refineries with soda or sulfuric acid, or by smelting them with soda and niter.
General Use: Used as a pigment and decolorizing agent in the glass industry; in toning baths in photography; in making electrodes for arc lights, electrical instruments and apparatus; rectifier in radio and television sets; in semiconductor fusion mixtures, selenium cells, telephotographic apparatus; rubber vulcanizing agent; catalyst in determination of Kjeldahl nitrogen; for dehydrogenation of organic compounds; in steel and copper (degasifier and machineability improver); as a dietary supplement; in the manufacture of pigments, textiles, petroleum, and medical therapeutic agents.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Selenium, > 99% wt (commercial grade)
Trace Impurities (commercial grade): > 0.2% tellurium, 0.1% iron, 0.005% lead and 0.005% copper.

OSHA PEL
8-hr TWA: 0.2 mg/m^3

ACGIH TLV
TWA: 0.2 mg/m^3
Excursion Limit: Provided the TLV-TWA is not exceeded, exposure may exceed 0.6 mg/m^3 for no more than 30 min/day; never exceed 1.0 mg/m^3.

NIOSH REL
10-hr TWA: 0.2 mg/m^3

IDLH Level
1 mg/m^3

DFG (Germany) MAK
TWA*: 0.1 mg/m^3
Category III: Substances with systemic effects (Onset of effect > 2 hr); Half-life > shift length (strongly cumulative)

Peak Exposure Limit:
1.0 mg/m^3, 30 min, average value, 1/shift

*Measured as the inhalable fraction of the aerosol.

Section 3 - Hazards Identification

ANSI Signal Word: Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Selenium exists as an amorphous red or black solid, or red, gray or black crystals; upon heating, it emits an odor of garlic or rotten horseraddish. Selenium fumes or dust are irritating to the eyes, skin, and mucous membranes. Inhalation of fumes may also result in respiratory system impairment, and central nervous system (CNS) and psychological effects. This combustible solid may burn, but does not ignite readily. Heating selenium can produce fumes of toxic selenium oxides (*e.g.*, selenium dioxide (SeO_2)).

Wilson Risk Scale	
R	1
I	3
S	1
K	1

HMIS	
H	1*
F	1
R	1
PPE†	

*Chronic effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin and/or eye contaet/absorption
Target Organs: Eyes, skin, CNS, cardiovascular system (CVS), respiratory system, blood, liver, kidneys, spleen
Acute Effects
Inhalation: Inhalation of selenium dust or fumes (fumes contain selenium dioxide - see Skin, below) may cause mucous membrane irritation, coughing, sneezing, breathing difficulty, shortness of breath, "metal fume fever" (chills, fever, headaches), hypotension (low blood pressure), psychological effects (depression, irritability, etc.), liver and kidney damage, and in extreme cases, pulmonary edema (aecumulation of fluid in the lungs), CNS depression, and coma. Note that toxicity of selenium (elemental) is considerably less than that of selenium compounds. Toxic effects of selenium fume inhalation may largely be due to selenium dioxide content of fumes.
Eye: Exposure to dust or fumes may result in irritation, swelling and redness of the eyelids.
Skin: Exposure to selenium fumes causes irritation, contact dermatitis and burns (fumes contain selenium dioxide which forms selenious acid (irritant) upon contact with moist skin or mucous membranes. Both selenium dioxide and selenious acid can also be absorbed through the skin, and produce systemic toxicity).

Copyright © 1998 by Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited. Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Ingestion: Acute systemic effects (see Inhalation) may result, although intestinal absorption of elemental selenium is minimal. Toxic effects ahve been reported following excessive consumption of dietary supplements.

Carcinogenicity: IARC lists selenium as Group 3 (Not classifiable as to carcinogenicity to humans); NTP, Class 2B (Reasonably antieipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals); EPA, Class D (Not classifiable as to human carcinogenicity). OSHA does not list selenium as a carcinogen.

Medical Conditions Aggravated by Long-Term Exposure: Asthma, allergies, known sensitization to selenium, chronic respiratory disease, gastrointestinal disturbanees, liver or kidney disorders, dermatitis.

Chronic Effects: Bronchial irritation (through inhalation), inflammation of eye lining and lids, gastrointestinal distress, persistent garlic odor on breath, increased dental carries, mottled teeth, metallic taste, pallor, skin lesions, lowered blood clotting efficiency and hemoglobin levels, irritability, excessive fatigue, anorexia, pain or anesthesia in extremities, and, in extreme cases of "selenosis," skin discoloration (reddish), fingernail and hair discoloration or loss can result. Some individuals may be more sensitive than others to selenium toxicity. Reported daily ingestion of 27 to 2310 mg resulted in nausea, vomiting, nail changes, fatigue, and irritability. Lower selenium intake (700-800 μg/day) has not been found to produce toxic effects. Animal testing suggests spleen, liver and kidney damage, and reproductive effects.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain and/or irritation develop.

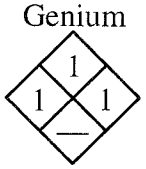
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Consider also administration of charcoal slurry cathartic.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat overexposure symptomatically and supportively. Monitor whole blood selenium levels.

Section 5 - Fire-Fighting Measures



Flash Point: Not applicable; combustible solid.

Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Flammability Classification: Combustible solid

Extinguishing Media: Use extinguishing agents suitable for surrounding fire.

Unusual Fire or Explosion Hazards: Containers may explode in heat of fire.

Hazardous Combustion Products: Heating selenium can produce toxic selenium oxides (*e.g.*, selenium dioxide (SeO_2)).

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Isolate spill area for at least 80-160 feet (25-50 m). *Do not* touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. *Do not* get water inside containers.

Small Spills: Vaeuum or carefully scoop up material and deposit in sealed containers.

Large Spills

Containment: Dike far ahead of spill for later disposal. *Do not* release into sewers or waterways.

Cleanup: Spills of selenium in waterways may be remediated by dredging.

Regulatory Requirements: None reported.

Section 7 - Handling and Storage

Handling Precautions: Avoid dust or fume inhalation, and skin and eye contact. Use only with ventilation sufficient to reduce airborne concentrations to non-hazardous levels (see Sec. 2). Wear protective gloves and clothing (see Sec. 8). Keep away from heat and ignition sources.

Storage Requirements: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Periodically inspect stored materials.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose operations and/or provide local exhaust ventilation at the site of chemieal release.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Where possible, use a contained transfer method for transferring selenium from drums or other storage containers to process containers. Arrange pre-employment and annual medical examinations emphasizing urinary selenium (should be < 0.1 mg/L), eyes, skin (chronic disorders), respiratory system, liver, kidneys, blood, and medical conditions aggravated by long-term exposure to selenium (see Sec. 3). Give special consideration to women of childbearing age, because of possible reproductive effects. Remove workers from selenium exposure if exposure-related garlic odor of breath is detected.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations ≤ 1 mg/m^3, use a dust and mist, or dust, mist and fume respirator, or air-purifying full face-piece respirator with high efficiency particulate (HEP) filter, or powered air-purifying respirator with dust and mist filter, or powered air-purifying respirator with dust, mist and fume filter, supplied air respirator, or SCBA with full facepiece; > IDLH/unknown/emergency, SCBA with full facepiece operated in pressure-demand or other positive-pressure mode, or supplied air respirator with full facepiece operated in pressure-demand or other positive-pressure mode in combination with SCBA. For escape, use an air-purifying, full facepiece respirator with HEP filter. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear impervious, chemically protective neoprene or rubber gloves, boots, aprons, gauntlets and body-covering clothing to prevent skin contact. Wear protective eyeglasses, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Amorphous or crystalline solid

Appearance and Odor: Red to bluish black, dark red, gray, or black, crystals odorless

Vapor Pressure: > 0.001 mm Hg at 68 °F (20 °C)

Formula Weight: 78.96 +/- 3

Specific Gravity (H_2O=1, at 4 °C): 4.26 to 4.81

Water Solubility: Insoluble

Other Solubilities: Soluble in sulfuric acid, carbon disulfide, ether, methylene iodide, benzene, quinoline, chloroform, aqueous potassium cyanide solution, potassium sulfite solution, caustic alkali solution. Insoluble in alcohol.

Boiling Point: 1274 °F (690 °C)

Melting Point: 338 °F (170 °C) to 422.6 °F (217 °C) (crystals)

Surface Tension: 92.5 dynes/cm at 423 °F (217 °C)

Ionization Potential (eV): 9.75238

Section 10 - Stability and Reactivity

Stability: Selenium is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include acids, fluorine, oxygen, cadmium, potassium, sodium, chlorine trifluoride, chromium trioxide, chromic oxide, lithium silicon, nitric acid, nitrogen trichloride, potassium bromate (explosive), silver bromate, bromine pentafluoride, and more materials. Contact with metal amides can be explosive. Metal carbides and chlorates incandesce in selenium vapor upon heating. Freshly precipitated amorphous selenium can react with water, producing selenous acid and hydrogen.

Conditions to Avoid: Unintended contact in storage areas or reactor vessels.

Hazardous Decomposition Products: Thermal oxidative decomposition of selenium can produce selenium dioxide.

Section 11- Toxicological Information

Toxicity Data:*

Genetic Effects:

Human, blood cultures: selenium (more than any tested selenium compounds) induced sister chromatid exchange.

Tumorigenicity:

Mouse, oral: 480 mg/kg/60 days continuous, resulted in tumors of the skin and appendages (equivoeal tumorigenic agent by RTECS criteria).

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Section 11- Toxicological Information, *continued*

Reproductive Effects:
Mouse, oral: 134 mg/kg, over multigenerations resulted in fetotoxicity, and fetal death.

Acute Inhalation Effects:
Rat, inhalation, LC_{Lo}: 33 mg/kg/8 hr resulted in hemorrhage, emphysema, and acute pulmonary edema.

Acute Oral Effects:
Rat, oral, LD_{50}: 6700 mg/kg resulted in somnolence (general depressed activity), dyspnea, other changes in nutrition and gross metabolism.
Mouse, oral, LD_{Lo} 134 mg/kg

* See NIOSH, *RTECS* (VS7700000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: *Scenedesmus*, TLm96=2.5 ppm; *E. Coli*, TLm96=90 ppm. Selenium toxicity occurs frequently among livestock ("alkali disease") of the Great Plains of the US, Canada and Mexico.
Environmental Fate: Selenium undergoes complex chemical and biological cycling through surface water and bottom sediments. It has been found to concentrate in some plants and fish.
Soil Adsorption/Mobility: Elemental selenium is insoluble in water and will have low mobility in the soil column.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Environmentally hazardous substance, solid, n.o.s.*
Shipping Symbols: –
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9
Special Provisions (172.102): 8, B54

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: None
b) Cargo Aircraft Only: None

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: –

*Classified as a hazardous substance when this material is one package which equals or exceeds the CERCLA RQ (see Sec. 15).

Section 15 - Regulatory Information

EPA Regulations:
Classified as a RCRA Hazardous Waste (40 CFR 261.24): Characteristic of Toxicity*
RCRA Hazardous Waste Number: D010
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per CWA Section 307(a)†
CERCLA Final Reportable Quantity (RQ), 100 lb. (45.35 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65 as Selenium compounds)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

*May or may not be characterized as a hazardous waste when subjected to the Toxicant Extraction Procedure (40 CFR 261.24).
†No reporting of release is required if diameter of solid pieces is equal to or exceeds 0.004 inches (100 µm).

Section 16 - Other Information

References: 1, 73, 103, 124, 136, 149, 176, 190, 209, 216, 222, 223, 224, 227, 230

Prepared By..... HM Spliethoff, MS
Industrial Hygiene Review..... DJ Wilson, CIH
Medical Review..... G Kelafant, MD

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Copyright © 1998 Genium Publishing Corporation. Any commercial use or reproduction without the publisher's permission is prohibited.

Safety Data Sheet

Section 1 – Chemical Products and Company Identification

Product Names: BioSolve® Pinkwater®

Product Uses: Remediation of hydrocarbon (oil, fuel, petrochemical) contamination, including: impacted soils, suppression of VOCs, decontamination of equipment and protective clothing, and surface washing

Manufacturer:
The BioSolve Company
24 Victory Lane
Dracut, MA 01826 USA

Contact Information:

+1 (800) 225-3909	US, Canada, Mexico and Puerto Rico
+1 (781) 482-7900	All other locations

Section 2 – Hazards Identification

Health Hazards:

Eye Contact:	Causes transient eye irritation
Skin Contact:	May cause mild, transient irritation
Ingestion:	May be harmful if swallowed; can cause gastrointestinal irritation, nausea, vomiting and/or diarrhea

Hazard Mitigation: Wear protective gloves and eye/face protection
Avoid prolonged breathing of spray

Environmental Hazards: Moderately toxic to aquatic life. Avoid discharge to storm drains and waterways

GHS Classification: Toxic to aquatic life, Acute Category 2

Section 3 – Composition/Information on Ingredients

Proprietary formulation with nonionic surfactants (32% active ingredients in water)

BioSolve products contain no caustic, d-limonene or hydrocarbon solvents.

BioSolve products do not contain any hazardous ingredients as defined by CERCLA, Massachusetts Right to Know Law and California Prop 65. All ingredients are TSCA compliant.

Section 4 – First Aid Measures

Eyes: Immediately flush eyes with water for at least 15 minutes. Hold eyelids apart while flushing to rinse entire surface of eye and lids with water. Seek medical attention for lasting irritation.

Skin: Rinse exposed area and wash with mild soap and water for several minutes. Seek medical attention if irritation develops.

Ingestion: Seek medical attention in the event of serious or persistent abdominal discomfort, nausea or diarrhea.

Inhalation: Inhalation of concentrated vapors resulting from spraying or heating in confined or poorly ventilated areas may cause irritation of nose and throat. Remove person to fresh air and seek medical attention if irritation persists.

Section 5 – Fire Fighting Measures

Suitable Extinguishing Media: None required; BioSolve products are non-flammable

Special Protective Equipment for Firefighters: None necessary

Unusual Fire or Explosive Hazards: None

Section 6 – Accidental Release Measures

In case of accidental release, breakage or leakage: Eliminate or contain source with inert material, such as sand, earth, absorbent pads, etc. Transfer liquid to suitable containers for recovery, re-use or disposal. Wipe up or mop up using water. Hard surfaces (e.g., floors, driveways) may be slippery; use care to avoid falling.

Rinse area with water. Avoid flow of run-off to surface waters. Always check with local regulations before discharging effluent to storm drains or sewers.

Section 7 – Handling and Storage

Handling: Minimize periods of exposure to extreme temperatures. Keep from freezing. If frozen, separation may occur; thaw and stir thoroughly prior to use. Freezing will not affect product performance.

Precautions: Chemical resistant gloves and eye protection are recommended while mixing and using.

Incompatibilities: Avoid contact with strong acids or strong oxidants.

Storage: Recommended storage temperature: 35º – 120º F (1º – 48º C).

Shelf Life: If unopened, more than 10 years.

Section 8 – Exposure Controls / Personal Protection

Eyes Protection: Safety glasses; chemical goggles or face shield recommended when spraying to protect against backsplash and drift.

Skin Protection: Rubber or latex gloves recommended.

Respiratory Protection: None required, except if application results in significant misting of product. If so, use of an approved air purifying respirator is recommended.

Engineering Controls: For indoor use or for use in a confined space, normal ventilation is generally satisfactory.

Section 9 – Physical and Chemical Properties

Appearance: Deep red

Odor: Mild, pleasant sassafras fragrance

Concentration: ~32% active ingredients as sold

Boiling Point	265ºF/129ºC	**Vapor Pressure mm/Hg**	Not available
Melting/Freezing Point	28ºF/-2ºC	**Vapor Density (Air=1)**	Not available
Flash Point	Non-flammable	**Surface Tension***	29 Dyne/cm @25ºC
Flammability Limits	Not applicable	**Viscosity (concentrate)**	490 centipoise
Reactivity with Water	None	**Viscosity (6% solution)**	1.5 centipoise
Evaporation Rate	Not determined	**Solubility in Water**	100%
Specific Gravity	1.01 gms/cc	**VOC Content**	Not determined
	8.43 lbs/U.S. gal	**pH**	9

*6% solution

Section 10 – Stability and Reactivity

Chemical Stability: Stable; will not decompose if used according to manufacturer's directions.

Conditions to Avoid: Prolonged exposure to heat may cause product degradation. Freezing should also be avoided as discussed in Section 7.

Incompatible Materials: Normally unreactive. Avoid strong alkalis, strong acids, strong oxidizing agents and materials with reactive hydroxyl compounds. These materials could damage the product and reduce its effectiveness during application.

Hazardous Decomposition Products: None are known.

Hazardous Polymerization: Will not occur.

Section 11 – Toxicological Information

Overview: No adverse acute or chronic health effects expected if product used in accordance with manufacturer's directions.

Carcinogenicity: No ingredient has been shown to cause cancer in laboratory animals.

Specific Organ Toxicity: None are known.

Section 12 – Ecological Considerations

Persistence and Degradability: The total of the organic components contained in this product is not classified as readily biodegradable (OECD-301 A-F). However, this product is inherently biodegradable with 60% degradation in 28 days (OECD-301B) and estimated >95% degradation in 120 days.

Bioaccumulation Potential: The bioaccumulation factor in fish has been estimated to be low, ranging from 87 to 344.

Mobility: No data available

Aquatic Toxicity:

LC_{50} of Concentrate (As shipped)		
Mysidopsis bahia	48-hours	3.6 mg/L
Menidia beryllina	96-hours	6.4 mg/L
LC50 of 3% Dilute Solution (As Used)		
Mysidopsis bahia	48-hours	185 mg/L
Menidia beryllina	96-hours	247 mg/L
LC50 of 6% Dilute Solution (As Used)		
Daphnia magna	48-hours	287 mg/L
Pimephales promelas	96-hours	124 mg/L
Onchorhynchus mykiss	96-hours	177 mg/L

Section 13 - Disposal

DO NOT DUMP INTO STORM DRAINS OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. As manufactured, BioSolve products do not meet the definition of a hazardous waste. Small quantities of unused and uncontaminated product may be discharged to a qualified wastewater treatment facility. Always obtain approval from local and Federal regulatory agencies prior to discarding this product into public sewers.

As your supplier, we have no control over your handling and use of this product. However, the intended use of this product as a remediation and/or surface washing agent may produce wastewater containing emulsified or dispersed hydrocarbons that may be classified as a hazardous waste and should be treated and disposed of accordingly.

Section 14 – Transportation Information

USDOT Freight Class 55 (Liquid Cleaning Compound, Non-Hazardous)
This product is not regulated by USDOT or Canadian TDG when shipped domestically by land.

North American Industry Classification System (NAICS) # 325613

U.S. ITC, Harmonized Tariff Schedule B Classification: 3402.90.30.00

Section 15 – Regulatory Information

This product is considered non-hazardous as defined by CERCLA, according to OSHA, Massachusetts Right to Know Law and California Prop 65.

Toxic Substances Control Act:	All components of this product are on the TSCA inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30.
CEPA – Domestic Substances List:	All substances contained in this product are listed on the Canadian Domestic Substances List (DSL) or not required to be listed.
Canadian CPR Compliance:	This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the SDS contains all the information required by the CPR
WHMIS Classification:	D2B Eye or skin irritant

Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with Federal, state or provincial and local laws.

Section 16 – Other Information

HMIS Rating	Health Hazard:	1 (Eye/Skin Irritant)
	Fire Hazard:	0
	Reactivity:	0
	Personal Protective Equipment:	Rubber gloves, safety glasses or face shield
NFPA Rating	Health:	1 (Eye/Skin Irritant)
	Flammability:	0
	Reactivity:	0
	Other Hazard:	None

BioSolve Pinkwater is on the US Environmental Protection Agency's NCP Product Schedule. This listing does NOT mean that EPA approves, recommends, licenses, certifies or authorizes the use of BioSolve Pinkwater on an oil discharge. This listing means only that data have been submitted to EPA as required by Subpart J of the National Contingency Plan, 40 CFR Section 300.915.

SDS Effective Date: January 1, 2018

The information contained herein is accurate to the best of our knowledge. The BioSolve Company makes no warranty of any kind, express or implied, concerning the safe use of this material in your process or application or in combination with other substances.

For more information, visit: www.biosolve.com

GEI Consultants

Daily Safety Briefing and Site Visitor Sign-In

Project Number:	**Project Name:**
[1]Date:	**Time:**
Briefing Conducted by:	**Signature:**

This sign-in log documents the tailgate briefing conducted in accordance with the site specific HASP. Personnel who perform work operations on site are required to attend each briefing and to acknowledge receipt of each briefing, daily.

TOPICS COVERED (check all those covered):

☐ Accident Reporting Procedures	☐ General PPE Usage	☐ Site Control	☐ Other:
☐ Cellular Phone Charged w/Service	☐ Heat Stress	☐ Site Emergency Procedures	☐ Other:
☐ Changes to the HASP	☐ Hearing Conservation	☐ Slips, Trips, Falls	☐ Other:
☐ Cold Stress	☐ Lockout/Tagout	☐ Traffic Safety	☐ Other:
☐ Confined Space	☐ Personal Hygiene	☐ Other:	☐ Other:
☐ Decon Procedures	☐ Respiratory Protection	☐ Other:	☐ Other:
☐ Exposure Guidelines	☐ Review of Hazards	☐ Other:	☐ Other:

Daily Safety Topic Description:

Personnel Sign-in List

Printed Name	Signature	Company Name	Time-In	Time-Out

[1] This form is applicable for *only* 1 day of site activity.

GEI Consultants

Accident/Incident Report Form

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

SECTION A — ACCIDENT/INCIDENT DETAILS

EMPLOYEE INFORMATION:

Name: _____

Home Address: _____
Street Address City State Zip Code

Contact Information: ( ) ( )
Primary Secondary

Date of Birth: _____

Date of Hire: _____

Branch: _____

Supervisor: _____

OTHER INJURED (IF APPLICABLE):

Name: _____

Home Address: _____
Street Address City State Zip Code

Contact Information: ( ) ( )
Primary Secondary

Date of Birth: _____

Date of Hire: _____

Branch: _____

Supervisor: _____

Date and Time Accident/Incident	Date and Time Reported
____ /____ /____ Month Day Year	____ /____ /____ Month Day Year
____ A.M. ____ P.M.	____ A.M. ____ P.M.

LOCATION OF INCIDENT/ACCIDENT

Project Name: _____

Client and Location: _____

or _____

Office Location: _____

INCIDENT TYPE: (Check All That Applies)

- ☐ **Personal Injury/Illness**
- ☐ **Vehicle Accident**
- ☐ **Property Damage**
- ☐ **Environmental Spill**
- ☐ **Other**

WITNESS INFORMATION

Name: _____

Contact Number: _____

Company: _____

WHAT HAPPENED TO THE INJURED PARTY: ☐First Aid Administered ☐Refused Treatment/Transport ☐Transported to Hospital ☐Returned to Work ☐ Went Home ☐ Went to Physician ☐ Unknown

Clinic/Hospital or Treating Physician: _____ Phone: _____
Name Street Address City State Zip Code

SECTION B — PERSONAL INJURY

Cause of Injury: _____

Part of Body Injured: _____ Multiple Injuries: ☐Y ☐N

Was PPE worn when injured? : ☐Y ☐N What PPE was worn? _____

WAS INJURY A RESULT OF THE USE A MOTOR VEHICLE: ☐ **YES** ☐ **NO** **(If yes, complete Section C)**

GEI Consultants

Accident/Incident Report Form

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

SECTION C — AUTO ACCIDENT ONLY

DRIVER/VEHICLE INFORMATION

Name of Insured: _____

Department: _____

Driver's License Number: _____

DOB: ____/____/____ State: _____

Description of Vehicle: License Plate Number: _____

Make: _____ Model: _____ Year:_____ Color:_____

Owner: _____

Name of Other Driver: _____

Driver's License Number: _____

State: _____

Description of Vehicle: License Plate Number: _____

Make: _____ Model:_____ Year:_____ Color:_____

Insurance Carrier: _____

Policy Number: _____Ph. Number:_____

SECTION D — PROPERTY DAMAGE OR CHEMICAL RELEASE ONLY

Type of Damage(s): _____

Cause of Damage(s): _____

Type of Chemical Released (if known): _____

Quantity of Chemical Released: _____

Spill Measures Employed: _____

SECTION E — NATURE OF ACCIDENT/INCIDENT AND EXTENT OF INJURIES/DAMAGES

(Please give a detailed description of what happened. Attach a sketch or picture if applicable)

_____

_____

_____

_____

_____

_____

_____

_____

_____

I hereby certify that the above information is true and correct to my understanding of this accident/incident.

_____ _____

Employee/Preparer's Name **Date and Time**

NEAR MISS REPORT

A near miss is a potential hazard or incident that has not resulted in any personal injury. Unsafe working conditions, unsafe employee work habits, improper use of equipment, or use of malfunctioning equipment have the potential to cause work related injuries. It is everyone's responsibility to report and/or correct these potential accidents/incidents immediately. Please complete this form as a means to report these near-miss situations. Send a copy of the completed form to the Project Manager, Regional Health and Safety Officer and the Corporate Health and Safety Officer.

Location: _____ Site Name: _____

Date: _____ Time: _____ ☐ a.m. ☐ p.m.

Weather conditions, site operations taking place during near miss. _____

Please check all appropriate conditions:

☐ Unsafe Act ☐ Unsafe equipment

☐ Unsafe Condition ☐ Unsafe use of equipment

Description of incident or potential hazard: _____

Employees or sub-contractors involved if applicable._____

Employee Signature _____ Date _____

Print Name _____

NEAR MISS INVESTGATION

Description of the near-miss condition: _____
Causes (primary & contributing) _____
Corrective action taken (Remove the hazard, replace, repair, or retrain in the proper procedures for the task) _____
Actions not yet taken_____

Signed: _____ Date Completed: _____

Print Name
Not completed for the following reason: _____Date:_____

GEI Consultants

Project Safety Briefing Form

Project Number:	**Project Name:**
Date:	**Time:**
Briefing Conducted by:	**Signature:**

This sign-in log documents that a project specific-briefing was conducted in accordance with the site-specific HASP and GEI's H&S policy. GEI personnel who perform work on site are required to attend this project briefing. Applicable health and safety SOPs and any additional hazards are also required to be reviewed during this briefing. Prior to the start of the project or upon the start of a new on-site project team member, this form must be completed. Please email this completed form to: *HealthandSafety@geiconsultants.com*

TOPICS COVERED (check all those covered):			
SOP HS-001 Biological Hazards		Accident Reporting Procedures	
SOP HS-002 Bloodborne Pathogens		Changes to the HASP	
SOP HS-003 Container Management		Cold Stress	
SOP HS-004 Driver Safety		Confined Space	
SOP HS-005 Electrical Safety - Lockout/Tagout		Decon Procedures	
SOP HS-006 Excavation/Trenching		Exposure Guidelines	
SOP HS-007 General Safety		General PPE Usage	
SOP HS-008 Hand and Power Tools		Heat Stress	
SOP HS-009 Hazardous Substances Management		Hearing Conservation	
SOP HS-010 Inclement Weather		Lockout/Tagout	
SOP HS-011 Ladders		Personal Hygiene	
SOP HS-012 Noise Exposure		Respiratory Protection	
SOP HS-013 Nuclear Density Gauge		Review of Hazard Evaluation	
SOP HS-014 Utility Markout		Site Control	
SOP HS-015 Respirator Fit Test		Site Emergency Procedures	
SOP HS-016 Traffic Hazards		Slips, Trips, Falls	
SOP HS-017 Water Safety		Traffic Safety	
SOP HS-018 Working Around Heavy Equipment		Other (Specify):	
SOP HS-019 Rail Safety		Other (Specify):	
SOP HS-020 Aerial Lift		Other (Specify):	
SOP HS-021 Mobile Equipment		Other (Specify):	
SOP HS-022 Aquatic Ecological Survey/Electrofishing		Other (Specify):	
SOP HS-023 Scaffolding		Other (Specify):	
SOP HS-024 Wilderness Safety		Other (Specify):	
SOP HS-025 Manual Lifting		Other (Specify):	

Personnel Sign-in List	
Printed Name	**Signature**

STANDARD OPERATING PROCEDURES

SOP No. HS-001 Biological Hazards

1.1 Objective

The objective of this Standard Operating Procedure (SOP) is to prevent or limit the potential for GEI personnel to encounter biological hazards during field activities.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for contact with biological hazards such as animals, insects, plants, and sewage. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for encounters with biological hazards and the control methods to be implemented by GEI employees. These hazards must be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.3 Mammals

During some site operations, animals such as stray or domesticated dogs or cats, raccoons, snakes, bears, rats, bats, etc. may be encountered. Employees should use discretion and attempt to avoid contact with animals. If these animals present a problem, efforts will be made to remove these animals from the site by contacting a licensed animal control technician.

1.3.1 Rabies

The rabies virus is transmitted through the bite of an infected animal or contact with saliva or brain/nervous system tissue of an infected animal. The rabies virus infects the central nervous system, causing disease in the brain. The early symptoms of rabies in people are fever, headache, and general weakness or discomfort. As the disease progresses, more specific symptoms appear and may include insomnia, anxiety, confusion, slight or partial paralysis, excitation, hallucinations, agitation, hypersalivation (increase in saliva), difficulty swallowing, and hydrophobia (fear of water). Death usually occurs within days of the onset of these symptoms.

If you are bitten or think you may be exposed, wash any wounds immediately and thoroughly with soap and water. Then go to the hospital emergency room and notify the Project Manager and the People Safety Team. The doctor, possibly in consultation with the state or local health department, will decide if you need a rabies vaccination. Decisions to start series of vaccinations will be based on your type of exposure and the animal you were exposed to, as well as laboratory and surveillance information for the geographic area where the exposure occurred. If possible have someone document what type of animal it was, how it was behaving prior to the bite, what caused it to bite the

employee, and if it's not a domestic animal that would be easy to find again in the future, try to get animal control on site to capture it. An Incident Report Form must be completed and submitted, per GEI's Incident reporting procedures. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

1.4 Insects and Arachnids

Insects, including bees, wasps, hornets, mosquitoes, ticks, spiders, etc., may be present at a job site making the chance of a bite/sting possible. Some individuals may have a severe allergic reaction to an insect bite or sting that can result in a life-threatening condition. Some insect bites can transmit diseases such as Lyme disease or a virus such as West Nile. The following is a list of preventive measures:

- Apply insect repellent prior to performing field work and as often as needed throughout the work shift.
- Wear proper personal protective equipment (PPE), including protective clothing (work boots, socks, and light colored clothing).
- Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many insects are most active (between dawn and dusk).
- When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible.
- Field personnel who have or may have insect allergies must have insect allergy medication onsite and must inform the Site Safety Officer (SSO) and the People and Safety Team of their particular allergy prior to commencing work.
- Field personnel should perform a self-check at the end of the day for ticks.

1.4.1 Tick-borne Diseases

Lyme Disease

Lyme disease is caused by infection from a deer tick that carries a spirochete (a bacterium). During the painless tick bite, the spirochete may be transmitted into the bloodstream, often after feeding on the host for 12 to 24 hours. The ticks that cause the disease are often no bigger than a poppy seed or a comma in newsprint. The peak months for human infection are from May to September.

Symptoms appear in three stages. First symptoms usually appear from 2 days to a few weeks after a person is bitten by an infected tick. Symptoms usually consist of a ring-like red rash on the skin where the tick was attached. The rash is often bulls-eye like with red around the edges and clear in the center. The rash may be warm, itchy, tender, and/or "doughy." This rash appears in only 60 to 80 percent of infected persons. An infected

person also has flu-like symptoms of a stiff neck, chills, fever, sore throat, headache, fatigue, and joint pain. These symptoms often disappear after a few weeks.

The second stage symptoms, which occur weeks to months later include meningitis, severe headache, drooping of the muscles on the face, called Bell's Palsy, encephalitis, numbness, withdrawal, and lethargy. These symptoms may last for several weeks to several months. Third stage symptoms, which occur months or years later include arthritis, heart problems, and loss of memory. The third stage symptoms may mimic multiple sclerosis and Alzheimer's disease.

When in areas that could harbor deer ticks, employees should wear light color clothing, and visually check themselves and check and be checked by another employee when coming from wooded or vegetated areas. If a GEI employee has a tick bite, the People and Safety Team and Project Manager must be contacted immediately. The employee will be offered the option for medical treatment by a physician, which typically involves antibiotics. An Incident Report form must be completed in compliance with the Incident Reporting procedures. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

If personnel feel sick or have signs similar to those mentioned above, the SSO and the People and Safety Team must be notified immediately.



Figure 1: From left to right, the deer tick adult female, adult male, nymph, and larva on a centimeter scale.

How to Remove a Tick

A tick can be removed from the skin by pulling gently at the head with tweezers. If tweezers are not available, use tissue paper or cloth to grasp the tick. It is important to grasp the tick as close to the site of attachment and use a firm steady pull to remove it. Wash hands immediately after with soap and water. The affected area should also be washed with soap and water, then disinfected with an antiseptic wipe, if available. All mouth parts must be removed from the skin. If the tick was removed by breaking off the

mouth parts, an irritation or infection may occur because the organism that is causing the disease can still enter the body through the skin.

Treatment for Lyme Disease

Treatment with antibiotics is effective and recovery is usually complete. For first stage symptoms, antibiotics are usually given orally. However, treatment for second and third stage symptoms is prolonged and recovery may take longer. Antibiotic treatment is usually provided intravenously for second and third stage Lyme disease.

Babesiosis

The deer tick can also cause Babesiosis, an infection of the parasite Babesia Microti. Symptoms of Baesiosis may not be evident, but may also include fever, fatigue and hemolytic anemia lasting from several days to several months. Babesiosis is most commonly diagnosed in the elderly or in individuals whose immune systems are compromised. If there are no signs or symptoms of Babesiosis, usually no treatment it needed. If an employee believes they might have Babesiosis they'll see a physician to be tested. Treatment usually consists of taking prescription medications for 7 to 10 days.

Ehrlichiosis

Ehrlichiosis is a tick-borne disease which can be caused by either of two different organisms. Human monocytic ehrlichiosis (HME) is caused by *Ehrlichia chaffeensis*, which is transmitted by the lone star tick (*Amblyomma americanum*). Human granulocytic anaplasmosis (HGA), previously known as human granulocytic ehrlichiosis (HGE), is caused by *Anaplasma phagocytophilia*, which is transmitted by the deer tick (*Ixodes scapularis*).

Ehrlichiosis is transmitted by the bite of infected ticks, including the deer tick and the lone star tick. The symptoms of HME and HGE are the same and usually include fever, muscle aches, weakness and headache. Patients may also experience confusion, nausea, vomiting and joint pain. Unlike Lyme disease or Rocky Mountain spotted fever, a rash is not common. Infection usually produces mild to moderately severe illness, with high fever and headache, but may occasionally be life-threatening or even fatal. Symptoms appear 1 to 3 weeks after the bite of an infected tick. However, not every exposure results in infection. For those that become infected a drug called Doxcycline will be prescribed.

Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is a tick-borne disease caused by a rickettsia (a microbe that differs somewhat from bacteria and virus). In the eastern United States, children are infected most frequently, while in the western United States, disease incidence is highest among adult males. Disease incidence is directly related to exposure to tick-infested habitats or to infested pets. Rocky Mountain spotted fever is characterized by a sudden onset of moderate to high fever (which can last for 2-3 weeks), severe headache, fatigue, deep muscle pain, chills and rash. The rash begins on the legs or arms, may include the

soles of the feet or palms of the hands and may spread rapidly to the trunk or rest of the body. Symptoms usually appear within 2 weeks of the bite of an infected tick. Like Ehrlichiosis the prescription drug Doxcycline is the first line treatment option.

1.4.2 Mosquito-Borne Disease

West Nile Virus
West Nile Virus is a mosquito-borne infection transmitted through the bite of an infected mosquito. The symptoms of West Nile Virus can be asymptomatic (no symptoms) or in more serious cases can lead to West Nile Fever. West Nile Fever can include fever, headache, tiredness, body ache, an occasional rash on the trunk of the body, and swollen lymph glands, In severe cases, people have developed West Nile Encephalitis or Meningitis which symptoms include fever, headache, neck stiffness, tremors, coma, and in some cases death. The incubation period for the disease is usually 2 to 15 days. The symptoms can range from a few days to several weeks. Most mosquitoes are not infected and the chance of infection from a mosquito bite of an on-site employee is very small.

1.5 Repellants

The following precautions will be used to help reduce the risk of mosquito bites:

Reduce mosquito-breeding areas by making sure wheelbarrows, buckets, and other containers are turned upside down when not used so that they do not collect standing water. According to the Environmental Protection Agency (EPA), many mosquitoes can breed in pooled water that's minimal enough to fill a bottle cap.

Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many mosquitoes are most active (between dawn and dusk).

Use mosquito repellant according to the manufacturer's directions when outdoors for long periods of time and when mosquitoes are most active.

Centers for Disease Control and Prevention (CDC) evaluation of information contained in peer-reviewed scientific literature and data available from the EPA has identified several EPA-registered products that provide repellent activity sufficient to help people avoid the bites of disease carrying mosquitoes. Products containing these active ingredients typically provide reasonably long-lasting protection:

- **DEET** (Chemical Name: N,N-diethyl-m-toluamide or N,N-diethly-3-methyl-benzamide)
- **Picaridin** (KBR 3023, Chemical Name: 2-(2-hydroxyethyl)-1-piperidinecarboxylic acid 1-methylpropyl ester)

- **Oil of Lemon Eucalyptus** or **PMD** (Chemical Name: para-Menthane-3,8-diol) the synthesized version of oil of lemon eucalyptus
- **IR3535** (Chemical Name: 3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester)
- **Permethrin** (3-Phenoxybenzyl (1RS)-cis,trans-3-(2,2-dichlorovinyl) -2,2-dimethylcyclopropanecarboxylate) **–** Permethrin kills ticks and can be used on clothing (but not skin)

The EPA characterizes the active ingredients DEET and Picaridin as "conventional repellents" and Oil of Lemon Eucalyptus, PMD, and IR3535 as "biopesticide repellents", which are derived from natural materials.

In general, higher concentrations of active ingredient provide longer duration of protection, regardless of the active ingredient, although concentrations above approximately 50 percent do not offer a marked increase in protection time. Products with less than 10 percent active ingredient may offer only limited protection, often from 1 to 2 hours. Products that offer sustained release or controlled release (micro-encapsulated) formulations, even with lower active ingredient concentrations, may provide longer protection times. Regardless of what product you use, if you start to get mosquito bites reapply the repellent according to the label instructions or remove yourself from the area with biting insects if possible.

Clothing and other products can be purchased pre-treated, or products can be treated using EPA-registered products. Permethrin is the only pesticide approved by the EPA for these uses. Permethrin binds tightly to the fabrics, resulting in little loss during washing and minimal transfer to the skin. Permethrin is poorly absorbed through the skin, although sunscreens and other products may increase the rate of skin absorption.

If you decide to use permethrin-treated clothing, consider these tips:

- Read the application instructions carefully and apply the product according to the label directions. Do not over-treat products.
- Permethrin treatments are only intended for use on fabrics; do not apply them directly to the skin or other items.
- Do not apply permethrin to clothing while it is being worn.
- Apply the product to clothing outdoors in well ventilated areas that are protected from wind.
- Hang treated fabrics outdoors and allow them to dry completely before wearing them.
- Wash permethrin treated clothing separately from other clothing items.

1.6 Poisonous Plants

The potential for contact with poisonous plants, such as poison ivy, oak, and sumac exists when performing fieldwork in wooded or boggy areas. Urushiol, an oily organic allergen found in plants, can cause an allergic reaction when in contact with the leaves or vines.

Poison ivy can be found as vines on tree trunks or as upright bushes. Poison ivy consists of three leaflets with notched edges. Two leaflets form a pair on opposite sides of the stalk, and the third leaflet stands by itself at the tip. Poison ivy is red in the early spring and turns shiny green later in the spring. Poison ivy grows throughout much of North America, including all states east of the Rocky Mountains. It is normally found in wooded areas, especially along edge areas where the tree line breaks and allows sunshine to filter through. It also grows in exposed rocky areas, open fields, and disturbed areas.

Poison oak can be present as a sparsely-branched shrub. Poison oak can grow anywhere in the United States with the exception of Hawaii, Alaska, and some southwest areas that have desert climates. Poison oak is similar to poison ivy in that it has the same leaflet configuration; however, the leaves have slightly deeper notches.

Poison sumac can be present in the form of a flat-topped shrub or tree. It has fern-like leaves, which are velvety dark green on top and pale underneath. The branches of immature trees have a velvety “down.” Poison sumac has white, “hairy” berry clusters. Poison sumac grows exclusively in very wet or flooded soils, usually in swamps and peat bogs, in the eastern United States.



Poison Ivy

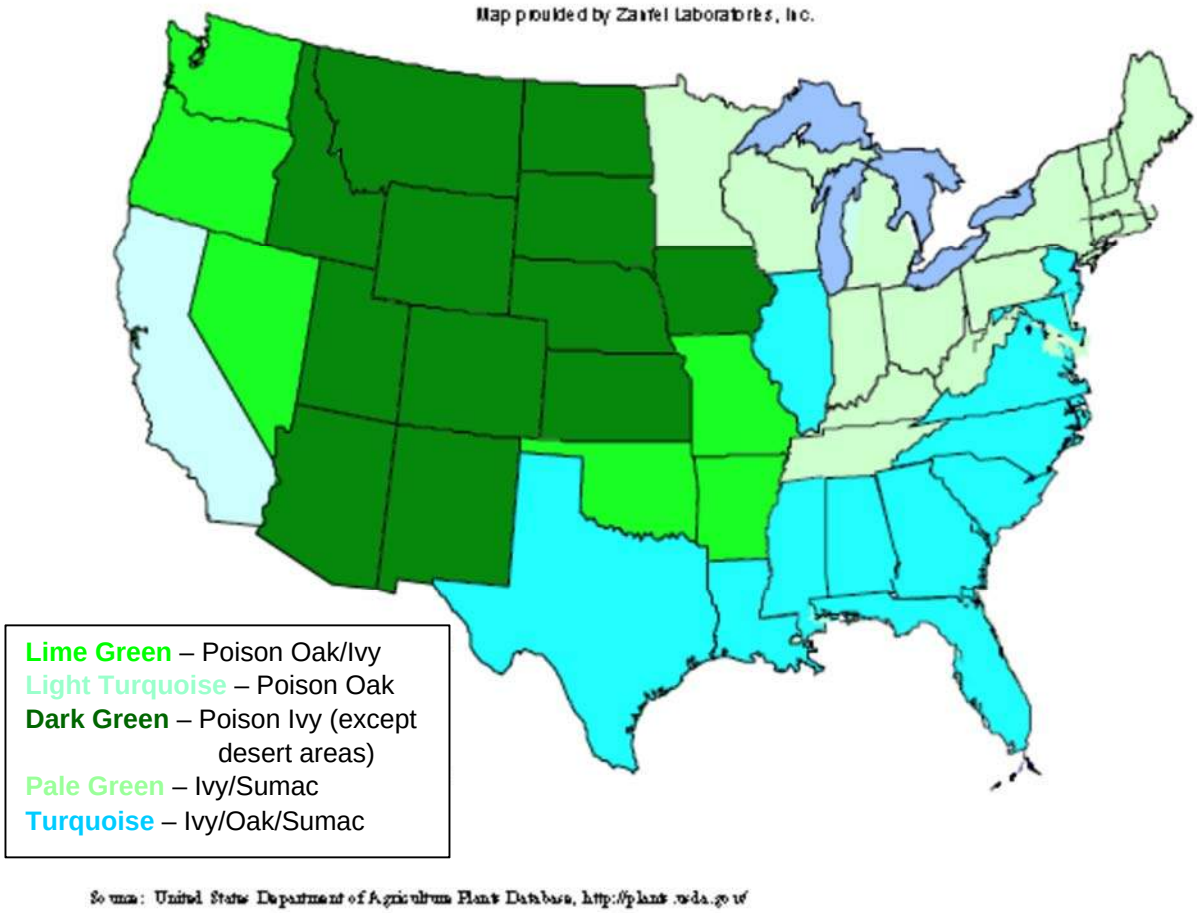


Poison Oak



Poison Sumac

U.S. Prevalence of Poison Ivy, Oak & Sumac



Source: United State Department of Agriculture Plant Database, http://plants.usda.gov/

To prevent exposure to these poisonous plants:

- Wear proper PPE, including long sleeves, long pants, boots, and gloves.
- Barrier skin creams, such as lotion containing bentoquatum (Tecnu®), may offer some protection prevent the occurrence of exposure symptoms.
- Contact with poison ivy, sumac, or oak may lead to a skin rash, characterized by reddened, itchy, blistering skin which needs first aid treatment. Employees with known allergies should identify themselves to the SSO or Project Manager prior to starting field work as a precautionary measure. If you believe you have contacted one of these plants:
    - Immediately wash skin thoroughly with soap and water, taking care not to touch your face or other body parts.
    - Contact the People and Safety Team and Project Manager immediately after caring for affected skin.

  - Wash exposed clothing separately in hot water with detergent.

- After use, clean tools, and soles of boots with rubbing alcohol or soap and lots of water. Urushiol can remain active on the surface of objects for up to 5 years.
- If a rash occurs, contact the People and Safety Team and complete and submit an Incident Report Form. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

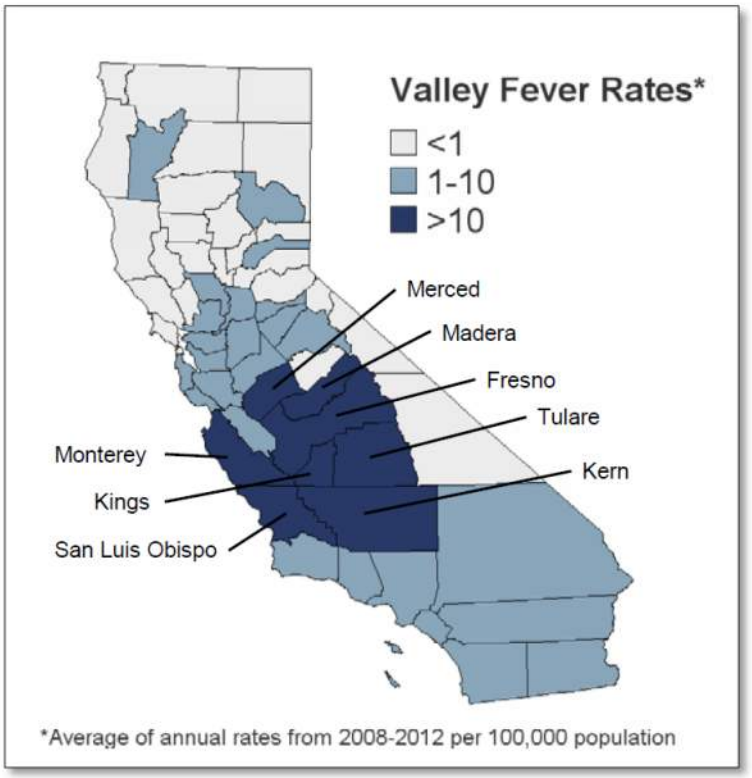
1.7 Sewage and Bacterial Impacted Sediments

Some project work may be conducted at sites that serve or have served as a combined sewer overflow and consequently may have received untreated sanitary sewage from numerous sources. Decomposed sewage can potentially be encountered within sites and their sediments. Sediments could contain soil and marine microorganisms, and bacterium associated with sewage. Many of these bacterium can cause illness through ingestion, direct contact, or the inhalation of a bio-aerosol possibly in the form of dust. Potential respiratory exposure to biological agents can also occur through the inhalation of aerosols produced during sediment handling activities. PPE as identified in the site-specific HASP will be worn to minimize potential exposures. Employees will follow the decontamination or disposal procedures identified in the HASP.

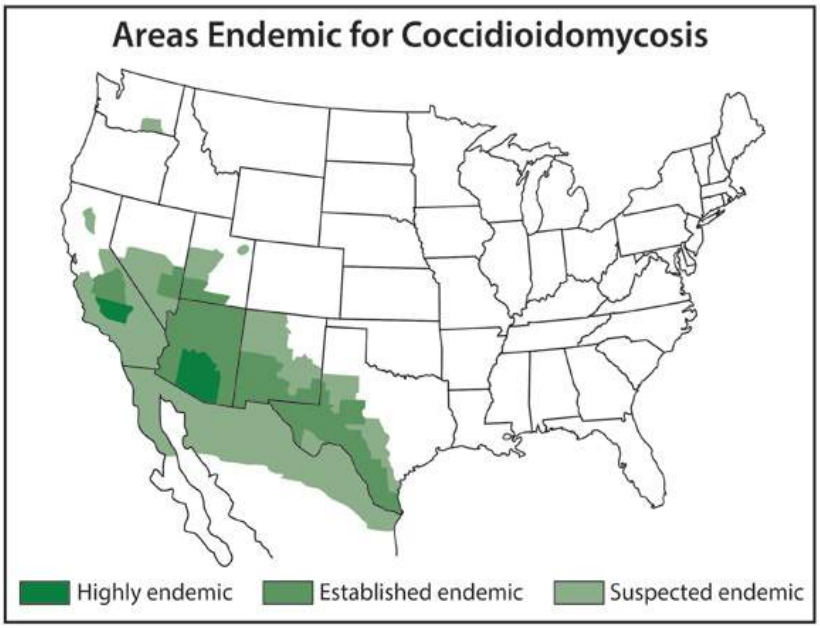
1.7.1 Fungal Spores in Soil – Valley Fever

Valley Fever is an illness that usually affects the lungs. It is caused by the fungus *Coccidioides immitis* that lives in the top 2 to 12 inches of soil in many parts of California. When fungal spores are present, any work activity that disturbs the soil, such as digging, grading, or other earth moving operations, or vehicle operation on dirt roads, can cause the spores to become airborne, therefore increasing the risk of Valley Fever. All employees on sites where the fungus is present, and who are exposed to dusty conditions and wind-blown dusts are at increased risk of becoming infected.

Valley Fever fungal spores are too small to be seen, and there is no reliable way to test the soil for spores before working in a particular place. Valley Fever can be found throughout the southwestern United States, parts of Mexico, and South America. Some California counties consistently have Valley Fever fungus present in the soil. In these regions Valley Fever is considered endemic. Health departments track the number of cases of Valley Fever illness that occur. This information is used to map illness rates as seen on the figures below from the Center of Disease Control Valley Fever Awareness website.



Rates of reported Valley Fever cases in California counties from 2008–2012. Darkest colored counties had the highest rates of Valley Fever.



When present, symptoms usually occur between 7 to 21 days after breathing in spores, and can include:

- Cough
- Fever
- Chest pain
- Headache
- Muscle aches
- Rash on upper trunk or extremities
- Joint pain in the knees or ankles
- Fatigue

Symptoms of Valley Fever can be mistaken for other diseases such as the flu (influenza) and TB (tuberculosis), so it is important for employees to obtain medical care for an accurate diagnosis and possible treatment.

While there is no vaccine to prevent Valley Fever, the following important steps must be taken in order to limit risk:

- Determine if the worksite is in an endemic area. Contact the local health department for more information about the risk in the county GEI is performing work that may disturb soils.
- Prepare work plans and work practices that reduce employee's exposure, which may include:
    - Provide air conditioned cabs with properly maintained dust filters for vehicles that generate heavy dust and make sure employees keep windows and vents closed.
    - Suspend work during heavy winds.
- When exposure to dust is unavoidable, National Institute for Occupational Safety and Health (NIOSH)-approved respiratory protection with particulate filters rated as N95, N99, N100, P100, or High Efficiency Particulate Air (HEPA) must be provided. The Project Manager must work with the Safety Team to develop and implement a respiratory protection program in accordance with California's Occupational Safety and Health Administration (Cal/OSHA's) Respiratory Protection standard (8 CCR 5144) for the project.
- Take measures to reduce transporting spores offsite, such as:
    - Clean tools, equipment, PPE, and vehicles before transporting offsite.
    - If employee's clothing is likely to be heavily contaminated with dust, provide coveralls and change rooms, and showers where possible.

1.8 Injury Reporting

If a GEI employee suffers an injury, bite, or sting on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.9 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.10 References

http://www.cdc.gov/ncidod/dvbid/westnile/index.htm
http://www.cdc.gov/ncidod/dvbid/westnile/qa/insect_repellent.htm
http://www.epa.gov/pesticides/health/mosquitoes/insectrp.htm
http://www.cdc.gov/niosh/topics/lyme/
Protecting Yourself from Ticks and Mosquitoes, NIOSH Fast Facts, Publication No. 2010-119
http://npic.orst.edu/pest/mosquito/ptc.html
http://www.cdc.gov/features/valley-fever-10-things/
https://www.cdph.ca.gov/HealthInfo/discond/Documents/VFGeneral.pdf
https://blog.epa.gov/blog/tag/mosquitoes/

1.11 Attachments

None

1.12 Contact

Health&SafetyTeam@geiconsultants.com

1.13 Review History

- June 2016
- June 2014
- November 2013
- October 2010

STANDARD OPERATING PROCEDURES

SOP No. HS-002 Infectious Materials and Bloodborne Pathogens Exposure Control Plan

1.1 Objective

GEI personnel may come in contact with potentially infectious agents (materials) when performing first aid or cardiopulmonary resuscitation (CPR). Employees may also come into contact with these agents when working at certain contaminated sites (i.e., urban sites, discarded contaminated needles, or sewer outfall exposures). This standard operating procedure (SOP) has been developed to minimize the potential for exposure to employees who may contact, directly or indirectly, infectious agents.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for contact with infectious materials and bloodborne pathogens. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for encounters with infectious materials or bloodborne pathogens and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

Universal Precautions (i.e., treat all potentially infectious materials as if it were infected) will be used by GEI employees.

1.3 Exposure Control Plan

1.3.1 Standard Procedures

Sampling of potentially infectious materials will be performed in a manner that minimizes the potential for creating splashes, droplets, or aerosols. Mechanical pipetting devices will be used for manipulating sanitary sewer effluent. Mouth pipetting is prohibited.

The use of glassware or equipment with sharp or pointed edges will be kept at a minimum to reduce the potential of injury that would create a direct route of entry into the body for infectious materials.

Minor cuts, scratches, or other breaks in the skin barrier will be covered prior to the handling of infectious materials. Employees experiencing exudative lesions or weeping dermatitis will refrain from direct contact with infectious materials.

Eating, drinking, smoking, or application of cosmetics is not permitted in areas where potentially infectious materials are handled or sampled.

Employees will wash and disinfect their hands, face, or other potentially contaminated skin surfaces upon completing the handling of infectious or potentially infectious agents or after rendering first aid.

1.3.2 Personal Protective Equipment

Personal Protective Equipment (PPE) will be worn to reduce the potential of exposures to splashes or aerosols. At a minimum, PPE will include safety glasses and appropriate gloves, but may also require the use of face, respiratory, foot, and full-body protection. Refer to the site-specific HASP for specific PPE requirements.

Disposable PPE used in the handling or sampling of infectious materials will be appropriately disposed of and not reused.

1.3.3 Medical Monitoring

Medical monitoring is required for an employee when a potential workplace exposure has occurred. The employee must follow the GEI Incident Reporting procedures regarding the potential exposure as soon as possible. For infectious agents in which a medically accepted vaccination has been developed (e.g., hepatitis B virus) (HBV) potentially exposed employees will be given the option to receive an inoculation at no cost. Employees who have been exposed will be given the option to receive a confidential medical evaluation also at no cost. Required records for exposed employees will be kept confidential.

1.3.4 Training

Employees with a reasonable risk for exposure must complete Bloodborne Pathogen training covering the following topics:

- An explanation of the Occupational Health and Safety Administration (OSHA) bloodborne pathogen standard.
- A general explanation of bloodborne diseases.
- An explanation of the modes of transmission of bloodborne diseases.
- An explanation of the GEI's Bloodborne Pathogen SOP and exposure control plan.
- Appropriate methods for recognizing tasks that involve potential exposure.
- An explanation of the use and limitations of methods to prevent exposure.
- Proper types, use, handling, decontamination, and disposal of PPE.
- The availability of HBV vaccines and the procedures for obtaining a vaccination.
- Appropriate actions to take during an emergency involving bloodborne pathogens.
- Post-exposure procedures.
- An explanation of required signs and labels.

1.4 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health & Safety Officer (RHSO).

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the RHSO will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health & Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.5 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.6 Attachment

None

1.7 Reference

OSHA 29 CFR 1910.1030 – Bloodborne Pathogens

1.8 Contact

Health&SafetyTeam@geiconsultants.com

1.9 Review History

- June 2016
- June 2014
- November 2013
- January 2011
- November 2010

STANDARD OPERATING PROCEDURES

SOP NO. HS-003 Container Management

1.1 Objective

This Standard Operating Procedure (SOP) has been developed to minimize the potential for injuries to GEI employees performing container and drum handling and sampling, through proper use of engineering and administrative controls, personal protective equipment (PPE), and education.

1.2 General

This SOP is intended for use by employees engaged in work with the management of containers that may contain hazardous substances or contaminated media. The site-specific health and safety plan (HASP) should include a hazard assessment and control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

Hazardous substances and contaminated media will be handled, transported, labeled, and disposed of in accordance with this paragraph. Drums and containers will meet the appropriate United States Department of Transportation (DOT), Occupational Safety and Health Administration (OSHA), and Environmental Protection Agency (EPA) regulations for the wastes that they contain.

Site operations will be organized to minimize the amount of drum or container movement. Prior to movement of drums or containers, employees exposed to the transfer operation will be notified of the potential hazards associated with the contents of the drums or containers. Unlabeled drums and containers will be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

Fire extinguishing equipment meeting the requirements of 29 CFR Part 1910, Subpart L, shall be on hand and ready for use to control incipient fires.

DOT specified salvage drums or containers and suitable quantities of proper absorbent will be kept available and used in areas where spills, leaks, or ruptures may occur. Where spills may occur, a spill containment program, which may be part of the HASP, will be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

1.3 Opening Drums and Containers

The following procedures will be followed in areas where drums or containers are being opened:

- Employees not actually involved in opening drums or containers will be kept a safe distance from the drums or containers being opened.
- If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation will be placed between the employee and the drums or containers being opened to protect the employee in case of accidental release.
- GEI employees will not handle or attempt to open bulging containers. Employees will not stand upon or work from drums or containers. GEI will contract with a hazardous waste company to handle, manage, and dispose of a bulging drum.

1.4 Material Handling Equipment

Several types of equipment can be used to move drums: (1) a drum grappler attached to a hydraulic excavator; (2) a small front-end loader, which can be either loaded manually or equipped with a bucket sling; (3) a rough terrain forklift; (4) a roller conveyor equipped with solid rollers; and (5) drum carts designed specifically for drum handling. GEI employees will not operate heavy equipment to move drums. This will be handled by an authorized subcontractor.

The following procedures can be used to maximize worker safety during drum handling and movement:

- Train personnel in proper lifting and moving techniques to prevent back injuries.
- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads, and make sure the vehicle can operate smoothly on the available road surface.
- Air condition the cabs of vehicles to increase operator efficiency; protect the operator with heavy splash shields.
- Supply operators with appropriate respiratory PPE when needed. Normally either a combination SCBA/SAR with the air tank fastened to the vehicle, or an airline respirator, and an escape SCBA are used because of the high potential hazards of drum handling. This improves operator efficiency and provides protection in case the operator must abandon the equipment.
- Have overpacks ready before any attempt is made to move drums.
- Before moving anything, determine the most appropriate sequence in which the various drums and other containers should be moved. For example, small

containers may have to be removed first to permit heavy equipment to enter and move the drums.

- Exercise extreme caution in handling drums that are not intact and tightly sealed.

- Ensure that operators have a clear view of the roadway when carrying drums. Where necessary, have ground workers available to guide the operator's motion.

1.5 Leaking, Open, and Deteriorated Drums

If a drum containing a liquid cannot be moved without rupture, immediately transfer its contents to a sound drum using a pump designed for transferring that liquid. Contract an approved vendor to immediately use an over pack container if the:

- Leaking drum contains sludge or semi-solids;

- Open drum contains liquid or solid waste;

- Deteriorated drum can be moved without rupture.

1.6 Radioactive Wastes

GEI does not routinely handle or manage radioactive waste. If required to do so for a project, procedures will be approved by the Corporate Health and Safety Officer (CHSO) and Regional Health and Safety Officer (RHSO).

1.7 Shock-Sensitive Wastes

GEI employees will not handle shock-sensitive waste. Shock-sensitive waste or chemicals may explode with friction, movement or heat. Some chemicals are shock-sensitive by nature-, others become shock-sensitive through drying, decomposition, or slow reactions with oxygen, nitrogen, or the container. Some chemicals that are, or can, become shock-sensitive will have that hazard noted in the safety data sheet (SDS).

- Drums and containers containing packaged laboratory wastes will be considered to contain shock-sensitive or explosive materials until they have been characterized. *Caution: Shipping of shock-sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Shippers will refer to 49 CFR 173.21 and 173.50.*

1.8 Laboratory Waste Packs

It is unlikely that GEI employees work in an environment where laboratory waste packs are used. However if one is found, do not handle or open it. Complete the incident reporting form to identify finding the pack and then work with the Project Manager to find the appropriate means of disposal.

1.9 Sampling of Drum and Container Contents

Sampling of containers and drums will be done in accordance with a site-specific sampling plan that will be developed in conjunction with a site-specific HASP.

1.10 Staging Areas

Drums and containers will be identified and classified prior to packaging for shipment. Drum or container staging areas will be kept to a minimum number as approved by the client to safely identify and classify materials and prepare them for transport. Staging areas will be provided with adequate access and egress routes. Bulking of hazardous wastes will be permitted only after a thorough characterization of the materials has been completed and approved by the Client. GEI employees will not sign manifests unless a written authorization agreement is in place with the Client.

1.11 Shipment and Training

Shipment of materials to off-site treatment, storage, or disposal facilities involves the entry of waste hauling vehicles into the site. U.S. Department of Transportation (DOT) regulations (49 CFR Parts 171-178) and EPA regulations (40 CFR Part 263) for shipment of wastes must be complied with. Employees managing hazardous waste on behalf of a client must complete annual RCRA training and triannual DOT hazardous materials training. Training must be current and a manifest agreement with the client must be in place before employees can sign hazardous waste manifests on behalf of a client.

1.12 Tank and Vault Procedures

GEI employees do not routinely sample vaults and tanks. Entry procedures will be coordinated and approved by the CHSO and RHSO.

1.13 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health & Safety Officer (RHSO).

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the RHSO will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health & Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the

potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.14 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection and appropriate training must be current

1.15 References

OSHA 1910.120 Hazardous Waste Operations and Emergency Response (j) Handling of Drums and Containers

1.16 Attachment

None.

1.17 Contact

Health&SafetyTeam@geiconsultants.com

1.18 Review History

- June 2016
- May 2014
- November 2013
- October 2011
- Initial Version Date Unknown

STANDARD OPERATING PROCEDURE
HS-004 Driver Safety

1.1 Objective

GEI has implemented a Safe Driving Program to encourage safe driving habits and promote the ongoing safety of our staff and the communities where we work. For more information, refer to the Operation of Vehicles section of GEI's Employee Handbook.

This Standard Operating Procedure (SOP) provides requirements and recommendations to minimize the potential risks while operating or riding in a motor vehicle.

1.2 General

GEI employees will adhere to the following requirements when operating a vehicle while conducting business on behalf of GEI. These requirements apply to GEI-owned, rental, and personal vehicles used to conduct GEI business:

- Employees must maintain a valid and current driver's license.
- Employees using a personal vehicle for work-related travel must have proper insurance coverage that meets the requirements in the state in which they reside.
- Employees must wear their safety belt while in a moving vehicle.
- Vehicle incidents will be reported in accordance with GEI's Incident Reporting procedures (*refer to* GEI's Safety App for smart phones or the Safety page on the GEI intranet.).
- Vehicles will be properly maintained and safely operated (*refer to* GEI's Fleet Maintenance Program).
- Employees will follow safe driving behaviors, which include limiting distractions such as manipulating radios or other equipment that may cause a distraction. Employees should not exceed the posted speed limit and should maintain a safe distance between other vehicles.
- When parking a vehicle at a job site, the employee should position the vehicle in a manner which reduces or eliminates the need to operate the vehicle in reverse. It is recommended, a safety cone should be placed at the rear of the vehicle after parking the vehicle and be removed prior to moving the vehicle. This precautionary measure makes the employee aware of other vehicles, equipment, and structures within the backup radius of the vehicle.

When driving an unfamiliar vehicle (rental or GEI-owned), it is the driver's responsibility to orient themselves to the vehicle by:

- Walking around the vehicle to observe the condition of the vehicle and hazards that could be within the travel path.
- Becoming familiar with the size of the vehicle.
- Note if the vehicle has anti-lock braking system (ABS[1]).
- Adjusting mirrors (rear and side).
- Adjust seats to be situated as far back as safely practical, away from the air bag, located in the steering wheel.
- Becoming familiar with dashboard, center console, and steering controls.
- Locating the turn signals, windshield wipers, lights, emergency flashers, and the heating, air conditioning, and defrost controls.

1.3 Driving Defensively

Driving defensively means not only taking responsibility for oneself and actions but also keeping an eye on "the other guy." Good defensive drivers may be able to anticipate what the other driver will do next. GEI recommends the following guidelines to help reduce risks while driving:

- Do not start the vehicle until each passenger and any belongings are secured in the vehicle.
- Remember that driving above or below the speed limit can increase the likelihood of a collision.
- Be aware of impaired drivers; if a car is straddling the center line, weaving, making wide turns, stopping abruptly, or responding slowly to traffic signals, the driver may be impaired or using a cellular telephone. Avoid an impaired driver by turning right at the nearest corner or exiting at the nearest exit.
    - If it appears that an oncoming car is crossing into your lane, pull over to the roadside, sound the horn, and flash the headlights.
    - If an unsafe or suspicious driver is observed, notify the police.
- Follow the rules of the road. Do not contest the "right of way" or try to race another car during a merge. Always be respectful of other motorists.

[1] ABS is a mechanism that allows the wheels on a vehicle to maintain contact with the surface of the road, based on inputs from the driver (braking), to prevent the wheels from locking up (ceasing rotation) and to avoid an uncontrolled skid.

- Allow large vehicles, including tractor trailers, extra breaking distance, turning radius, and avoid traveling in the other driver's blind spots.
- Do not follow too closely. GEI employees should use a minimum of "3-second following distance."
- While driving, be cautious, aware, and responsible.
- Use extra caution, observe road signs, and reduce speed in construction areas and school zones.
- Always be aware of pedestrians, bicyclists, and motorcyclists.

1.4 Cellular Phone Use and Other Distractions

Refer to the *Portable Communication Device Use While Driving* section of the GEI Employee Handbook for GEI's policy on the use of cellular telephones while operating a vehicle.

1.5 Drugs and Alcohol

The use of illegal drugs or alcohol is prohibited when driving a vehicle on GEI business. Be aware of the side effects of prescription and over-the-counter medications which can impair an employee's ability to drive.

1.6 Adverse Driving Conditions

When operating a vehicle, its possible adverse driving conditions may be encountered. Below is a list of possible conditions and how they can be mitigated.

1.6.1 Driving at Night

Vision maybe limited at night due to impairment of the driver's depth perception, color recognition, and peripheral vision. Another factor adding danger to night or early morning driving is fatigue. Drowsiness makes driving more difficult by dulling concentration and slowing reaction time. Effective measures to minimize these hazards by preparing the car and following guidelines:

- Check the headlights to ensure they are properly aimed. If you notice the headlights are not properly aimed, report it to the Branch Manager, or if applicable the rental car agent. Misaimed headlights blind other drivers and reduce the driver's ability to see the road.
- In addition to the known hazards of consuming alcohol prior to driving, night driving can potentially be affected because the recovery rate of glare from headlights is prolonged. Thus reducing your ability to see.

- Smoking in GEI vehicles and rentals is not permitted. When driving a personal vehicle for business, avoid smoking while driving. Nicotine and carbon monoxide may hamper night vision.
- Observe driving safety as soon as the sun goes down. Twilight is one of the most difficult times to drive, because the eyes' pupils are constantly changing to adapt to the growing darkness Always use headlights at dusk and at dawn; lights will not help the driver see better in early twilight, but they will make it easier for other drivers to see your car. Drive at a speed that allows you to see the road that is within the headlights span. Driving in a manner that prevents you from seeing hazards as they are illuminated is known as overdriving the headlights; it may be necessary for the driver to reduce speed to be prepared to brake within the illuminated area of the headlights.
- If an oncoming vehicle does not lower beams from high to low, avoid glare by watching the right edge of the road and using it as a steering guide.
- The driver should make frequent stops for light snacks and exercise. If the driver is too tired to drive, stop in a safe area and get some rest.

1.6.2 Snow/Freezing Conditions

When snow and ice are present, be prepared by following these winter driving safety tips.

1.6.2.1 Prepare the Vehicle Before a Snowstorm

- Check under the hood and take a look at the vehicles cooling system. Make sure the vehicle contains adequate antifreeze and the hoses are in good condition.
- Test heaters and defrosters ahead of time to make sure they are in good working condition.
- Test the windshield wipers and check the condition of the wiper blades. If wipers leave streaks on the windshields, replace the blades at the next possible opportunity. Keep the receipt to expense the cost with GEI or with the car rental company.
- It is recommended that a windshield washer/antifreeze solution is used during winter conditions.
- Check the lights on the vehicle and periodically clear them of snow and dirt.
- Vehicle batteries need extra power in cold conditions. Make sure the battery's terminals are clean and cables are secure.
- Determine if the vehicle has a anti-lock brake (ABS) system.
- Keep the gas tank at least half-full in the winter to help avoid gas line freeze up.

1.6.2.2 Driving During and After a Snowstorm

- Wear sunglasses to aid in limiting reflection from snow.
- Be aware of blind spots created by snow banks.
- Be extra cautious of pedestrians and other vehicles in intersections.
- Allow extra time for braking and increase the distance between your car and the car immediately in front of the car.
- Reduce speed and do not exceed the posted limit.
- If the tires starts to lose traction, remove the foot off the gas and gradually reduce speed. Accelerate slowly once traction is regained.
- If the vehicle starts to skid, and does not have anti-lock brakes, steer into the skid. This will bring the back end of the car in line with the front. Avoid using the brakes. If the vehicle does have anti-lock brakes, firmly brake as you steer into the skid.

1.6.3 Driving In the Rain

To prevent losing control of the car on wet pavement, take these preventive measures.

- Prevent skids by driving slowly and carefully, especially on curves.
- Steer and brake with a light touch.
- When necessary to stop or slow, do not brake hard or lock the wheels.
- Maintain mild pressure on the brake pedal.

Skidding
If the car begins to skid, ease the foot off the gas, and carefully steer the car in the direction you want the front of the car to go. For cars without anti-lock brakes, avoid using the brakes. This procedure, known as "steering into the skid," will bring the back end of the car in line with the front. If the car has anti-lock brake systems (ABS), brake firmly as you steer into the skid.

Hydroplaning
Hydroplaning happens when the water in front of the tires builds up faster than the car's weight can push it out of the way. The water pressure causes the car to lose contact with the road surface and slide on a thin layer of water between the tires and the road. At this point, the car can be completely out of contact with the road, making it possible for the driver to skid or drift out of the lane, or even off the road.

To avoid hydroplaning, keep the tires properly inflated and maintain good tread on the tires. If tires need to be replaced on a company vehicle, notify the branch manager or their designee. Slow down when roads are wet, and stay away from puddles. Try to drive in the tire tracks left by the cars in front of the vehicle. If the car begins to hydroplane, do not brake or turn suddenly. This could throw the car into a skid. Ease the foot off the gas until the car slows; accelerate slowly once traction is regained. If braking is needed, do so gently with light pumping actions. If the car has ABS, brake normally; the car's computer will mimic a pumping action, as necessary.

If weather conditions worsen to the point where the driver is not comfortable driving, pull the vehicle over to a safe location until conditions improve. Do not drive during severe weather conditions. Do not attempt to drive on roads with standing water or that have been flooded. Find an alternate route if these conditions exist.

1.6.4 Off Road

If operation of a vehicle is required off public or private roads or in situations where four-wheel-drive vehicles are required, the appropriate vehicle for the situation will be used.

Be sure any gear or equipment is secured inside the vehicle so it doesn't bounce around while the vehicle is off-road.

- Know the underside of the vehicle. Look under the vehicle and learn where the lowest-hanging parts are located so they are not damaged.
- Scout tricky terrain on foot. Don't hesitate to get out of the vehicle to examine, up close, the terrain and soil conditions. And be sure to scout out what's on the other side of a hill ahead of time so there are no surprises.
- Drive cautiously. Drive, "as slow as possible, as fast as necessary." Remember to use the gears to efficiently manage engine power, braking, and torque.
- Create a mental picture. Look ahead and visualize the paths to the vehicle will travel. Follow those paths.
- Drive straight up and down hills. Avoid diagonal lines that put the vehicle in a situation where it might roll.

1.7 Driver Training

GEI employees are required to complete driver safety training every 3 years. This training is managed by the People Team and will be assigned through GEI's e-learning provider.

1.8 Injury Reporting

GEI employees will report incidents involving GEI personnel or subcontractor personnel, such as: lost time injuries, injuries requiring medical attention, near miss incidents, fires, fatalities, accidents involving the public, chemical spills, vehicle accidents, and property damage. The following steps must be followed when an incident occurs:

1. In life-threatening situations, immediately call 9-1-1.
2. Stop work activity to address any injury, illness, property damage, spill or other emergency.
3. **Immediately** report any incidents to your Supervisor/Project Manager and Regional Health & Safety Officer.
4. If your injury or illness is not life-threatening, call Medcor Triage at 1-800-775-5866 to speak with a medical professional.
5. Complete an Incident Report Form **immediately** after addressing the incident. Report forms are available on GEI's Safety App (for smart phones) and on the Safety page on the GEI intranet.

For vehicle accidents involving another vehicle or damage to property, the employee will take pictures of each vehicle or property involved in the incident and obtain a police report. In some municipalities police will not be dispatched to a non-injury accident, but every effort needs to be made to try and obtain the report.

1.8.1 Injury Triage Service

If a GEI employee experiences a work-related injury that is not life-threatening, the employee will initiate a call to Medcor Triage at 1-800-775-5866. The injured employee will detail any medical symptoms or complaints which will be evaluated by a Registered Nurse (RN) specially trained to perform telephonic triage. The RN will recommend first aid self-treatment or refer the injured employee for an off-site medical evaluation by a health professional at a clinic within GEI's workers compensation provider network. GEI employees are still required to follow our Accident Reporting procedures as listed above.

1.9 Limitations

Follow safety procedures as defined in the site-specific HASP.

1.10 References

National Safety Council
Oklahoma Safety Council
GEI Consultants, Inc. Employee Handbook

1.11 Attachments

None

1.12 Contact

SafetyTeam@geiconsultants.com

1.13 Review History

- December 2017
- November 2016
- May 2014
- November 2013
- January 2011

STANDARD OPERATING PROCEDURES

HS-005a Electrical Safety

1.1 Objective

Electrical hazards are typically the most serious physical hazards GEI employees encounter when working on or near an electric substation, conducting intrusive activities such as excavation or drilling, using powered hand tools, or working near overhead utilities. This Standard Operating Procedure (SOP) has been developed to minimize the potential for exposure to energized electrical equipment while performing work activities.

1.2 General

Employees who face a risk of electric shock will be trained and become familiar with electrically-related safety practices in the GEI annual Health and Safety training. This training will include safety-related work practices that pertain to their respective job assignments and minimum approach distances.

An activity hazard analysis conducted for the project scope of work will evaluate the potential for electrical shock and be incorporated in the site-specific health and safety plan (HASP). In addition, site-specific training will be conducted by the Project Manager or their designee to discuss the project electrical hazards and include a review of the HASP requirements.

Annual health and safety training will include review of this electrical safety SOP and GEI's lockout/tagout requirements. Retraining will be required when there is a change in job assignments; a change in the energy control procedures; or a new hazard is introduced. Retraining may also be conducted through the Project Safety Briefing and documented on the Project Safety Briefing form.

Safe work practices will be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts when work is performed near or on equipment or circuits that are or may be energized. Employees may not enter spaces containing exposed energized parts unless proper illumination, protective shields, protective barriers, or insulating materials (if necessary) are provided to enable employees to work safely. If portable ladders are needed near electrical equipment, they will have non-conductive side rails.

1.3 Personal Protection

Measures to mitigate exposure to overhead and subsurface electrical transmission and distribution lines should be adhered to at all times when working adjacent to electrical hazards. These measures include:

- Electrical Hazard (EH)-rated footwear and hardhat are required when working onsite. Additional personal protective equipment (PPE) may be needed as referenced in the site specific HASP.
- Avoid carrying tools/equipment above waist height if overhead electric hazards exist.
- Maintain the minimum approach distance (MAD) from bus bars, transformer/capacitor electrodes, and overhead transmission/distribution lines.
- Stop work immediately and vacate the work area in the event lightning is observed.

Measures of protection that should be adhered to within an active substation perimeter or if work adjacent to the substation perimeter consists of intrusive activities:

- Contact utility clearance agency at least 48 hours prior to any invasive activities for mark out of underground public utilities.
- Obtain the most recent as-built drawings of the transmission/distribution line layout from the client.
- Mark out of underground transmission/distribution lines by the client survey/mark out personnel if applicable.
- Conduct work under the supervision of the client's Health and Safety representative per client requirements.
- Conductive items such as jewelry or clothing containing metals will not be worn unless they are rendered non-conductive by insulating means such as covering or wrapping with materials that specifically rated as non-conductive, or other insulating means.
- Use hand digging tools specifically designed for use on substation property (i.e., insulated digging bar, long-handled spoon shovel, etc.). In addition, rubber gloves and fire-resistant clothing are required if hand digging in a substation.
- Use insulated lineman's gloves when handling equipment that may come into contact with electrical utilities.
- EH-rated footwear is required when working onsite.
- Flame resistant clothing that meets National Fire Protection Association (NFPA) 70E standards is to be worn.

- Avoid carrying tools/equipment above waist height if overhead electric hazards exist.
- Ground vehicles or equipment **within the substation perimeter** using 4-aught gauge grounding cable. Adhere to specific client or site requirement for grounding.
- Maintain a minimum clearances on substations in accordance with 29 CFR 1910.333 and NFPA 70E standards when working near energized equipment.
- Maintain a minimum offset of 3 feet from marked underground transmission/distribution lines.
- Avoid working within or outside of a substations in conditions of high humidity, rain, or thunderstorms.
- Stop work immediately and vacate the work area in the event lightning is observed.

1.3.1 Minimum Approach Distance

According to OSHA, the MAD is "…the closest distance an employee is permitted to approach an energized or grounded object." MADs ensure that employees do not approach or take any conductive object closer to energized equipment than the allowed distances. All GEI employees conducting work onsite must follow the MADs shown below:

Nominal Voltage in Kilovolts	Minimum Approach Distance: Phase to Ground Exposure
0.05 to 1.0	Avoid Contact
1.1 to 15.0	2'1"
15.1 to 36.0	2'4"
36.1 to 46.0	2'7"
46.1 to 72.5	3'
72.6 to 121	3'2"
138 to 145	3'7"
161 to 169	4'
230 to 242	5'3"
345 to 362	8'6"
500 to 550	11'3"
764 to 800	14'11"

Reference: Table R-6 in OSHA regulation CFR 1910.269 (l) (10)

Unqualified employees must maintain a 10-foot distance from all electrical sources. Vehicular and mechanical equipment will also maintain minimum clearance distances of 10 feet.

Site personnel will assume that all electrical equipment at surface, subsurface, and overhead locations are energized until the equipment has been designated as de-energized by a client representative. Client representatives will be responsible for de-energizing and lockout/tagout of all electrical equipment. If the equipment cannot be de-energized, work will stop and the GEI Field Representative and/or the Site Safety Officer (SSO) will consult with the Project Manager and CHSO. GEI will notify the client prior to working adjacent to this equipment, and will verify that the equipment is energized or de-energized in the vicinity of the project area.

All power lines that have been indicated by the client to be de-energized must be locked out by the client or their representative, such that the lines cannot be energized when personnel are working near them. The lines will not be unlocked and re-energized until GEI notifies the client that they have completed work in the area and that all personnel are clear of the area. The client representatives will thoroughly familiarize GEI personnel with site-specific lockout/tagout procedures during the site orientation. Conductors and parts of electrical equipment that have been de-energized, but not been locked or tagged out, shall be treated as live/energized. Only qualified persons may work on electric circuit parts or equipment that has not been de-energized. Such persons will be made familiar with the use of special precautionary techniques, PPE, insulating and shielding materials, and insulated tools.

If power lines cannot be de-energized, the SSO will consult with the client to discuss how to proceed. Work tasks will only commence after determining that a safe working distance (MAD) can be maintained and all personnel working in the area have been informed of the limitation. All work performed within the substation boundaries requires the use of task-specific PPE as described in the HASP.

GEI will verify that the contractor or subcontractor has located and marked all electric, gas, water, steam, sewer, and other utility service lines before any intrusive work is started. In each case, any utility company that is involved should be notified in advance by the contractor, and its approval or services will be obtained, if necessary.

1.3.2 Ground-Fault Circuit Interrupters (GFCI)

GEI employees will use approved ground-fault circuit interrupters for personnel protection when using electrical tools and equipment. Equipment will be plugged into receptacles protected by a GFCI, extension cords with built-in GFCIs, or a GFCI adapter is to be used.

1.3.3 Equipment Inspection

Each extension cord, plug and receptacle, and any equipment connected by the cord and plug, will be visually inspected before each day's use for external defects, such as deformed or missing pins or insulation damage, and for indications of possible internal damage. Each receptacle and plug will be tested for correct attachment of the equipment grounding conductor. The equipment grounding conductor will be connected to its proper terminal.

Inspection of equipment will be performed before first use; before equipment is returned to service following any repairs; before equipment is used after any incident which can be reasonably suspected to have caused damage (e.g., when an extension cord is run over), and at intervals not to exceed 3 months. Cords and receptacles which are fixed and not exposed to damage will be tested at intervals not exceeding 6 months. Equipment found damaged or defective will not be used and will be properly tagged as "Out of Service"; notify the Branch Manager so that the equipment can be replaced or repaired. If the equipment cannot be repaired it will be disposed of properly.

1.4 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or supervisor/project manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health & Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.5 Limitations

- Follow safety procedures as defined in the site-specific HASP at all times.
- If lockout/tagout procedures are going to be performed by GEI employees or GEI subcontractors, the specific procedure will be reviewed with the CHSO and the RHSO.

1.6 References

OSHA 29 CFR 1910.147 Appendix A – The control of hazardous energy (lockout/tagout)

1.7 Attachments

None

1.8 Contact

Health&Safetyteam@geiconsultants.com

1.9 Review History

- February 2017
- May 2014
- October 2011
- August 2010 (Titled Lock Out/Tag Out)

STANDARD OPERATING PROCEDURES

SOP No. HS-006 Excavations and Trenches

1.1 Objective

The objective of this Standard Operating Procedure (SOP) is to highlight the hazards and safety procedures when work activities include excavations and/or trenches. The following guidelines will be followed when excavations or trenches are present on GEI projects.

1.2 General

This SOP is intended for use by employees engaged in work on project sites that include trenching and/or excavation operations. The site-specific health and safety plan (HASP) must include a hazard assessment for the project that identifies the potential for trenching and excavation hazards and the control methods to be implemented by GEI employees. These hazards must be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

An "excavation" is any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal.

A "trench" (trench excavation) is a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.

Do not enter a trench or excavation without consulting with the Project Manager, Corporate Health and Safety Officer (CHSO), or Regional Health and Safety Officer (RHSO).

1.2.1 Personal Protective Equipment

Employees will be provided with the personal protective equipment (PPE) necessary to help protect them from the hazards of work activities related to excavations and/or trenches. All employees will wear a hard hat, steel toe or composite toe boots, and safety glasses at a minimum. In addition, face shields, gloves, fall protection and hearing protection may be required. PPE must be maintained in good condition, kept clean and properly stored when not in use. More information regarding PPE is located in Section 6 of GEI's Corporate Health and Safety Program.

1.3 Hazards

Hazards associated with excavations and trenches can include collapse, falls, falling objects, hazardous atmospheres, and incidents involving mobile equipment. One cubic yard of soil can weigh as much as a car.

1.4 Entry

GEI employees will not enter trenches or excavations that do not comply with OSHA 29 CFR 1926.650. If a project requires GEI employees to enter a trench or excavation, the trench or excavation must meet the following requirements described in the following sections.

Do not enter a trench or excavation without consulting with the Project Manager, Corporate Health and Safety Officer (CHSO), or Regional Health and Safety Officer (RHSO).

1.4.1 Competent Person

The excavation must be inspected prior to the start of each shift by a competent person who most likely will work for the contactor performing the work. The competent person is an individual who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary, or dangerous to workers, soil types and protective systems required, and who is authorized to take prompt corrective measures to eliminate these hazards and conditions. GEI generally does not act as the competent person.

1.4.2 Soil Type

The competent person for the project will determine what the soil type is and what type of protective system will be implemented. The type of soil where the excavation or trench is being dug has significant influence on what type of protective system will need to be in place. There are four types of soil: stable rock, type A, type B, and type C. As you progress from stable rock to type C, the cohesive properties of the soil change the soil becomes less stable.

1.4.3 Protective System

A protective system is required for trenches or excavations greater than 5 feet in depth unless the excavation is made entirely in stable rock. In special situations the competent person may require a protection system for an excavation that is less than 5 feet deep. The competent person is responsible for assessing the soil type and the protective systems required for a specific trench when an excavation is less than 20 feet deep. If the excavation is greater than 20 feet in depth, the protection system requires a design by a registered professional engineer or based on tabulated data prepared and/or approved by a registered professional engineer.

The protective system will be designed based on soil type, depth of excavation, water level, loads adjacent to the excavation, changes in weather conditions, or other operations in the area. Protective systems can include sloping or benching of the sidewalls, shoring the sidewalls using an approved support system, or shielding workers with a trench box or other similar type of support.

The different types of protective systems include:

Benching is a method of protecting workers from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels of steps, usually with vertical or near vertical surfaces between levels. Benching cannot be done with Type C soil.

Sloping involves cutting back the trench wall at an angle inclined away from the excavation.

Shoring requires installing aluminum hydraulic or other types of support structures to prevent soil movement and cave-ins.

Shielding protects workers by using trench boxes or other types of supports to prevent soil cave-ins.

Designing a protective system can be complex because many factors must be considered: soil classification, depth of cut, water content of soil, changes caused by weather or climate, surcharge loads (e.g., spoil, other materials to be used in the trench) and other operations in the vicinity.

1.4.4 Access and Egress

Excavations and trenches greater than 4 feet in depth require a safe access and egress including ladders, steps, or ramps. These points of access and egress are to be no greater than 25 feet of lateral travel in any direction.

1.4.5 Atmospheric Hazards

Where oxygen deficiency (atmospheres containing less than 20.7% oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation will be tested before employees enter excavation.

1.5 Subcontractor Oversight

When GEI is overseeing excavation activities performed by a subcontractor, the following safety hazards should be monitored:

- Care must be taken not to create new hazards like narrow walkways along edges of an excavation.
- Heavy equipment must not be parked or working at the edge of the excavation.
- Spoils should not be stockpiled within 2 feet of the trench edges.
- Confirm with subcontractor that underground utilities have been located before any excavation or trenching activities begin (*refer to* SOP HS-014 Utility Mark-out).
- Confirm with the subcontractor that the excavation or trench has been tested for hazardous atmospheres before entering.
- Confirm with the subcontractor that the excavation or trench has been inspected by a competent person before each work shift and after any type of precipitation. If hazards are identified during this inspection, verify that the hazards are controlled prior to entering the trench or excavation.
- GEI employees will not work under raised or suspended loads.
- Excavations/trenches must be protected at the end of a work shift if they are to be left open. These trenches/excavations must be covered and a sign that reads "Hole" must be placed in a location that will notify anyone of the hazard. Or a secure barricade will need to be installed.

In circumstances where GEI employees are working on sites where a contractual agreement with the excavation contractor does not exist and we cannot confirm the above stated conditions, entry into trenches or excavations will not be conducted. Any safety concerns that arise should be communicated to the Project Manager and, if necessary, the client.

1.6 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened.

The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.7 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

Some states, including Massachusetts, require a trench permit prior to trenching or excavation activities. Verification of local requirements will be evaluated in the planning stage.

1.8 References

OSHA 29 CFR 1926.650 – Subpart P; *Excavations*
OSHA Construction eTool – http://www.osha.gov/SLTC/etools/construction/index.html
OSHA FactSheet Trenching and Excavation Safety – viewed on 9/13/2016
https://www.osha.gov/OshDoc/data_Hurricane_Facts/trench_excavation_fs.pdf

1.9 Attachments

None

1.10 Contact

Health&SafetyTeam@geiconsultants.com

1.11 Review History

- September 2016
- May 2014
- November 2013
- January 2011
- Initial Version Date Unknown

STANDARD OPERATING PROCEDURES

SOP No. HS-008a Non-Powered Hand Tools

1.1 Objective

This Standard Operating Procedure (SOP) is intended for use by employees working with non-powered hand tools. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the hazards associated with the non-powered hand tools that will be used. These hazards should be reviewed during the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.2 General

Misuse of hand tools accounts for the majority of accidents and injuries involving hand tools. Only use a tool for the task which it was designed for. If the right tool isn't available contact the Project Manager and discuss what is needed. Improper maintenance is another leading cause of injuries. Employees using hand tools may be exposed to a number of other potentially serious hazards: falling objects (i.e., objects can fall as a result of contact with tools or objects which are abrasive or splash), harmful dust, fumes mists, vapors, and gases, as well as contact with electrical power sources.

1.2.1 Condition of Tools

All hand tools, whether furnished by GEI or the employee, will be maintained in safe working condition. All hand tools must be inspected before use. Never use a tool if its handle has splinters, burrs, cracks, splits or if the head of the tool is loose. Never use impact tools such as hammers, chisels, punches or steel stakes having mushroomed (flattened) heads. Tag worn, damaged or defective tools "Out of Service" and do not use them; notify your Branch Manager or Project Manager so that the tool can be replaced or repaired. If the tools cannot be repaired they will be disposed of properly. GEI does not issue or permit the use of unsafe hand tools.

1.2.2 Personal Protective Equipment

Employees using hand tools will be provided with the personal protective equipment (PPE) necessary to protect them from the hazard of the tool as well as the associated hazards with using the tool. (i.e., projectile debris, dust, etc.). <u>All employees will wear work gloves, steel toe or composite toe boots, and safety glasses at a minimum</u>. In addition, face shields and hearing protection may be required. Most hand injures can be avoided with the proper use of PPE. PPE must be maintained in good condition, kept clean and properly stored when not in use. More information regarding PPE is located in Section 6 of GEI's Corporate Health and Safety Program.

1.2.3 General Safe Practices

Never wear sandals, open-toed or canvas shoes when working with tools. Always tie back long hair. Avoid loose-fitting clothes which might become entangled in a tool. Always remove rings and other jewelry. Make sure your grip and footing are secure when using large tools. Never carry tools up ladders; use a tool belt, hoist, or a rope. Use extra caution when using tools at heights – a falling tool could kill a co-worker. Always pass a tool to another person by the handle – never toss it to them. Never use a tool with hands are wet, oily, or greasy. Select ergonomically-designed tools for work tasks when movements are repetitive and forceful. Always make sure observers are at a safe distance. Always secure work with a vice, clamp, or other support.

1.3 Non-Power Hand Tools

Non-powered hand tools include anything from axes to wrenches. Even though the tool is powered by human inertia, injuries from improper use of non-powered hand tools often involve severe disabilities.

1.3.1 Knives

Only use a knife with a sharpened blade. Pull the knife through the object and away from your body; pulling motions are easier to manage. Never use a knife if its handle has splinters, burrs, cracks, splits or if the blade is loose. Knives should never be used as screwdrivers, pry bars, or can openers. Never pick up knives by their blades. Always carry knives with their tips/points toward the floor. Never carry knives, scissors, or other sharp tools in pockets. Never attempt to catch a falling knife. When not in use, knives should be stored in sheaths. Box cutters will be self-retracting.

1.3.2 Wrenches

Never use wrenches that are bent, cracked, badly chipped, or having loose or broken handles. Discard any wrench with spread or battered jaws; if the handle is bent; or if a wrench has broken or battered points and notify your Branch Manager so that a replacement can be made. Never slip a pipe over a single head wrench handle to increase leverage. Never use a shim to make a wrench fit. Pull on a wrench using a slow, steady motion. Do not use push force on a wrench; you could lose your balance if the wrench slips.

1.3.3 Screwdrivers

Always match the size and type of screwdriver blade to fit the head of the screw. Do not hold the work piece against your body while using a screwdriver. Never put your fingers near the tip of a screwdriver when tightening a screw. Never use a screwdriver to make a starting hole for screws. Never use a screwdriver as a chisel, pry bar, or nail puller. When performing electrical work, always use an insulated screwdriver. Never use a screwdriver to test the charge of a battery.

1.3.4 Hammers

Never use a hammer if your hands are oily, greasy or wet. Always check behind you before swinging a hammer. Use a claw hammer for pulling nails. Never strike nails or other objects with the "cheek" of the hammer. Do not strike a hardened steel surface, such as a cold chisel, with a claw hammer. Never strike one hammer against another hammer. Never use a hammer as a wedge or a pry bar.

1.3.5 Pliers

Never use pliers which are cracked, broken, or sprung. Never use pliers as a wrench or a hammer. Do not attempt to force pliers by using a hammer on them. Never slip a pipe over the handles of pliers to increase leverage. When performing electrical work, always use insulated pliers. When using diagonal cutting pliers, shield loose pieces of cut material from flying into the air by using a cloth or your gloved hand.

1.3.6 Snips

Never use snips as a hammer, screwdriver, or pry bar. Always wear safety glasses or safety goggles when using snips to cut materials. Always wear work gloves when cutting materials with snips. Keep the blade aligned by tightening the nut and bolt of the snips. Never use straight cut snips to cut curves. Always use the locking clip on the snips when you have finished using them. Never leave or store snips in the open position.

1.3.7 Hand Saws

Always keep handsaws sharp and free of rust to prevent them from binding or jumping. Never carry a saw by the blade. Always hold the work piece firmly against a work table. Keep control of saws by releasing downward pressure at the end of the stroke. Never use an adjustable blade saw such as a hacksaw, coping saw, keyhole saw, or bow saw, if the blade is not taut. Oil saw blades after each use. Never force the saw through the cut as this may cause the saw to buckle or fly out of the groove and cause injury.

1.3.8 Chisels

Only use sharpened chisels. Never use chisels having mushroomed (flattened) striking heads. Whenever possible, hold a chisel by using a tool holder. Clamp small work pieces in a vise and chip towards the stationary jaw of the vise. Chip or cut away from yourself and keep both hands in back of the cutting edge. Always wear safety glasses or a face shield.

1.3.9 Vise and Clamps

Never use a vise having worn or broken jaw inserts, or having cracks or fractures in the body of the vise. Position the work piece in the vise so the entire face of the jaw supports the work piece. When clamping a long work piece in a vise, support the far end of the work piece by using an adjustable pipe stand or saw horse. Never slip a pipe over the handle of a vise to increase leverage. Never use a C-clamp for hoisting materials. Never use a C-clamp as a permanent fastening device.

1.3.10 Jacks

A manufacture's rated capacity must be clearly marked on all jacks and all jacks must have a stop indicator. When using a jack, never exceed the capacity of the stop indicator. Jacks should be lubricated and inspected regularly. When setting up a jack, ensure the base is centered on a firm, level surface. The jack head should also be placed against a level surface. Lift force should be applied evenly. Put a block under the base of the jack when the foundation is not firm. If it seems likely the cap could slip, place a block between the jack cap and load. Immediately block the load after it is lifted.

1.4 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or supervisor/project manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health & Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.5 Limitations

Follow safety procedures as defined in the site-specific HASP or in the manufacturer's specifications. Appropriate PPE must be worn correctly to provide the intended level of protection. If a hand tool is being used that is not identified in this SOP consult the manufacturer's literature and contact the Safety Team so we can include the information in a future version of this SOP.

1.6 References

OSHA Standards for the Construction Industry, Subpart I
Risk Analytics, LLC Hand Tools Training, 2006

1.7 Attachments

None

1.8 Contact

Health&SafetyTeam@geiconsultants.com

1.9 Review History

- July 2016
- May 2014
- August 2011
- October 2010
- One revision date unable to be found

STANDARD OPERATING PROCEDURES

SOP NO. HS-009 Hazardous Substances Exposure Management

1.1 Objective

This Standard Operating Procedure (SOP) is intended to outline the steps GEI employees will take to identify potential hazards associated with exposure to hazardous substances, the risks associated with these hazards, and the proper controls to use to minimize exposure. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential of encountering a hazardous substance and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.2 General

A hazardous substance is any substance that has one or more of the following intrinsic properties:

- Explosiveness
- Flammability
- Ability to oxidize
- Human toxicity (acute or chronic)
- Corrosiveness (to human tissue or metal)
- Ecotoxicity (with or without bioaccumulation)
- Capacity, on contact with air or water, to develop one or more of the above properties

1.3 Hazard Identification

An initial identification of hazards should be done based on a review of available documents including lists of chemicals used on site, analytical data from soil, surface water, groundwater, air, spill history, site history, equipment on site, maps, photos, and a preliminary survey.

Once hazardous substances are identified the regulated exposure limits need to be identified. Each substance may have a state/federal exposure value for each of the following (if applicable):

Action Level – An airborne level, typically one-half of the permissible exposure limit (PEL) designated in Occupational Safety and Health Administration's (OSHA's) substance-specific standards, 29 CFR 1910, Subpart Z, calculated as an

8-hour time weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Ceiling Limit – The exposure limit a worker's exposure may never exceed.

Sampling and Analytical Error – A statistical estimate of the uncertainty associated with a given exposure measurement.

Short-Term Exposure Limit (STEL) – The average exposure to a contaminant to which a worker may be exposed during a short time period (typically 15-30 minutes).

Time Weighted Average (TWA) – The average exposure to a contaminant over a given period of time, typically 8 hours.

1.4 Risk Identification

Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances will be identified. GEI employees and GEI subcontractors who will be working on the site will be informed of risks that have been identified.

Risks to consider include, but are not limited to:

- Potential exposures exceeding the permissible exposure limits and published exposure levels
- Potential Immediately Dangerous to Life and Health (IDLH) concentrations
- Potential skin absorption and irritation sources
- Potential eye irritation sources
- Potential hazardous atmospheres, including oxygen deficiency and fire and explosion hazards

1.5 Engineering Controls, Work Practices, and Personal Protective Equipment for Employee Protection

Engineering controls, work practices, and personnel protective equipment (PPE) for substances regulated in OSHA Subpart G (Occupational Health and Environmental Control) and Subpart Z (Toxic and Hazardous Substances) will be implemented in to protect employees from exposure to hazardous substances and safety and health hazards.

1.5.1 Elimination/Substitution

The first control method should be to try and eliminate or substitute the hazards with a safer alternative. This is the most effective solution as shown is Figure 1 below. If you can remove the hazard than you no longer need to find a way to protect the employee

from it. Or you can substitute a different piece of equipment or chemical to use that doesn't pose the same hazard and doesn't create a new one.

1.5.2 Engineering Controls

Engineering controls implement physical change to the workplace, which eliminates/reduces the hazard on the job/task. Examples include:

- Change the process to minimize contact with hazardous chemicals
- Isolate or enclose the process
- Use of wet methods to reduce generation of dusts or other particulates
- General dilution ventilation
- Use of fume hoods

1.5.3 Administrative Controls (Work Practices)

Administrative controls establish efficient processes or procedures to help protect the employee. Examples of these are:

- Rotate job assignments
- Adjust work schedules so that workers are not overexposed to a hazardous chemical

1.5.4 Personal Protective Equipment

The use of PPE to reduce exposure to risk factors is the last line of defense. All other options should be exhausted before use of PPE. Examples of PPE are:

- Chemical protective clothing
- Respiratory protection
- Gloves
- Eye or hearing protection
- Steel toe boots

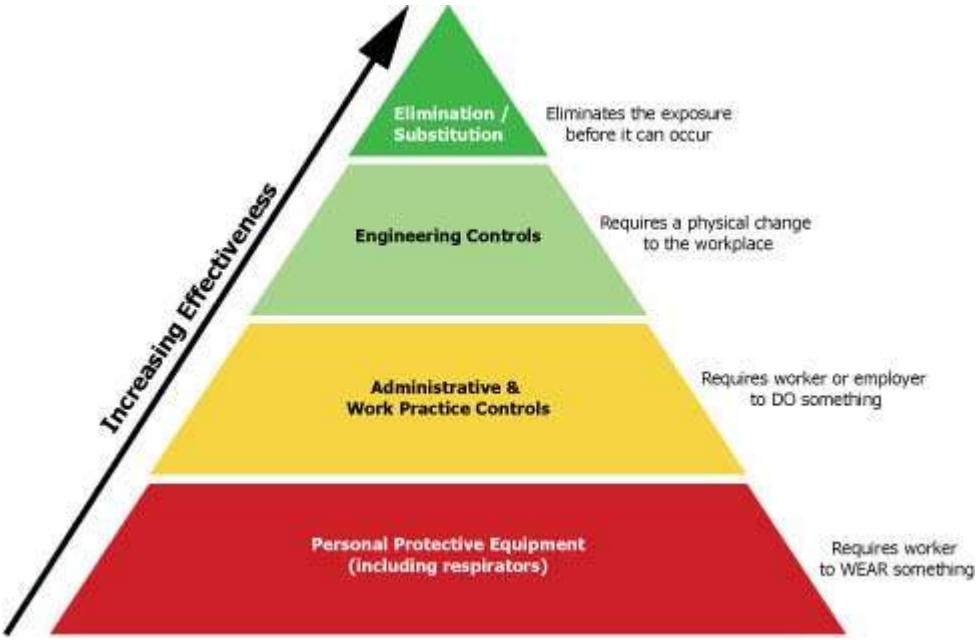


Figure 1: Hazard Mitigation Effectiveness Pyramid

1.5.5 Engineering Controls, Work Practices, and PPE for Substances Regulated in Subparts G and Subpart Z

Engineering controls and work practices will be instituted to reduce and maintain employee exposure at or below the PELs for substances regulated by 29 CFR Part 1910.

Engineering controls that may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices may include removing non-essential employees from potential exposure during opening of drums, wetting down dusty operations, and positioning employees upwind of potential hazards.

If engineering controls and work practices are not feasible, or not required, a reasonable combination of engineering controls, work practices, and PPE will be used to reduce and maintain at or below the PELs or dose limits for substances regulated by 29 CFR Part 1910, Subpart Z.

GEI will not implement a schedule of employee rotation as a means of compliance with PELs or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

The provisions of 29 CFR, subpart G, will be followed.

1.5.6 Engineering Controls, Work Practices, and Personal Protective Equipment for Substances Not Regulated in Subparts G and Subparts Z

An appropriate combination of engineering controls, work practices, and PPE will be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by 29 CFR Part 1910, Subparts G and Subparts Z. GEI will use published literature and Safety Data Sheets (SDS) as a guide in making the determination of what level of protection is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

1.5.7 Decontamination Procedures

Decontamination procedures will be developed, communicated to employees, and implemented before employees or equipment enter areas on site where potential for exposure to hazardous substances exists. Procedures will be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

GEI employees leaving a contaminated area will be properly decontaminated; contaminated clothing and equipment leaving a contaminated area will be properly disposed of or decontaminated.

Decontamination procedures will be monitored by the site safety officer (SSO) to determine their effectiveness. When such procedures are found to be ineffective, the site safety officer will contact the Corporate Health and Safety Officer and appropriate steps will be taken to correct deficiencies.

Location
Decontamination will be performed in areas that will minimize the exposure to employees, equipment, and the environment.

Equipment and Solvents
Equipment and solvents used for decontamination will be decontaminated or disposed of properly.

Personal Protective Clothing and Equipment
Protective clothing and equipment will be decontaminated, cleaned, laundered, maintained, or replaced as needed to maintain their effectiveness.

Employees whose clothing comes in contact with hazardous substances will immediately remove that clothing and follow the directions on packaging or SDS sheet for how to properly clean the exposed area. The clothing will be disposed of or decontaminated before it is removed from the work zone.

Commercial Laundries or Cleaning Establishments
Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment will be informed of the potentially harmful effects of exposures to hazardous substances.

Showers and Changing Rooms
Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, these will be provided and meet the requirements of 29 CFR 1910.141 (Sanitation). If temperature conditions prevent the effective use of water, then other effective means for cleansing will be provided and used.

1.6 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health and Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.7 Limitations

None

1.8 References

OSHA 1910.120 Hazardous Waste Operations and Emergency Response
OSHA 1910 Subpart G Occupational Health and Environment Control
OSHA 1910 Subpart Z Toxic and Hazardous Substances
OSHA 1910.141 General Environmental Controls – Sanitation
http://www.business.govt.nz/worksafe/information-guidance/legal-framework/hsno-act-1996/defining-hazardous-substances/ (Viewed 7/8/2016)
https://www.osha.gov/SLTC/hazardoustoxicsubstances/ (Viewed 7/8/2016)
https://www.osha.gov/SLTC/hazardoustoxicsubstances/control.html (Viewed 7/11/2016)

1.9 Attachments

None

1.10 Contact

Health&SafetyTeam@geiconsultants.com

1.11 Review History

- July 2016
- May 2014
- November 2013
- August 2011 known as Hazard Identification and Management
- February 2011 known as HS-008 Contaminant Properties

STANDARD OPERATING PROCEDURES

SOP No. HS-010 Inclement Weather

1.1 Objective

This Standard Operating Procedure (SOP) is intended for use by employees engaged in work with the potential to be affected by inclement weather. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for working in inclement weather and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.2 General

Employees should be aware of local weather conditions and monitor advisories issued by the National Weather Service and other local reporting services. Depending on location and season, storms are capable of producing heavy rain, floods, extreme temperatures, high wind conditions, lighting, tornados, and/or snowfall.

1.2.1 Heavy Rain

If working or driving in a rain storm, use extreme caution. When driving, turn your low beam lights on when the rainfall becomes heavy. Employees should be aware of the following:

- Heavy rain decreases visibility, especially when driving.
- Surfaces and tools become slippery.
- If you are working in the rain and your clothes become wet there is a risk of hypothermia when exposed to winds, even in warm temperatures.
- If the storms are going to produce thunder and/or lightning, leave the work area immediately and move to a safe area.
- Use your best judgment to determine if the rainfall becomes too heavy to continue working safely.

1.2.2 Lightning

Lightning can strike as far as 10 miles from the area where it is raining. That's approximately the distance you can hear thunder. **If you can hear thunder, you are within striking distance. Seek safe shelter immediately.** This can be within a building or vehicle. Wait 30 minutes after the last clap of thunder or flash of lightning before going outside again.

1.2.3 Flooding

Flooding may occur as a result of heavy rain in a short period of time. Flooding can be particularly acute in canyon areas where dry creek beds can turn into raging rivers from rainfall in distant or higher elevation areas. Be aware of this and your surroundings and move to a safe place if you begin to see signs that flooding may occur. Signs of potential flooding include sudden appearance of water in dry creek beds, increased water flow in rivers or streams, or quick rise in water levels.

Do not attempt to drive through areas or streets that are flooded. Seek alternate routes. Be particularly cautious at night when flooded areas are difficult to see. Urban flooding can stop traffic; increase the potential for traffic accidents; and can trap people in vehicles.

1.2.4 Extreme Temperatures

Work activities may take place in extreme heat or cold. Be prepared if these conditions are anticipated. Have the appropriate personal protective equipment (PPE) available; exercise proper fluid intake; and take breaks to prevent heat and cold stress. For more information about these conditions see the heat stress and cold stress programs found in GEI's Health and Safety Program.

1.2.5 High Winds, Tropical Storms, and Tornados

High Winds can be extremely dangerous. Appropriate measures will be taken to secure equipment and loose items when working in windy conditions. The project manager should be contacted about the weather conditions and, if necessary, work should be postponed.

Tropical storms are described as storms with sustained winds ranging from 39 to 73 miles per hour (mph) and hurricanes produce sustained winds that exceed 74 mph. When winds approach 40 mph (gale force winds) twigs begin to break off of trees and vehicles will veer off of the road. When winds approach 40 mph or the GEI employee feels unsafe based on the activities being performed, stop work and seek shelter as soon as possible. Blowing or falling debris and overhanging limbs/signs can be a significant hazard. If possible, avoid driving in these conditions; 70 percent of injuries during hurricanes are a result of vehicle accidents. Note that tall or elevated equipment will have manufacturer's safe operating wind speeds defined that could be less than 40 mph. The operator's manual should be consulted prior to operation of the equipment.

A tornado is a violent, dangerous, rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure. Based on the Fujita Scale, or F-Scale, numbers begin at F0: 40-72 mph and go to F6: 319-379 mph (F6 is

generally theoretical). Nearly three-fourths of tornados are on the weak F0-F1 scale with just over two-thirds of deaths resulting from the violent F4-F5 tornados.

If a tornado is seen, stop work and seek shelter immediately. If a tornado siren is sounded move immediately to safety indoors and then move to a windowless interior space, basement, stairwell, or designated fall-out shelter. Windows should not be opened before an oncoming tornado. If there is no shelter available, seat belt yourself into your stationary vehicle or seek a depression or low spot on the land surface.

1.2.6 Snowfall and Ice Conditions

Working in the winter months may result in activities taking place during periods of snowfall or icy conditions. If you are working during or after snow has fallen, dress appropriately for the conditions. Snow and ice can cause working surfaces to become slippery. Clear snow and ice from work areas to prevent slip hazards. Use caution when performing snow or ice removal activities to prevent injuries. Driving in snowy and icy conditions is also hazardous. Reduce speed and use caution if you must drive in these conditions.

If the weather conditions deteriorate and you do not feel safe working in these conditions, stop work, move to a safe indoor location, and contact your project manager to let them know the weather, work conditions, and your location.

1.3 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.4 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection. Protection in extreme weather conditions can best be accomplished if the conditions are anticipated and actions are taken. Monitor local weather conditions prior to starting work.

1.5 References

Center for Disease Control and Prevention – Natural Disasters and Severe Weather
http://www.bt.cdc.gov/disasters/

National Lightning Safety Institute

NOAA, National Weather Service

Office of Climate, Water, and Weather Services

1.6 Attachment

None

1.7 Contact

Safety Team
Health&SafetyTeam@geiconsultants.com

1.8 Review History

- Previous revision dates were not documented
- May 2014
- July 2016

STANDARD OPERATING PROCEDURES

SOP No. HS-012 Noise Exposures

1.1 Objective

This Standard Operating Procedure (SOP) is intended for use by employees engaged in work with elevation noise levels. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for work in loud environments and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.2 General

Working in loud environments can cause hearing damage and loss if the proper protection is not in place. The following procedures describe methods to mitigate unhealthy noise levels and protect hearing.

1.3 Hazard Identification

If projects involve noise levels above OSHA regulations, employees should take steps to remove the noise exposure. Common sources of elevated noise levels are heavy equipment, power tools, pumps, and generators. GEI has an established Hearing Conservation Program located in the GEI Health and Safety Program.

1.4 Risk Identification

Hearing protection is required if noise levels in a work area are known to be above 85 decibels (dB), which can be measured with a noise meter. When decibel levels are not known, hearing protection is required if you need to raise your voice to talk to someone standing within a normal speaking distance from you.

1.5 Mitigation

There are three options that can be used to help mitigate a noise hazard:

1.) Remove the hazard by taking away the source of the noise.

2.) Remove the employee from the source of the noise.

3.) Provide the employee with appropriate personal protective equipment (PPE).

The first option for employee protection is to remove the hazard by taking away the source of the noise or using engineering controls to reduce the level.

If this cannot be accomplished, the next control measure is to remove the employee from the source. This can be done by moving the work area to a quieter location or distancing the employee from the noise source. For example, GEI employees do not need to be standing next to an operating drill rig or other heavy equipment. By distancing themselves from heavy equipment or other noise sources the need for hearing protection can be eliminated/reduced.

The final option, if the above two options aren't feasible, disposable ear plugs that are made available to GEI employees are to be used. Additional means of hearing protection will be provided, such as ear muffs, if the disposable ear plugs are not adequate.

When using hearing protection, employees will need to make a greater effort to be aware of the surroundings which may include moving equipment, traffic, and other site hazards.

1.6 Proper Use of Hearing Protection

DISPOSABLE EAR PLUG FITTING INSTRUCTIONS

Before fitting any ear plugs, make sure your hands are clean.
Foam ear plugs are disposable and not intended for reuse.

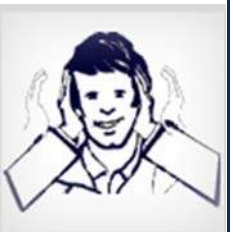
Hold the ear plug between your thumb and forefinger. Roll and compress the entire ear plug to a small, crease-free cylinder. While still rolling, use your other hand to reach over your head and pull up and back on your outer ear. This straightens the ear canal, making way for a snug fit.



Insert the ear plug and hold for 20 to 30 seconds. This allows the ear plug to expand and fill your ear canal.



Test the fit. In a noisy environment, and with earplugs inserted, cup both hands over your ears and release. You should not notice a significant difference in the noise level. If the noise seems to lessen when your hands are cupped over your ears, your ear plugs are not fitted properly. Carefully remove the earplugs (see instructions below) and refit following instructions, above.



Always remove ear plugs slowly, twisting them to break the seal. If you remove them too quickly, you could damage your ear drum.	

REUSABLE EAR PLUG FITTING INSTRUCTIONS

Before fitting any ear plugs, make sure your hands are clean.

Reusable ear plugs should be inspected and cleaned often in soapy water. If they become hard, torn, or deformed they should be discarded and replaced.

Reach around your head and pull up and back on your outer ear. This straightens out the ear canal, making way for a snug fit. Hold the stem end of the ear plug and insert it well inside your ear canal until you feel it sealing and the fit is comfortable.	
Test the fit. In a noisy environment, and with ear plugs inserted, cup both hands over your ears and release. You should not notice a significant difference in the noise level. If the noise seems to lessen when your hands are cupped over your ears, your ear plugs are not fitted properly. Carefully remove the ear plugs (see instructions below) and refit following instructions, above.	
Always remove ear plugs slowly, twisting them to break the seal. If you remove them too quickly, you could damage your ear drum.	

1.7 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety

Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, People Team, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.8 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.9 References

OHSA 29 CFR 1910.95 – Occupational Noise Exposure

OHSA 29 CFR 1926.101 – Hearing Protection

Texas American Safety Company (TASCO)

1.10 Attachments

None

1.11 Contact

Health&SafetyTeam@geiconsultants.com

1.12 Review History

- June 2016
- May 2014
- November 2013
- February 2011
- November 2010

STANDARD OPERATING PROCEDURE

SOP HS-014 Utility Mark-out

1.1 Objective

This Standard Operating Procedure (SOP) provides guidance for utility mark-out procedures related to drilling, excavation, or other sub-surface or intrusive activities to avoid injury to GEI employees or property damage. This SOP is applicable when GEI is responsible for its operation or our subcontractor's operation for utility mark-out. A utility mark out is when paint, flags or other markers are put in place to identify the location of an underground utility.

Clients or local agencies may have additional requirements or procedures to mark out of utilities. If local utility mark-out procedures differ from those described within this SOP, applicable state or municipal regulations should be followed.

1.2 General

This SOP is intended for use by employees engaged in work with sub-surface or intrusive activities. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for subsurface hazards and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.2.1 Contractor/GEI Responsibilities

- The contractor or GEI employee will pinpoint each exploration area with white paint, flags, or stakes. personal protection equipment (PPE), including eye protection when using spray paint will be worn.
- Exploration locations should be marked-out with sample identification number(s) and type of sample (e.g., boring, test-pit, or monitoring well).
- The contractor compiles information about the work areas on a request form specified by the state utility mark-out program and submits it. Work area location maps can be sent to the utility mark-out program to clarify locations.
- The mark-out program customer service representative will provide a mark-out ticket number and a list of utilities notified upon receipt of the request information. This information will be recorded on the GEI documentation form in Appendix B and/or in other project documents.
- If known, the contractor or GEI employee will also notify non-member utility operators (e.g., apartment complexes, commercial complexes, railroads with communication cables, etc.).

1.2.2 Utility Mark Outs

- Utility companies or their sub-contractors will only mark-out, or clear, utilities under their responsibility. Generally, this means that they will only mark-out utilities within the public right-of-way up to private property boundaries. Information needed to determine the location of utilities on private properties will be requested from the property owner. This may include available property drawings or as-built figures. If this information is not available, additional non-intrusive surveys of the property may be required by a private utility locator to find underground utilities by using techniques such as ground penetrating radar (GPR).
- American Public Works Association (APWA) Uniform Color Code For Marking Underground Utility Lines are:
    1. **White** – Proposed Excavation
    2. **Pink** – Temporary Survey Markings
    3. **Red** – Electric Power Lines, Cables, Conduit and Lighting Cables
    4. **Yellow** – Gas, Oil, Steam, Petroleum, and Gaseous Material
    5. **Orange** – Communications, Alarm, Signal Lines, Cables or Conduit
    6. **Blue** – Water
    7. **Purple** – Radioactive Materials
    8. **Green** – Sanitary and Storm Sewers and Drain Lines

1.2.3 Utility Mark Out Review

- Before the intrusive work activities begin, the contractor or GEI employee will verify that each utility company has completed a utility location for the work area or the location has been cleared by a private locator and record this on the mark-out request information sheet.
- A visual survey of the project area will be done prior to the start of intrusive activities. This visual inspection will be done to identify signs, manholes, utility boxes, or other evidence of an underground utility is present and has been considered.
- The contractor or GEI employee can begin work on the scheduled work date and time if the utility operators have responded, taking care to find and preserve markings that have been made.
- Completed clearance documentation will be located on the excavation site during excavation activities and kept in project files.

1.2.4 Excavations

- When excavating near a buried utility, observe the approximate location around that utility.
- If exposing a utility, proper support and protection must be provided so that the utility will not be damaged.
- If the excavation work requires significant spans of the utility to be exposed, it is the contractor's responsibility to support the infrastructure (to prevent sagging or collapse) as needed. Contact the utility operator for support, guidance, or assistance.
- When the excavation is complete, provide proper backfill for utilities that have been exposed.
- Take care not to damage the conduit or protective coating of a utility. If the damage occurs, leave the damaged utility exposed and immediately call the utility owner.
- If a gas line is encountered, everyone will be evacuated according to the site evacuation procedures and the contractor must notify police, fire, and emergency personnel. No attempt should be made to tamper with or correct the damaged utility. All site personnel are to evacuate to the site's predetermined meeting point or a location a minimum of 300 feet away from the incident location.
- If the contractor needs to dig within the approximate location of a combustible, hazardous fluid, or gas line (natural gas, propane or gasoline), soft digging is required (hand digging, vacuum extraction) to a maximum depth of 5 feet. The approximate location is defined as 24 inches on either side of the designated center line of the utility if the diameter is not provided or 24 inches from each outside edge if the diameter is provided.

1.3 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health & Safety Officer (RHSO).

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification and/or the receipt of the Incident Report Form, RHSO will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.4 Limitations

- Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.
- Mark-out notification time usually does not include holidays. Make sure holidays are considered and mark-out time is scheduled accordingly. Under no circumstances are intrusive activities allowed to be performed prior to the required mark-out.
- Do not use white paint if precipitation is eminent. Consider using stakes if snow is predicted.

1.5 References

Reference the website for the "Call Before You Dig – 811" for the utility mark-out agency for the state you working in prior to site work. If you have issues locating the appropriate agency, contact the Safety Team for assistance.

1.6 Attachments

Attachment A – Standard Utility Color Codes

Attachment B – GEI Utility Clearance Documentation Form

1.7 Contact

Health&SafetyTeam@geiconsultants.com

1.8 Review History

- June 2016
- May 2014
- November 2013
- February 2011
- November 2010

ATTACHMENT A

COLOR CODE FOR UTILITY MARKING

(BASED ON 'THE AMERICAN PUBLIC WORKS ASSOCIATION' RECOMMENDATIONS AND THE ANSI STANDARD Z-53.1 FOR SAFETY COLORS)

UTILITY	COLOR
PROPOSED EXCAVATION	WHITE
ELECTRIC POWER LINES, CABLES, CONDUIT AND LIGHTING CABLES	RED
POTABLE WATER	BLUE
STEAM, CONDENSATE, GAS OR OIL COMPRESSED AIR	YELLOW
TELECOMMUNICATIONS, ALARM OR SIGNAL LINES, CABLES OR CONDUIT	ORANGE
TEMPORARY SURVEY MARKINGS	PINK
SEWER AND STORM DRAINS	GREEN
CHILLED WATER, RECLAIMED WATER, IRRIGATION AND SLURRY LINES	PURPLE
OTHER	LIGHT BLUE

ATTACHMENT B

Utility Clearance Documentation

Please print clearly. *For more room, use back of page.*

Client: _____

GEI Project Name & Number: _____

Site: _____

Excavation/Drilling Location ID: _____

Excavator/Driller: _____

GEI PM: _____ GEI Field Team Leader: _____

Utility Drawings Reviewed: _____

Provided By: _____ Reviewed By: _____

Utility Clearance Call Date: _____ Name of Utility: _____

Utility Clearance Call Date: _____ Name of Utility: _____

Utility Clearance Received from (utility & rep name): _____ Date: _____

Utility Clearance Received from (utility & rep name): _____ Date: _____

Company that completed clearance: _____ Date: _____

GEI Staff Responsible for Oversight: _____

Metal Detector Survey (yes/no): _____ Drilling Location Cleared by: _____

Contractor Name: _____ Company Name: _____

Contractor Signature: _____ Date: _____

GEI Staff Responsible for Oversight: _____

Private Location Clearance Required (yes/no): _____ Date: _____

Contractor Name: _____ Company Name: _____

Contractor Signature: _____ Date: _____

Methods used for utility location (i.e. GPR, electronic pipe location) _____

GEI Staff Responsible for Oversight: _____

Hand clearing Performed (yes/no): _____ Methods: _____ Date: _____

Contractor Name: _____ Company Name: _____

Contractor Signature: _____ Date: _____

GEI Staff Responsible for Oversight: _____

GEI Consultants, Inc. Representative (name & title): _____

GEI Consultants, Inc. Representative Signature: _____ Date: _____

Based upon the best available information, appropriate utility clearance procedures were performed for the invasive work specified. If client ordered site specific deviations from existing GEI utility clearance procedures, they are approved by the client signature below:

Client Representative (name & title): _____

Client Representative Signature: _____ Date: _____

Notes:

STANDARD OPERATING PROCEDURES

SOP No. HS-016 Traffic Hazard Management

1.1 Objective

The objective of this Standard Operating Procedure (SOP) is to prevent or limit the potential for GEI personnel to encounter traffic hazards during field activities.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for traffic hazards. The site-specific health and safety plan (HASP) will include a hazard assessment for the project that identifies the potential for exposure to traffic hazards and the control methods to be implemented by GEI employees, including review or attainment of necessary permits, traffic control plans, and flagger/police detail requirements for the local jurisdiction. Routine checks of the work zone will be made to ensure there are adequate levels of protection. These hazards will be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.3 Traffic Hazard Management

Traffic Hazard Management is the process of identifying and managing the potential risks associated with the movement of traffic through, around, or past a work area. This Traffic Hazard Management SOP is designed to assist employees in identifying and managing these hazards. Work areas should be as safe as possible. It is the responsibility of GEI employees to follow the Traffic Hazard Management SOP and adhere to these safety standards. Safety is not negotiable.

Under no circumstances are GEI employees permitted to commence work in a situation that the employee believes or knows their health and safety, or the health and safety of others, is at risk.

Major risk factors for work site Traffic Hazard Management include:

- The speed of traffic moving through a work site.
- The distance and clearance between moving traffic, workers, vehicles and equipment, and over-head power lines.
- Traffic volume and vehicle composition.
- Nature and conditions at the work site and approaches to the work site.

- Other factors such as the time of day, sight distance, weather, presence of pedestrians, or cyclists, and the type of work being carried out.
- Other hazards in proximity to the work site (e.g., power lines, open excavations) that may have conflicting safety management measures that need to be considered when developing the HASP.

1.4 Site Preparation

The following management measures will be considered whenever working in traffic areas. In addition, remain aware of the amount of traffic around the working area. The work space should be large enough for the job to be completed safely. Check permit, traffic control plans, and flagger/police detail requirements for the local jurisdiction. Perform routine checks of the work zone to make sure there are adequate levels of protection.

1.4.1 Traffic Barriers and Warning Signs

GEI employees will comply with the U.S. Department of Transportation's (DOT) Manual on Uniformed Traffic Control Devices (MUTCD) and/or state regulations for temporary traffic barriers (cones, barriers) and sign placement when required for working in traffic areas. Clearly define the work site by placing traffic barriers around the work space to indicate the space that is needed to safely perform the work. The traffic barrier will help make the work site more visible to other workers, pedestrians, cyclists, and moving vehicles. Place traffic barriers in such a way as to give yourself and equipment adequate space to work within the barriers. OSHA suggests placing the first warning sign at a distance calculated to be 4 to 8 times (in feet) the speed limit (in MPH).

1.4.2 Adequate Light

Requirements for night conditions and work areas with poor visibility are similar to day requirements. However there are a number of additional things to consider, such as visibility of the work site to advancing traffic and sufficient lighting. OSHA requires lighting for workers on foot and equipment operators to be at least 5-foot-candles or greater.

Visibility of the work area can be increased by employing the following measures:

- Using parked vehicles hazard and flashing lights.
- Wearing reflective personal protective equipment (PPE), such as a safety vest, in good condition.
- Providing adequate lighting to illuminate the work area with lights positioned so that there is no glare to approaching drivers.
- Placing reflective advance warning signs and traffic barriers so that they are visible to road users.

1.4.3 Distance from the Nearest Traffic Lane

Work areas located along roadsides will have a minimum clearance as defined by DOT's MUTCD and/or state or local DOT regulations for traffic barrier and sign placement.

1.4.4 PPE

The proper PPE, as outlined in the project HASP, will be worn when appropriate. The color/type of safety vest will comply with site regulations.

1.5 Equipment Operation

Vehicles and heavy equipment operators should use a spotter when possible if it is necessary to drive in reverse to reduce risk of collision with oncoming traffic. If it is necessary to drive against the flow of traffic make sure this area is within the work zone and properly blocked off from oncoming traffic.

1.6 Pedestrian Safety

When working near pedestrian traffic, a safe alternate pedestrian route will be established. Refer to local regulations when establishing pedestrian walkways.

1.7 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health & Safety Officer (RHSO).

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the RHSO will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.8 Limitations

Follow safety procedures as defined in the site-specific HASP, federal DOT, and local jurisdictions. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.9 References

DOT's Manual on Uniformed Traffic Control Devices (2009 Edition)

Hazard Exposure and Risk Assessment Matrix for Hurricane Response and Recovery Work: https://www.osha.gov/SLTC/etools/hurricane/work-zone.html

1.10 Attachments

None

1.11 Contact

Health&SafetyTeam@geiconsultants.com

1.12 Review History

- November 2016
- May 2014
- November 2013
- August 2011
- October 2010 Initially HS-027 Traffic Hazards

STANDARD OPERATING PROCEDURES

SOP No. HS-018 Working Around Heavy Equipment

1.1 Objective

The objective of this Standard Operating Procedure (SOP) is to prevent or limit the physical hazards when working around heavy equipment.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for working near heavy equipment. The project site-specific health and safety plan (HASP) should include a hazard assessment for working near heavy equipment to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.3 Heavy Equipment Precautions

Heavy equipment (e.g., excavators, backhoes, drill rigs, etc.), can present many physical hazards that can result in serious injury or death if the proper safety precautions are not followed. The following is a list of precautions to be aware of when working around heavy equipment:

- Wear appropriate personal protective equipment (PPE), including at a minimum reflective, high-visibility safety vest, hard hat, safety glasses, and steel/composite toe boots.
- Always keep your distance from moving equipment.
- Do not assume the operator knows where you are or where you are going.
- Make sure to make eye contact and receive acknowledgement of your presence with the operator.
- Avoid working near heavy equipment, but if unavoidable, communicate your location with the operators. If using hand signals, discuss the signals with the equipment operator prior to starting work.
- Watch for moving equipment. Construction sites can have a lot of activity and equipment may be moving in an unpredictable manner.
- Do not rely on back-up or other alarms. They may not be working or you may not hear them with the noise of other activities taking place in the area.
- Stay out of the swing radius of cranes, excavators, or other equipment that swings or rotates.
- Do not walk beside a moving vehicle, the vehicle may turn, slip, or the load may shift causing the vehicle to go off course.
- Do not ride on the outside of a moving equipment.

- Never walk under or stand too close to a load suspended by cranes or hoists.
- Do not walk behind a piece of equipment that is backing up without acknowledgment from the operator it is safe to proceed. If working next to heavy equipment is unavoidable, be aware of the hazards including pinch points and moving parts. Use a spotter to watch the work area for moving equipment.
- If necessary, ask the operator to stop equipment operation to perform your work tasks.
- Verify the location and operation of emergency shut-off devices on the equipment.
- Be aware of the fuels and chemicals associated with the equipment. Have a spill prevention and response plan in place that includes the appropriate containment materials (i.e., spill kit).
- Do not wear loose fitting clothing when working around moving equipment (i.e., drill rig augers).
- Do not operate heavy equipment.
- Do not use cellular telephones near operating equipment.

1.4 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.5 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.6 References

OSHA 29 CFR 1926.600 – Subpart O; Motor Vehicles, Mechanized Equipment, and Marine Operations.

www.toolboxtopics.com/Construction/ (Viewed 10/16)

Caterpillar Safety – http://safety.cat.com/ (Viewed 10/16)

1.7 Attachments

None

1.8 Contact

Health&SafetyTeam@geiconsultants.com

1.9 Review History

- October 2016
- May 2014
- November 2013
- August 2011
- October 2010

STANDARD OPERATING PROCEDURES
SOP No. HS-024 Wilderness Safety

1.1 Objective

Employees may be involved with projects that requires performing tasks that include traversing through wilderness areas. The following guidelines, along with the site-specific health and safety plan (HASP) and standard operating procedures (SOPs) will be followed when employees perform work in wilderness areas.

1.2 General

The purpose of this standard operating procedure (SOP) is to assure the safe deployment and return of personnel during field activities involving traversing through wilderness areas. The HASP will include a hazard assessment for the project that identifies the potential for encounters with wilderness hazards and the control methods to be implemented by GEI employees. These hazards will be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.3 Trip Planning

1. **Always communicate your itinerary** with other employees to include routes to be used, and estimated travel/return times. Create a Trip Plan and leave it with a reliable person who will be expecting your return.

2. **Set a deadline** for when sending out assistance should be considered if you are overdue or haven't been in communication with anyone.

3. **Before your trip**, learn about the hazards you may encounter and take adequate precautions. Select appropriate clothing and pack first aid kits, and safety equipment in a backpack. Essentials include, but are not limited to: plenty of water, and high energy food, signal mirror, matches, emergency thermal foil blanket, whistle, bear spray (worn in a quickly accessible locations such as a hip or chest holster) (MFWP, 2017) , etc. Make sure cell phones are fully charged. If cell phone coverage is not expected take alternate forms of communications such as a SPOT GPS device, contact the Regional Health and Safety Officer (RHSO) or Corporate Health and Safety Officer (CHSO) for additional information. Check weather reports and reschedule trip if needed.

4. **Know your own limitations**. Do not attempt to traverse areas that you or your coworkers are not physically capable of handling. You are responsible for your safety; be alert and stay alive.

5. **Track your location** using map and/or compass. If you don't have this knowledge, let your project manager and the safety team know so that arrangements can be made for proper training. If you encounter trouble, do not hesitate to turn back. SPOT GPS devices are also available for employee use.

6. **During bad weather** like rain, snow, and fog, you may be safer if you stay put rather than attempt to travel.

Source: National Park Service (NPS, 2017a).

1.4 Stream Crossings

Most major stream crossings are bridged, but not all. High water or bridge damage can also mean encountering unexpected or difficult stream crossings. In addition, water releases from dams upstream may impact stream flow rates and water levels. Check with Dam Operators to determine if releases are in progress or scheduled.

Time your crossing accordingly. Find the best crossing area by looking for wider, shallower areas with safe downstream conditions. Cross in the morning before snowmelt swells the water level, if applicable. Unbuckle your pack straps, wear secure footwear, and angle your travel across the current. Don't tie yourself to another person or object while you cross. *Do not attempt an unsafe crossing*—if in doubt, turn back or wait for help.

1.5 Trail Conditions

With a few exceptions, most trails typically follow valley bottoms to high passes, as the terrain is usually too steep to follow high ridges. This may also be true around lakes, reservoirs and wetland areas. Trails are often not marked or easily identified, or may be covered with deep snow. Contact the Ranger Station prior to departure to verify trail conditions.

1.6 Snow Travel

Travel over steep snow requires the proper equipment and clothing which may include sturdy waterproof insulated boots, an ice axe, heavy duty rope, cold weather clothing, and gloves. Slip, trips, and falls are of primary concern on snow covered trails, more so on ground sloping towards water such as streams, lakes, and reservoirs. A hazard assessment for these conditions, and their controls, will be included in the HASP.

1.7 Hypothermia

Hypothermia is "a medical emergency that occurs when your body loses heat faster than it can produce heat, causing a dangerously low body temperature." (Mayo Clinic, 2017) Hypothermia can occur quickly or more slowly from long exposure to cold, rain and wind. It is possible to get hypothermia in temperatures as high as 50 degrees Fahrenheit.

Early signs of the condition are hard to detect, so when it is wet and cold, watch for these symptoms in your party: poor judgment, lethargy, shivering, and clumsiness. Prevent hypothermia by wearing wool or synthetic layers (NOT cotton), stocking cap, and rain gear.

Avoid exposure to the wind, especially when wet or sweaty. Wear adequate rain gear and wool or polypropylene clothing layers, not cotton. Nearly half of body heat is lost through the head, so always wear a stocking cap when weather dictates. Eat high-energy foods. Treatment of hypothermia can be complex, but the key is to prevent further heat loss, and to re-warm and re-hydrate the victim.

1.8 Heat Illness

Heat exhaustion can be brought on by warm weather, exertion, and dehydration. Symptoms are hot, red, moist skin and fatigue, frequently accompanied by a headache. When the weather is warm, take frequent short breaks in the shade, and drink plenty of water. If your urine is dark yellow, you need to drink more water. Failure to observe and treat the signs of heat exhaustion can lead to heat stroke, an extremely serious condition.

1.9 Emergencies

It is important to track your location using map and/or compass. If you encounter trouble, do not be hesitate to turn back. SPOT GPS devices are also available for employee use. If you become injured, provide whatever treatment you can. Do not leave an injured person alone. Use either your cell phone or the SPOT technology to contact emergency services for help.

If cellular service is available, call 911 and provide the following information:

- Nature of the emergency: date and time it occurred, details of incident and injuries.
- Your name and cell phone number.
- Injured person's condition: airway, breathing and circulation—normal or on the extreme? Has first aid been given? Is CPR in progress?
- Location: the closest known location, or approximate distance or walking time from a known location. Mark it on your topo map as best you can.
- Resources: number of people (adult/juvenile) and equipment left at the scene.
- Injured person's information: name, address, phone, age, weight, who to notify.
- Color of injured party's belongings: tent, pack, clothing.

If you become lost, stay calm and think through the situation. Use your cell phone or SPOT GPS Device, if possible. Refer to your position on the topo map. If you are truly lost, stay where you are—you will be found sooner. Stay warm and dry. If you are tempted to follow a river or creek, remember that these are often the most dangerous routes. Create a signal visible from the air. Lay out brightly-colored clothing in a forest clearing. Use a signal mirror. If possible, build a shelter to reduce exposure to the elements and place a bright color item outside.

1.10 Cell Phones

Because cell phone coverage may be patchy in wilderness areas, have a SPOT GPS Device on-hand. If there is no SPOT GPS Device and cell phone coverage is lacking or intermittent, there may be a chance to reach a cell signal by climbing to a ridge top. If it's not safe to climb to the ridge top, do not attempt it. From the backcountry, report emergencies by calling 911 or pushing the appropriate button on your SPOT GPS Device. Once connected to an emergency operator, state who you are, your specific location, and the other information outlined under Section 1.9, above. Knowledge of one's location is vital to the success of any rescue, therefore **it is important to track your location** using map and/or compass. Also, provide your cell phone number so you can be called back; don't move if they are planning to return a call. Sometimes just a foot or two makes a difference in getting a call through to a cell phone in the wilderness.

1.11 Cougars and Bears

As you walk in the wilderness, keep an eye out for wildlife tracks. If you notice cougar tracks, "(four toes, and usually no claw prints since their claws are retractable) and droppings, and scan trees for fresh claw marks. If you see something that signals that a cougar might be in the area, consider making a returning the way you've come from before you encounter one face-to-face." (The Clymb, 2017)

If you are in known cougar or bear territory, it's a good idea to be noisy to avoid startling a cougar or a bear. Talk among your group, carry a bell, and get extra loud when the wind is blowing strong or around loud water. (The Clymb, 2017)

1.11.1 Cougars

Seldom seen, cougars (also called mountain lion, puma, panther, or catamount) are large animals, often over 100 pounds, with long rope-like tails. They are usually reddish-tan to gray-brown, with black markings on the face and tail tip. Report all cougar sightings to a ranger. The cougar is a potentially dangerous animal, although attacks on humans are rare.



Cougar.
Photo source: Wikipedia.

Keep bear spray in a readily-accessible location (hip or chest holster) at all times; it may help to deter an attacking lion. (MFWP, 2017)
See subsection "Bear Spray and Cougars" below.

If you see a cougar:

- Ready your can of bear spray (with the safety removed).
- Pick up small children immediately so they won't panic, flee, or make rapid movements.
- Do not approach, especially one that is near a recent prey-kill or has kittens.
- Stop. Stay calm and do not turn your back. Do not run.
- Face the animal, stand upright, talk calmly and firmly to the cougar and give it a way to escape if you can.
- Do all you can to appear larger, for example, open your jacket and slowly raise and wave your arms.
- If the cougar becomes more aggressive, become more aggressive toward it; convince the animal that you are not prey, but a danger to it. Be prepared to use your bear spray in case the cougar approaches too closely.
- Fight back if attacked.

Bear Spray and Cougars. In 2001, A Montana Fish Wildlife and Parks (MFWP, 2017) mountain lion biologist and field technicians used bear spray to successfully thwart an attacking lion. Below are some guidelines that may help

> Bear spray goes out about 25 feet. If the user sprays a cloud 25 feet out and a lion is moving in from a greater distance, it could meet the cloud of active bear spray ingredients. However, mountain lions are less likely to charge so they may work their way around the initial orange cloud. Some experts

suggest that even the sound of the spray coming out of the can and the appearance of the orange cloud of capsaicin may be enough to deter a mountain lion that is simply curious or confused about whether what they see is prey.

Wildlife experts recommend a canister that contains six-seconds of spray. A burst of two to three seconds will create a cloud of orange. It may be necessary to spray a second burst if the animal retreats and returns, or if the first cloud disperses in the wind.

1.11.2 Bears

It's normal to be frightened when you encounter a bear. The reality is that most encounters with bears rarely lead to aggressive behavior and attacks are even rarer. Remember, most bears prefer to avoid contact with humans, and any bear you do see is probably just as frightened as you are. "Each bear and each experience is unique; there is no single strategy that will work in all situations and that guarantees safety. Most bear encounters end without injury. Following some basic guidelines may help to lessen the threat of danger. Your safety can depend on your ability to calm the bear." (NPS, 2017b)

Remain as composed as possible and follow these simple guidelines whenever you are in bear country. The best way to prevent an unpleasant bear encounter is to avoid them all together. Bears usually avoid people, and most people don't even know when they've come close to a bear.

To ensure a surprise or unpleasant encounter with a bear doesn't occur, avoid moving through bear habitat silently and alone. Travel in groups (the larger the better) and make lots of noise by talking or singing. Put distractive devices (e.g., smart phones, etc.) away and pay attention to your surroundings.

If You Meet a Bear

If you meet a bear on the trail, stop, remain calm, ready your bear spray (or other deterrent), and evaluate the situation. Identify yourself by speaking in a calm, appeasing tone. Stay together if you are in a group; you will appear larger and more intimidating. Remain still; stand your ground but slowly wave your arms. Make yourselves look as large as possible. Do not allow the bear to access your food. Do not drop your pack – you provide protection for your back.



American Black Bear.
Photo source: Wikipedia.

If the bear is stationary, **move away slowly and sideways**; this allows you to keep an eye on the bear and avoid tripping. Moving sideways is also non-threatening to bears. Do NOT run, but if the bear follows, stop and hold your ground. Bears can run as fast as a racehorse both uphill and down. Like dogs, they will chase fleeing animals. Do NOT climb a tree. Both grizzlies and black bears can climb trees. Leave the area or take a detour. If this is impossible, wait until the bear moves away. Always leave the bear an escape route. (Bear Smart, 2017; NPS, 2017b)

Bear Spray. Wear a can of bear spray in a hip or chest holster at all times. If a bear is near, keep a can of pepper spray ready (with the safety removed) in case the bear approaches too closely. Bear spray goes out about 25 feet.

Try to figure out whether the bear is a grizzly or a black bear. As you will see below, grizzly bears and black bears tend to behave differently in a given situation, so it helps to know which species you're dealing with. If possible, try to determine whether there are cubs present or whether the bear is defending an animal carcass or other food source. Females with cubs or bears defending food sources are more likely to act aggressively as they defend their cubs and/or food.

Back away slowly, preferably in the direction you came. Walk, don't run, and keep your eye on the bear so you can see how it will react. In most cases, the bear will flee.

Campsite

If you are in your campsite or other place bears shouldn't be, **and you are sure the bear is a black bear**, ensure the bear has a clear and safe escape route with no people or obstacles in its way. Stand tall and look it directly in the eye. Yell at the bear and firmly tell it to leave: "Get out of here, bear!" Keep a can of pepper spray ready (with the safety

removed) in case the bear approaches too closely. **Never try to "move" a grizzly bear!** (Bear Smart, 2017)

Dealing with a 'Defensive' Encounter

Sometimes a bear that feels threatened will 'act' aggressively to defend against a perceived threat. This is often the case with a mother bear with cubs, a bear defending a food source, or a surprise encounter. The closer you are to the bear when it becomes aware of you, the more likely it is to react defensively: it may pop its jaws or swat the ground with its front paw while blowing and snorting, and/or it may lunge or "bluff charge" toward you in an attempt to get you to leave.

In this situation, the bear doesn't want to fight any more that you do. It is simply trying to communicate that you are too close. Try to appear non-threatening by remaining still and calm. Ready your bear spray by removing the safety lock. Speak in an appeasing voice and back away, increasing your distance from the bear. Leave the area immediately.



Grizzly Bear. Photo source: Wikipedia.

ct almost always involve grizzly bears surprised at close range, on a carcass, or protecting young. The very few defensive attacks by black bears have been females protecting cubs (but these are very rare).

If you encounter a bear on a carcass, get as far away from the bear's cache as possible; leaving the area quickly and quietly preferably in the same direction you came in. If the bear is about to make contact, use your bear spray. Do not play dead and do not act aggressively. Get as far away from the food cache as possible. If you do not have your bear spray and the bear makes contact, fight back.

If a bear that is behaving defensively is intent on making contact, your first line of defense is always your bear spray. Point the nozzle just above the bear's head so that the spray falls into the bear's eyes, nose and throat. When it is 20 to 30 feet away, give it a long blast. That should be enough to discourage it and send it in the other direction. (Source: Bear Smart)

If the encounter was a surprise or it involves a grizzly bear with or without cubs, and *the bear makes physical contact*, fall to the ground and "play dead." Roll over onto your stomach and cover your neck and the back of your head with your hands. Keep your legs and elbows wide so the bear can't flip you over. When the attack stops, remain still and

wait for the bear to leave. Do NOT get up until you are absolutely certain the bear is no longer in the area – even if you have to wait 30 minutes or longer.

If an attack is prolonged or the bear starts eating you, it is no longer being defensive and it is time to fight back. Kick, punch or hit the bear with whatever weapon is available. Concentrate your attack on the face, eyes and nose. (Bear Smart, 2017)

1.11.3 Other Wildlife

During warm weather, black flies, deer flies, horse flies, spiders, and mosquitoes can be a nuisance. Wearing insect repellent, long sleeved shirts, and long pants may help. Yellow jackets are common in warm weather, and may nest in rotten logs or in the ground. Please *refer to* SOP, Biological Hazards (HS-001) for more information about insects and arachnids.

Deer are found nearly everywhere in the wilderness and show little fear of humans. Do not feed deer. They can be dangerous, striking out with their hooves or antlers. Feeding deer can also be harmful to their health. They crave the salt found in human urine, feces and food. An inadequately dug cathole latrine can be a deer's delight, so bury human waste properly (4-6 inches deep and 4-6 inches in diameter [SectionHiker, 2017]).

Nonnative mountain goats have become accustomed to human contact. Goats are also attracted to the salts in urine and sweat. To reduce their impacts on plants and soil, urinate on large rocks or areas free of vegetation, such as the trail tread. Store anything that smells of sweat, including clothes, boots and packs, inside your tent.

Mothers of some animals may become dangerous if you disturb their young. **Never get between a female bear and her cub.** Young animals, such as fawns, may be temporarily left by their mother. Do not be tempted to pick up these young animals, even if you think something is wrong with them. A lingering human scent can lead to abandonment.

1.12 Biological Hazards

Personnel may encounter potential biological hazards such as animals, insects, and plants when traversing through wilderness areas. The HASP will include a hazard assessment for encounters with biological hazards and control methods to be implemented by GEI employees. Specific information is available in SOP, Biological Hazards (HS-001).

1.13 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the RHSO will conduct an investigation and evaluation on what happened and how and why it happened. The CHSO will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.14 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE will be worn correctly to provide the intended level of protection.

1.15 References

GEI Consultants Inc. SOPs
HS-001 Biological Hazards
HS-010 Inclement Weather
HS-017 Water Safety

Get Bear Smart Society
http://www.bearsmart.com/play/bear-encounters/ viewed on 3/21/17

The Mayo Clinic.
http://www.mayoclinic.org/diseases-conditions/hypothermia/basics/definition/con-20020453 viewed on 3/21/17

Montana Fish, Wildlife, and Parks. MFWP.
http://fwp.mt.gov/recreation/safety/wildlife/lion/lionBearSpray.html viewed on 3/21/17

National Park Service. NPS. 2017a.
http://www.nps.gov/olym/planyourvisit/wilderness-safety.htm viewed on 3/21/17

--. NPS. 2017b.
https://www.nps.gov/subjects/bears/safety.htm viewed on 3/22/17

SectionHiker. How to Dig a Cathole.
http://sectionhiker.com/how-to-dig-a-cathole/ viewed on 3/22/17

Texas Parks & Wildlife.
http://tpwd.texas.gov/state-parks/park-information/alligator-safety viewed on 3/21/17

The Clymb. “Avoid Cougar Attacks: 7 Things to Do If You Encounter a Big Cat”
http://blog.theclymb.com/tips/avoid-cougar-attacks/ viewed on 7/12/2016

1.16 Attachments

None

1.17 Contact

Health&SafetyTeam@geiconsultants.com

1.18 Review History

- July 2016
- November 2015
- July 2014

STANDARD OPERATING PROCEDURES

SOP No. HS-025 Manual Lifting

1.1 Objective

The purpose of this Standard Operating Procedure (SOP) is to identify and reduce potential work-related musculoskeletal disorder (WMSD) hazards. The SOP is intended to comply with state regulations and safe work practices developed by the Occupational Safety and Health Administration (OSHA). Modifications to meet these requirements will be made to this program as changing laws or regulations dictate.

1.2 General

Lifting heavy items is one of the leading causes of injury in the workplace. Overexertion and cumulative trauma when lifting are significant factors for injuries. When employees use smart lifting practices and work in their “power zone”, they are less likely to suffer from back sprains, muscle pulls, wrist/elbow/spinal and other injuries caused by lifting heavy objects. Common things to consider prior to lifting an object are: weight of the object, awkward postures, high-frequency and long duration lifting, inadequate handholds, and physical/environmental factors.



Figure 1: Lifting Power Zone

1.3 Safe Lifting Guidelines

The following safe lifting guidelines will be followed by employees involved in manual lifting activities:

- Before manual lifting is performed, a hazard assessment must be completed. The assessment must consider size, bulk, and weight of the object(s), if mechanical lifting equipment is required, if two-man lift is required, whether vision is obscured while carrying and the walking surface and path where the object is to be carried.
- Get a co-worker to help if equipment or other item is too heavy to lift.
- If possible, use powered equipment instead of manually lifting heavy materials. Lifting equipment such as dollies, hand trucks, lift-assist devices, jacks, or carts can be provided for employees.
- Reduce lifts from shoulder height and from floor height by repositioning the shelf or bin to closer to the power zone.
- Make sure walkways are clear of tripping hazards before moving materials.
- Use your legs and keep your back in a natural position while lifting. Keep the load close to your torso.



- Test the load to be lifted to estimate its weight, size, and bulk and to determine the proper lifting method.
- Do not twist while carrying a load. Instead, shift your feet and take small steps in the direction you want to turn.
- Make sure there are appropriately marked and sufficiently safe clearances for aisles and at loading docks or passageways where mechanical-handling equipment is used.
- Properly stack loose or unboxed materials which might fall from a pile by blocking, interlocking, or limiting the height of the pile to prevent falling hazards.
- Bags, containers, bundles, etc. should be stored in tiers that are stacked, blocked, interlocked, and limited in height so that they are stable and secure to prevent sliding or collapse.

- Storage areas should be kept free from accumulation of materials that could lead to tripping, fire, or explosion.
- Work methods and stations should be designed to minimize the distance between the person and the object being handled.

Supervisors should periodically evaluate work areas and employees' work techniques to assess the potential for and prevention of injuries. New operations should be evaluated to engineer out hazards before work processes are implemented.

1.4 Regulations

OSHA does not have a standard which sets limits on how much a person may lift or carry. They do however state that lifting loads heavier than about 50 pounds will increase the risk of injury.

The National Institute for Occupational Safety and Health (NIOSH) has developed a mathematical model that helps predict the risk of injury based on the weight being lifted and other criteria. The NIOSH model is based on previous medical research into the compressive forces needed to cause damage to bones and ligaments of the back. The mathematical model is incorporated in the *Applications Manual for the Revised NIOSH Lifting Equation*, which can be found on the NIOSH website (http://www.cdc.gov/niosh/docs/94-110/). It should be noted, however, that this NIOSH document provides only voluntary guidelines.

If there is a situation that arises where an employee is required to perform manual lifting on a reoccurring basis, the NIOSH Lifting Equation will be used to determine the appropriate weight that employee can safely lift. The lifting equation establishes a maximum load of 50 pounds for employees that are less likely to have to lift something, and don’t have to do any long distance travel or maneuvering of the item. This 50 pounds is then adjusted to account for:

- how often the employee is lifting
- twisting the back during lifting
- the vertical distance the load is lifted
- the distance of the load from the body
- the distance the employee must move while lifting the load
- how easy it is to hold onto the load

GEI uses 50 pounds as a standard. However each individual should not attempt to carry loads heavier than they can safely manage.

1.5 Training

Training will include general principles of ergonomics, correct manual lifting techniques to avoid musculoskeletal injuries, recognition of hazards and injuries, procedures for reporting hazardous conditions, and methods and procedures for early reporting of injuries.

1.6 Lifting Assistance

If employees are assigned a task that involves repetitive lifting and carrying of equipment the Safety Team and Project Manager should be contacted to conduct an ergonomic evaluation. The task should be discussed to determine if there is an alternative method that can be used. The alternative method should institute an engineering or administrative control to reduce/limit the amount of lifting that is required of the employee. Some examples include providing smaller containers to reduce the weight of what needs to be lifted; providing a device that helps carry awkwardly-shaped objects easier; or using a winch, fork lift, or other device to lift the item(s) for the employee.

1.7 Injury Reporting

Injuries experienced during manual lifting activities should receive prompt medical attention. If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health and Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health & Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future musculoskeletal injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.8 Limitations

Follow safety procedures for manual lifting.

1.9 References

OSHA Technical Manual (OTM), Section VII: Chapter 1 - Back Disorders and Injuries
https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=29936 (Viewed 7/12/2016)
https://www.osha.gov/SLTC/etools/electricalcontractors/materials/heavy.html (Viewed 7/12/2016)

1.10 Attachments

None

1.11 Contact

Health&SafetyTeam@geiconsultants.com

1.12 Review History

- July 2016
- August 2014

STANDARD OPERATING PROCEDURES
SOP NO. HS-026 Hazard Identification and Management

1.1 Objective
This Standard Operating Procedure (SOP) is intended to outline the steps GEI employees will take to identify potential hazards on site, the risks associated with these hazards, and the proper engineering controls, work practices, and personal protective equipment (PPE) to use to minimize the associated risks.

1.2 Hazard Identification
Establishing proper work procedures by conducting a job hazard analysis will should be performed for all projects involving field work. An initial identification of hazards will be completed based on past and current property usage of the site, what tasks are required to perform the job, what equipment is needed to complete the assigned tasks, what hazards are in the working area etc.

The site-specific health and safety plan (HASP) will include a hazard assessment for the project that identifies the potential hazards and how to alleviate the hazard. These hazards will be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.3 Risk Assessment
A risk assessment will be performed for all aspects of field work. This analysis is to determine the quantitative or qualitative value of risk related to a tangible situation and a recognized hazard. Identification, studies, and monitoring of any hazard to determine its potential, origin, characteristics, and behavior are examples of what could be included and performed during a risk assessment. The assessment will increase awareness of workplace hazards and provide an opportunity to identify and control workplace hazards.

1.3.1 Assessment Guidelines
It is necessary to consider certain general guidelines for assessing the foot, head, eye and face, and hand hazard situations that exist in an occupational operation or process, and to match the protective devices to the particular hazard.

Assessments should be conducted:

- Prior to starting any work at the site
- As conditions change
- Workplace layout changes
- Environmental changes
- Process changes

- Yearly or other pre-determined interval

1.3.2 Hazard Sources

Some examples of hazard sources include but are not limited to:

- Items, materials, or machinery in motion
- Extreme temperatures
- Chemical exposures
- Harmful dust
- Light radiation
- Falling objects or potential from dropping objects
- Sharp objects
- Rolling or pinching objects
- Layout of workplace and location of co-workers
- Electrical hazards
- Noise exposures
- Confined spaces
- Working near or on water
- Fall hazards
- Traffic or other activities taking place on the site
- Air quality issues

1.4 Prevention – Control Methods

Control methods should be considered in the following hierarchy:

- Elimination
- Substitution
- Engineering Controls
- Administrative Controls
- Personal Protective Equipment

1.4.1 Elimination and Substitution

Elimination and substitution, while most effective at reducing hazards, also tend to be the most difficult to implement in an existing process. If the process is still at the design or development stage, elimination and substitution of hazards may be inexpensive and

simple to implement. For an existing process, major changes in equipment and procedures may be required to eliminate or substitute for a hazard. Employees should work with the Safety Team to find solutions.

1.4.2 Engineering Controls

Engineering controls are used to remove a hazard or place a barrier between the work and the hazard. It's implemented to control the hazard at the source. Examples may include machine guards, sound deading/dampening panels, traffic barriers, guardrails, and shields.

1.4.3 Administrative Controls

Administrative controls change the work procedures such as programs, schedules, and supervision to reduce employee exposure to hazards. The controls are frequently used with existing processes where hazards are not particularly well controlled. Examples of administrative controls are requiring frequent breaks or implementing a specific method to perform a task.

1.4.4 Personal Protective Equipment Selection

To select the proper PPE, the potential hazards must be known. The protective equipment selected must ensure a level of protection *greater than* the minimum required in order to help protect employees. The user must be supplied with a properly fitting protective device and given instructions on care and use. Users must be aware of all warning labels for and limitation of the PPE. Employees must be aware that the PPE does not eliminate the hazard.

1.4.5 Hazard Re-Assessment

As necessary, the workplace should be re-assessed for hazards by identifying and evaluating new equipment and processes, reviewing accident records, and re-evaluating the suitability of previously selected PPE. Re-assessment should occur at a defined regular schedule interval.

1.5 Job Safety Analysis

A job safety analysis (JSA) sometimes referred to as a job hazard analysis (JHA) or an activity hazard analysis (AHA) is the breaking down of any method or procedure into its component parts to determine the hazards connected with each key step and the requirements for performing it safely.

When a JSA is being created, make sure it isn't too general where the resulting information is not enough to assess the hazard and select proper controls, and be careful not to add unnecessary steps.

1.6 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health & Safety Officer (RHSO).

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the RHS) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.7 Limitations

Limitations may arise on a project specific basis and will be addressed as they arise.

1.8 Attachments

None.

1.9 References

Risk Analytics, LLC Hazard Assessment Training Program, January 2011

1.10 Contact

Health&SafetyTeam@geiconsultants.com

1.11 Review History

- November 2016
- June 2015

STANDARD OPERATING PROCEDURES

SOP No. HS-029 Overtime and Fatigue Management

1.1 Objective

A consistent standard was developed for GEI Consultants, Inc. relative to overtime / fatigue management with the aim of reducing risk associated with worker fatigue, allow for sufficient sleep, and increase mental fitness in an effort to control employee turnover and absenteeism. The following guidelines will be followed when working extended hours or work shifts on GEI projects.

1.2 General

Extended or unusual work shifts may be more stressful physically, mentally, and emotionally. Non-traditional shifts and extended work hours may disrupt the body's regular schedule, leading to increased fatigue, stress, and lack of concentration. These effects lead to an increased risk of operator error, injuries and/or accidents.

Society is oriented toward traditional daytime work hours and work at night will often intensify fatigue and reduce alertness. Workers generally will not acclimate to night work, and sleep patterns will generally be disrupted so the non-work periods do not provide full recovery, resulting in sleep deprivation. Studies suggest that it can take up to 10 days to adapt to a night time work schedule.

Fatigue is a message to the body to rest. It is not a problem if the person can and does rest. However, if rest is not possible, fatigue can increase until it becomes distressing and eventually debilitating. The symptoms of fatigue, both mental and physical, vary and depend on the person and his or her degree of overexertion. Some examples include:

- weariness
- sleepiness
- irritability
- reduced alertness, lack of concentration and memory
- lack of motivation
- increased susceptibility to illness
- depression
- headache
- giddiness
- loss of appetite and digestive problems

Employees and Subcontractors will adhere to the following principles to address worker Overtime / Fatigue Policy:

- Maximum Number of Days in a 21-Day Window = Nineteen (19) days
- Number of Days off = Two (2) days
- Maximum Number of Hours in a Shift = Sixteen (16) Hours / Eighteen (18) hours with approval from
- GEI
- High Overtime Percentage = Overtime totaling more than 75% over a 40 hour work week
- High Overtime Period = last rolling 3 months

1.3 Training

Initial and annual training must be provided on how to recognize fatigue, how to control fatigue through appropriate work and personal habits, and reporting of fatigue to supervision. During training instructors will emphasize that proper sleep and nutrition can also help reduce worker fatigue.

1.4 Ergonomic Controls

Ergonomic equipment will be used to improve workstation conditions such as anti-fatigue mats for standing, lift assist devices for repetitive lifting, proper lighting and control of temperature, and other ergonomic devices as deemed appropriate (see GEI Safe Lifting SOP). Work tasks to control fatigue will be analyzed and evaluated periodically by GEI's health and safety staff. Assessments can be requested per GEI's Ergonomic Program. In addition, to reduce fatigue, chairs should be used by employees to sit periodically and take provide periodic rest breaks.

1.5 Safety Critical Positions

Employees identified as working in safety critical positions, such as working with hazardous materials or operating equipment, must report fatigue/tiredness and lack of mental acuity to their supervisors or Project Manager. In addition the Corporate Health and Safety Officer will be notified to make safety critical decisions and take appropriate actions to prevent loss.

1.6 Prescription and OTC Drug Use

Employees must not chronically use over-the-counter or prescription drugs to increase mental alertness. Employees should refrain from taking any substance known to increase fatigue in that employee, including fatigue that sets in after the effects of the drug wear off.

1.7 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.8 References

1.9 https://www.osha.gov/SLTC/emergencypreparedness/guides/extended.html

1.10 Attachments

None

1.11 Contact

Corporate Health & Safety Officer
East Regional Health & Safety Officer
South Regional Health & Safety Officer
Central Regional Health & Safety Officer
West Regional Region Health & Safety Officer

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

CORPORATE ENVIRONMENTAL, HEALTH AND SAFETY PROCEDURE

LAND USE

CEHSP E08.02 – Noise Construction and Utility Activities

Revision 7: 12/31/2014 Effective Date: 01/01/2015

CONTENTS

SECTION 1.0 – PURPOSE
SECTION 2.0 – APPLICABILITY
SECTION 3.0 – INTRODUCTION
SECTION 4.0 – COMPLIANCE REQUIREMENTS
- 4.1 – FIELD OPERATIONS
- 4.2 – OPERATIONS UNDERTAKEN OUTSIDE OF PERMISSIBLE TIMES
- 4.3 – MONITORING NOISE METHODOLOGY

SECTION 5.0 – DEFINITIONS
SECTION 6.0 – REFERENCES
- ATTACHMENT 1 – NORMAL FIELD OPERATION REGULATIONS
- ATTACHMENT 2 – UTILITY NOISE MITIGATION PLAN TEMPLATE
- ATTACHMENT 3 – CONSTRUCTION NOISE MITIGATION PLAN TEMPLATE
- ATTACHMENT 4 – NOISE REGULATIONS FOR OPERATIONS UNDERTAKEN OUTSIDE OF PERMISSIBLE TIME

1.0 PURPOSE

IT IS THE POLICY OF CON EDISON TO COMPLY WITH STATE AND LOCAL REGULATIONS PERTAINING TO NOISE. The purpose of this procedure is to ensure that all company personnel perform appropriate actions to prevent ***unreasonable noise*** and comply with permissible noise limits.

2.0 APPLICABILITY

This Corporate Environmental, Health and Safety Procedure (CEHSP) applies to all Con Edison personnel and contractors, both on and off Con Edison facilities and at field locations, who attend to Con Edison equipment, facilities, or operations that create noise that could be considered unreasonable.

3.0 INTRODUCTION

New York City, and many local governments in the Company's service area have restrictions on the level of noise that may be produced. In general, these limits apply to two types of situations: ***facility operations***, and ***field operations***. In New York City, however, three distinct situations apply: ***facility operations***, construction activities and utility activities (street work). In addition, the restrictions vary by time of day. Con Edison has compiled tables summarizing the noise regulations applicable in the Company's service area. These tables can be found in Attachments *1* and *2*.

In addition, New York State regulations address noise from certain heavy duty trucks. These requirements are discussed in Section 4.4, New York State Noise Requirements.

© 1998-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

4.0 COMPLIANCE REQUIREMENTS

Equipment and operations associated with Con Edison facilities and services can produce noise. All equipment used by Con Edison should be in good working order, properly maintained, and properly used. Where possible, noisy equipment should not be located near ***noise-sensitive areas and/or sensitive receptors***, e.g., schools, hospitals, and churches.

Where a given operation could be accomplished using a variety of equipment, equipment with operating characteristics that produce less noise should be used. The facility or field manager is responsible for ensuring compliance with all federal, state and local noise regulations.

Qualified personnel should execute the procedures regarding noise measurements described in the following sections. Qualified personnel are defined as personnel from Con Edison Technical Service, who are trained to make noise measurements according to American National Standards Institute ***(ANSI)*** standards, and are operating under the advice from Con Edison's Environment, Health and Safety (EH&S) noise subject matter expert (SME). The person should be familiar with the make and type of equipment used in these measurements, calibration and should be experienced in general noise data collection procedures. The person should be able to identify ***impulsive*** and ***tonal noise.*** Measurements should be made using a Type 1 ***Sound Level Meter (SLM)*** / preamplifier/microphone combination.

4.1 FIELD OPERATIONS

Field operations include maintenance, installation, upgrade, and repair of Con Edison equipment. These types of operations include repair or installation of aboveground and belowground power transmission conduits (electrical, natural gas, steam), repair or installation of power transmission equipment, tree maintenance, on-site or off-site construction or demolition, and use of any safety equipment associated with these procedures.

Most field operations, other than operations undertaken outside of permissible times, can be thought of as construction activities. Construction activities additionally covered under this CEHSP include any activity (except tunneling) necessary or incidental to the erection, demolition, assembling, altering, installing, or equipping of buildings, public or private highways, roads, premises, parks, utility lines including such lines in already-constructed tunnels or other property, land clearing, grading, excavating and filling. Many communities have time restrictions on such activities, which must be adhered to. Additional requirements (discussed below), including the preparation of a Noise Mitigation Plan and additional sound-reducing devices, are required for work performed in New York City.

Unreasonable Noise

In addition to time restrictions, certain noise codes have specific regulations that must be followed regarding field activities. These regulations are summarized below.

- Construction devices – Prohibiting use of construction devices (e.g., air compressor, pile driver, bulldozer, crane, hoist) so as to create unreasonable noise.

- Containers and construction material – Prohibiting handling or transport of any container or any construction material in a public place so as to create unreasonable noise.

© 1998-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

- Exhausts - Except as otherwise provided in the New York City code, prohibiting discharge into the open air of the exhaust of any device, including but not limited to any steam engine, diesel engine, internal combustion engine or turbine engine, so as to create unreasonable noise.

- Power tools – Prohibiting use of power tools (e.g., nail guns, saws, vacuums, drills) so as to create unreasonable noise.

- Schools, hospital, courts – Prohibiting unnecessary noise through the use of any device on any street adjacent to any school or court while the same is in session, or adjacent to any hospital.

- Sensitive receptors – Prohibiting unnecessary noise through the use of any device within 50 feet of a school, house of worship, hospital, retirement community, open tract of serene land, park or recreation area, and psychiatric centers.

4.1.1 Utility Activities Within New York City

Negotiations with NYCDEP from 2005 to 2006 resulted in the partial exemption for utility-related construction, such as street activities, cable and pipe replacements, and new infrastructure installation.

Utility-related Construction must meet the following requirements:

- Each site where utility-related construction activities occur, or construction devices/tools are used, must have a filled-out Utility Noise Mitigation Plan on-site and posted. This requirement does not apply to safety devices utilized while performing routine maintenance task, such as ventilation blowers.

- OJT/Tailboard Talk training for all personnel who perform utility-related construction is required. Although our present CEHSP and GEIs satisfy this training requirement, additional training has been developed to assist with full compliance.

- The new code has restrictions on the types of tools that can be used, rather than list noise limits for each type as in the prior code requirements.

- Sensitive Receptors such as hospitals and schools adjacent to work locations should be communicated with prior to work starting when possible.

- For work longer than 3 days continuously in one location, postings and other communication must be sufficient to inform all residents within 200 feet of schedule.

Utility Noise Mitigation Plans

A utility noise mitigation plan template is included as *Attachment 3*. The utility noise mitigation plan should be filled out by the job supervisor or field foreman prior to the start of construction activities – only devices deemed in compliance with NYCDEP regulations shall be utilized. If there are any deviations from the approved items, the ConEd noise SME must be consulted prior to the start of work activities.

Elements of the utility noise mitigation plan include the following requirements:

© 1998-2014 Consolidated Edison Co. of New York, Inc.

- Self-certification that tools/equipment maintained so they operate at normal manufacturer's operating specifications.
- Tools/equipment must be equipped with appropriate manufacturer's noise reduction device.
- Specialized vehicles require use of additional noise mitigation measures.
- Use of noise-insulating fabric for portable pumps, compressors, generators, etc.
- Quieter equipment shall be used when available or when required by the NYCDEP. Prohibit unnecessary engine idling.
- Properly install and secure steel traffic plates – must re-set and secure within 24 hours of a call from the DEP to the utility.
- Notify all residents within 200 feet of construction area when work is scheduled to be longer than 3 days.
- Notification shall include information on schedules/work locations.
- Respond to all noise complaints/official DEP notice on same day. If after hours, respond next day.
- Phase in vehicles with quieter backup alarms – already being done at ConEd.
- Establish / implement formal noise mitigation training program.
- Includes field supervisory personnel and subcontract supervisors.
- Supervisors shall field-train all field workers.
- Minimize noise impact of sensitive receptors.
- Schools, hospitals, places of worship, etc.
- Required to work with facility owner/operator.
- Perimeter ***noise barriers*** must be used in accordance with 28-101(g) of NYC Chapter 28.
- If project is non-emergency, long-term (greater than 15 days) where there is a dedicated lane, must comply with 28-100 through 28-104.

Permissible Hours of Utility Activities

Regulations concerning utility activities within New York City are listed below. All utility-related construction activities which fall outside these hours require after-hours authorization from the NYCDEP, the NYCDOB, or the NYCDOT. Additional noise mitigation methods may also be required if the NYCDEP so indicates for after-hours work.

Hours of Work are to be in accordance with NYC DOT permit stipulations and/or NYC DOT Highway Rules, generally 7 AM through 10 PM weekdays for utility activities. Please note the

© 1998-2014 Consolidated Edison Co. of New York, Inc.

extension to 10 p.m., also applies to Con Edison's contractors. Additional mitigation techniques for receptors within 200 feet may be required by the DEP for hours between 10 PM and 7 AM during weekdays and 7PM through 7AM during weekends.

4.1.2 Construction Operations Within New York City

Construction Activities

General construction and demolition will have to meet the Utility requirements in addition to the following:

- More complex Mitigation Plans (must be completed as part of planning the work and prepared with the assistance of the noise SME)
- Specific mitigation requirements for a variety of tool/equipment types
- Certain activities may require enclosures/barriers to reduce noise
- Certain projects with perimeter construction fences shall be required to have noise attenuating material added to the fencing
- Quieter or "smart" back-up alarms are required.

Construction Noise Mitigation Plans

All construction work performed within New York City must be performed in accordance with NYC Administrative Code, Chapter 28. For all construction activities, a Noise Mitigation Plan (*Attachment 3*) must be completed. Only NYCDEP-approved devices or equivalent may be used on-site. NYCDEP must approve the plan, however would pre-approve generic plans with checklists for certain repetitive work. Consult with the Corporate Environmental Health and Safety Department for assistance.

The Mitigation Plan must be written and clearly posted at the job site. Elements of the construction and demolition noise mitigation plan include the following requirements:

- More complex Mitigation Plans (must be completed as part of planning the work and prepared with the assistance of the noise SME)
- Residents within 200 feet of a construction site shall be given notice when work is scheduled for longer than 3 days. Conspicuous posting of such information, or where necessary notification of building managers/owners, shall satisfy this requirement.
- The owner/operator of sensitive receptors (e.g. schools, hospitals and places of worship), adjacent to this site, shall be contacted when practicable to coordinate work to minimize impact on the property.
- Self-certification that tools are maintained so that they operate at normal manufacturer's operating specifications. The NYCDEP will refer to an outside source to determine if your equipment "may be the source of a noise complaint".

© 1998-2014 Consolidated Edison Co. of New York, Inc.

- Use of mufflers/noise mitigation devices on equipment and construction vehicles to meet requirements. *(Note: If equipment continues to exceed level as specified in the Appendix of Rules, a five day cure periods is allowed to perform maintenance, replace equipment and file an Alternative Noise Mitigation Plan.)*

- Mitigation of noise from internal combustion engines.

- Prevention of vehicle idling and use of quieter backup alarms.

- Use of noise barriers if site is within 75 feet of a residential receptor or 200 feet of ANY receptor.

- By January 1, 2008, quieter or "smart" back-up alarms will be required.

- Construction projects that are not regard as "utility work" (e.g. building construction or demolition, major renovation, or any installations) that are not completed within **15 calendar days**, will not fall under the same exemption as work on the system.

- Construction material shall not be handled in such a way as to create unreasonable noise.

Permissible Hours of Construction

Regulations concerning construction activities within New York City are listed below. All construction activities which fall outside these hours require after-hours authorization from the NYCDEP, the NYCDOB, or the NYCDOT. Additional noise mitigation methods (such as noise barriers) are required if work is performed outside these hours.

Hours of Work are to be in accordance with NYC DOT Permit Stipulations and/or NYC DOT Highway Rules, generally 7 AM through 6 PM weekdays for construction activities. Additional mitigation techniques for receptors within 200 feet may be required by the DEP for hours between 7 PM and 7 AM during weekdays and during weekends. There is an exception for occupied one or two family dwellings, convents or rectories between 10 a.m. and 4 p.m. on wither Saturday or Sunday (Note: Must be a minimum of 300 feet from house of worship).

4.1.3 Operations Outside New York City

Permissible Hours of Construction

Regulations concerning normal field operations are listed in the table in *Attachment 1*, Normal Field Operation Regulations. Except where indicated, these are simply day and time restrictions imposed by the various communities. In many cases, providing that field operations do not occur outside these day and time restrictions, the field operations will be in compliance with the local noise codes.

Specific Requirements

Some noise codes require special muffler requirements on devices such as engines, air compressors, and pavement breakers. In addition, certain communities impose noise limits on construction activities. If there are specific noise levels stated in the Special Requirements column of the table in *Attachment 1*, noise monitoring may be required. Careful attention should be given to the equipment and vehicles used in field operations utilizing impact equipment that

© 1998-2014 Consolidated Edison Co. of New York, Inc.

emit high impulsive noise levels such as pile drivers, pavement breakers, and steam shovels. [6] P

The following procedures apply only to field operations that require noise monitoring as indicated in *Attachment* 1 and may be skipped if no special requirements are listed in Attachment 1.

4.2 OPERATIONS UNDERTAKEN OUTSIDE OF PERMISSIBLE TIMES

In some jurisdictions, noise from operations undertaken outside of permissible times as a result of dealing with emergency situations is exempt from local noise restrictions. However, some jurisdictions impose time limits on such operations, may require a variance for such operations, and/or may require repair operations to commence within a certain time limit of the ***emergency event***. NYC may issue variance from noise standards for the construction activity. Variance may be granted for the initial period of three days and then renewed. The variance must be clearly posted. If work must begin without variance, an application must be submitted within ***12*** **hours** of commencement.

4.2.1 Utility Activities Within New York City

For utility work conducted outside of 7AM – 10 PM on weekdays, additional authorization must be obtained from NYCDOB, NYCDOT or NYCDEP to work outside those hours. From 6PM – 10PM weekdays, any required daytime noise mitigation controls must be utilized. From 10PM – 7AM weekdays and 7PM – 7AM weekends, additional noise mitigation controls may be required by the DEP if there are any receptors within 200 feet. This will be determined on a case-by-case basis.

4.2.2 Construction Operations Within New York City

In New York City, in the case of urgent necessity in the interest of public safety, the NYCDEP is authorized under the New York City Noise Code to issue a variance from the provisions of the Construction Activity Noise Code provisions for any such construction activity. Such a variance may be granted for an initial period of up to 3 days, and may be renewed for periods of 3 days or less while such urgent necessity continues. The variance must be clearly marked on the license or permit, which must be prominently posted at the job site.

4.2.3 Operations Outside New York City

Refer to the Noise Regulations for Operations Undertaken Outside of Permissible Times (*Attachment 4*), for any required variances, time limitations, and exemptions regarding operations undertaken outside of permissible times. [8] R/P

4.3 NOISE MONITORING METHODOLOGY

The noise measuring device should be set to use the descriptor specified in the local noise code, as indicated in Special Requirements column of the *Attachment* 1. Noise that is considered impulsive must be noted and used in the evaluation of the maximum allowable levels given in *Attachment 3*, the Normal Field Operation Regulations Table. Measurements should be made in such a way as to exclude ***extraneous noises***. Measurements should not be made while ***adverse meteorological conditions*** are occurring in the study area.

© 1998-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

Repeat this procedure for each boundary at the property line. Compare the measured property line levels with the maximum allowable levels for the corresponding area in *Attachment* 1. If measured noise levels are below the maximum allowable noise levels for the corresponding types of noise, as indicated in the Special Requirements column of (*Attachment* 1), then noise levels from the Normal Field Operations meet the requirements of the local noise code. If measured levels exceed the maximum allowable levels, the noise from l field operations exceeds the local noise codes. [7]

New York City no longer requires noise measurements for normal field locations. Use ***A-weighted*** measurements. All measurements must be taken by "qualified personnel" only.

5.0 DEFINITIONS

Adverse Meteorological Conditions: Rain, snowfall, snow-covered ground, wet ground, gusty winds, and high winds. Measurements should not be made during these types of conditions.

ANSI: Acronym for "American National Standards Institute".

A-Weighted: Measurement that assigns each frequency a "weight" through the use of a filter network that is related to the sensitivity of the ear at that frequency. The level of the filtered signal is displayed as the A-weighted level. The A-weighted frequency characteristic was originally designed to mirror the 40-phon equal-loudness-level contour of the 1933 Fletcher-Munson data.

Emergency Event: The need for immediate repair of Con Edison equipment associated with Con Edison operations due to situations that are causing or are likely to cause service interruptions, or situations that present an imminent danger to the public. Examples include repair or installation of aboveground and belowground power transmission conduits (e.g., electrical, natural gas, steam), immediate repair or installation of power transmission equipment, and immediate tree maintenance.

Extraneous Noises: Noises that are not associated with Con Edison operations. Extraneous noises include, but are not limited to, passing automobiles or trucks, railway activity, nearby aircraft, nearby construction or demolition, natural sounds, and other nearby noises not associated with Con Edison operations.

Facility Operations: Operational procedures of Con Edison facilities which are essential for normal Con Edison operations. Examples include power generation, compressors, turbines, pipes and valves, bulk material transport, deliveries, fans, and any on-site maintenance or modifications.

Field Operations: Maintenance, installation, upgrade, and repair of Con Edison equipment associated with Con Edison operations. Examples include repair or installation of aboveground and belowground power transmission conduits (e.g., electrical, natural gas, steam), repair or installation of power transmission equipment, tree maintenance, and on-site construction or demolition.

Impulsive Noise: A single short burst or a series of short bursts of sound pressure. The pressure-time history of a single burst includes a rise to peak pressure, followed by a decay of the pressure envelope. The pressure-time history of a single burst includes a 6 dB, or greater, rise to peak pressure, followed by a decay of the pressure envelope, when the rise to peak

© 1998-2014 Consolidated Edison Co. of New York, Inc.

pressure occurs in 1 second or less. For noise containing a series of short bursts of sound pressure, the noise will be considered impulsive if each impulse in the series is separated in time by less than 1 second. Examples include thunder, noise as a result of pile-driving, steam-shoveling, etc.

Noise Barrier: A structure used for the purpose of placing near a noise source to reduce the noise level measurable at a receptor location.

Noise-Sensitive Area (a.k.a Sensitive Receptor): Tracts of land where serenity and quiet are extraordinarily important and serve an important public need, and where the preservation of these qualities is essential for the area to serve its intended purpose. Such areas could include amphitheaters, particular parks, or portions of parks or open spaces dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet. Examples are grounds for ambulatory hospital patients and patients and residents of sanitariums and old-age homes.

Octave Band: A filter with a single transmission band or passband with relatively low attenuation extending from a lower band-edge frequency greater than zero to a finite upper edge frequency which is twice the lower band-edge frequency. The nominal midband frequency, for a set of contiguous octave bandpass filters, is one of a series that includes 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, and 8000 hertz, extended by successive multiplication or division by 10.

Qualified Personnel: Personnel from Con Edison Technical Service, who are trained in calibrated noise measurements and calibrated ***octave band*** measurements, according to ANSI standards, and are operating under the advice from Con Edison EH&S. Qualified personnel should be familiar with the make and type of equipment used in the measurements, and experienced in general noise data collection procedures. Qualified personnel should be able to identify impulsive and periodic noise.

Receptor: Real property, including but not limited to buildings, grounds offices and dwelling units, from which sound levels from sound sources outside such property may be measured.

Sound Level Meter (SLM): Device used to measure sound pressure level with a standardized frequency weighting and indicated exponential time weighting for measurements of sound level, or without time weighting for measurement of time-average sound pressure level or sound exposure level.

Tonal Noise: For the purposes of this document, noise containing single-frequency tones, when the sound pressure of any single-frequency tone in any octave band exceeds the non-tonal masking noise in the corresponding octave band by 6-dB or more. This corresponds, in general, to a tone being prominent when it is more than 10 dB above the threshold of audibility. Examples of tonal noise would include transformer hum, idling engine noise, and constant-rpm engine noise.

Unreasonable Noise: Any excessive or unusually loud sound that annoys, disturbs, injures, or endangers the comfort, repose, health, peace, or safety of a person or that causes injury to plant or animal life, or damage to property or business.

6.0 REFERENCES

© 1998-2014 Consolidated Edison Co. of New York, Inc.

NOTE: Con Edison is subject to numerous local noise regulations. For guidance, tables have been developed summarizing these local noise regulations applicable in Con Edison's service area. These tables include:

- Attachment 1, Field Operation Regulations
- Attachment 4, Noise Regulations for Operations Undertaken Outside of Permissible Time

For purposes of the References section, the annotations are limited to citations to New York City and New York State regulations. Readers are referred to the Tables for local requirements.

Note: Regulations are subject to change without notice, especially local noise regulations. For compliance with local regulations, please confirm with Law as needed. References are forthcoming.

© 1998-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

REVISION HISTORY

Revision Date	Revision #	Summary of Change	Author
12/310/2014	7	Periodic review completed with one minor note added to the reference section. "*Regulations are subject to change without notice, especially local noise regulations. For compliance with local regulations, please confirm with Law as needed*"	S. Mahoney

© 1998-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

ATTACHMENT 1
FIELD OPERATION REGULATIONS

CITY, TOWN or VILLAGE	ALLOWABLE NORMAL OPERATION DAYS/HOURS	SPECIAL REQUIREMENTS
Airmont	Mon-Sat 8:00am-10:00pm	L_{10} (1) levels must not exceed 60dB(A) at construction site boundary
Beacon	7:00am-11:00pm	
Briarcliff Manor	Mon-Sat 8:00am-7:00pm	Blasting and Rock Drilling permitted only Mon-Fri 9:00am-5:00pm
Bronxville	Mon-Fri 8:00am-6:00pm	
Buchanan (Village of)	8:00am-7:00pm	
Chestnut Ridge (Village of)	Mon-Sat 8:00am-7:00pm	L_{10} (1) levels must not exceed 60dB(A) at construction site boundary
Clinton	7:00am-8:00pm	
Croton on Hudson	Mon-Sat 8:00am-10:00pm Sundays 10:00am-8:00pm	
Dover	7:00am-9:00pm	
Greenburg	Mon-Fri 7:00am-8:00pm Sat 9:00am-6:00pm; no work on Sunday	
Hyde Park	6:00am-11:00pm	
LaGrange (Town of)	6:30am-9:00pm	
Larchmont	Mon-Fri 8:00am-7:00pm Sat 9:00am-6:00pm Sun 10:00am-5:00pm	L_{10} (1) levels must not exceed 70dB(A) at a distance of 40 feet
Lewisboro	Mon-Sat 8:00am-7:00pm	
Mamaroneck	Mon-Fri 8:00am-8:00pm Sat 9:00am-6:00pm Sun 9:00am-5:00pm	Pile Drivers and Steam Shovels permitted only Mon-Fri 8:00am-6:00pm No noise permitted beyond property border
Millbrook (Village of)	7:00am-10:00pm	Hours of restriction only apply when within 500 feet of residential zone.
Montebello	Mon-Sat 8:00am-10:00pm	L_{10} (1) levels must not exceed 60dB(A) at construction site boundary
Mount Pleasant	8:00am-6:00pm	• L_{10} (1) levels must not exceed 70dB(A) at a distance of 400 feet when bordering residential zone from 8:00am-6:00pm. • L_{10} (1) levels must not exceed 55dB(A) at a distance of 400 feet when bordering residential zone from 6:00pm-8:00am. • L_{10} (1) levels must not exceed 75dB(A) at a distance of 400 feet bordering nonresidential zone during business hours. • L_{10} (1) levels must not exceed 80dB(A) at a distance of 400 feet bordering nonresidential zone during nonbusiness hours.
Mount Vernon	Mon-Fri 7:00am-6:00pm No weekends permitted unless have current permit from the Committee of Buildings	• L_{10} (1) levels must not exceed 70dB(A) at 400 feet when bordering residential zone from 8:00am-8:00pm. • L_{10} (1) levels must not exceed 55dB(A) at 400 feet when bordering residential zone from 8:00pm-8:00am. • L_{10} (1) levels must not exceed 75dB(A) at 400 feet when bordering commercial zone during business hours. • L_{10} (1) levels must not exceed 75dB(A) at 400 feet when bordering commercial zone during non-business hours. • Sound levels must not exceed 80dB(A) at the site boundary when bordering a manufacturing zone. • Sound levels must not exceed 55dB(A) at site boundary when near any noise-sensitive areas.

© 1998-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

ATTACHMENT 1 (CONTINUED)
FIELD OPERATION REGULATIONS

CITY, TOWN or VILLAGE	ALLOWABLE NORMAL OPERATION DAYS/HOURS	SPECIAL REQUIREMENTS
New Castle	Mon-Fri 7:30am-8:00pm Sat-Sun 10:00am-5:00pm	No blasting on Saturday, Sunday or holidays
New Rochelle (Residential)	Mon – Fri 8:00am-10:00pm Sat-Sun 10:00am-5:00pm 10:00pm-8:00am	• L_{10} (1) levels must not exceed 70dB(A) at a distance of 400 feet in residential areas. • Sound levels must not exceed 55dB near any sensitive receptor. • Compressors require mufflers with 20dBA or more Insertion Loss. • Pavement Breakers manufactured before 12/31/74 require mufflers with 5dBA or more Insertion Loss. • For residential areas, no noise must be audible beyond property perimeter.
New Rochelle (Commercial)		L_{10} (1) levels must not exceed 75dB(A) at a distance of 400 feet during normal business hours L_{10} (1) levels must not exceed 80dB(A) at a distance of 400 feet at all other times In manufacturing areas, during a 24hour period, L_{10} (1) levels must not exceed 80 dB(A) when measured at construction site boundary
New York City	Mon-Fri 7:00am-6:00pm	
North Castle	8:00am-6:00pm(or sundown) Sundown – 8:00am	• Sound levels must not exceed 70dB(A) at a distance of 400 feet when bordering residential zone. • Sound levels must not exceed 75dB(A) at a distance of 400 feet when bordering commercial zone. • Air Compressors require mufflers with 20 dBA or more Insertion Loss. • Paving Breakers manufactured before 12/31/74 require mufflers with 5 dBA or more Insertion Loss. • Sound levels must not exceed 55dB(A) in residential areas or 65dB(A) in commercial / manufacturing areas
North Hempsted (Village of)	Mon-Fri 8:00am-9:00pm Sat-Sun 10:00am-6:00pm	
Ossining (Town of)	Mon-Fri 8:00am-8:00pm Saturday 9:00am-5:00pm	
Ossining (Village of)	Mon-Fri 7:30am-8:00pm Saturday 9:00am-5:00pm	
Pawling (Village of)	Mon-Sat 7:00am-8:00pm	L_{10} (1) levels must not exceed 80dB(A) at construction site boundary. IMPULSIVE Noise must not exceed 130dB(A) at property line.
Peekskill	Mon-Fri 7:30am-8:00pm Saturday 9:00am-5:00pm	No holiday work permitted
Piermont	7:00am-5:00pm	
Poughkeepsie (City)	6:30am-9:00pm	Other hours for construction (emergency work) only with a permit issued by the Building Inspector
Poughkeepsie (Town)	7:00am-10:00pm	
Ramapo	Mon-Sat 8:00am-10:00pm	L_{10} (1) levels must not exceed 60dB(A) at construction site boundary

© 1998-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

CITY, TOWN or VILLAGE	ALLOWABLE NORMAL OPERATION DAYS/HOURS	SPECIAL REQUIREMENTS
Sleepy Hollow (Village of)	Mon-Fri 8:00am-9:00pm Saturday 9:00am-9:00pm	
Sloatsburg	Mon-Fri 7:00am-7:00pm	
Suffern	Mon-Fri 7:00am-8:00pm	
Unionvale	7:00am-8:00pm	
West Haverstraw	Mon-Fri 6:00am-9:00pm Saturday 8:00am-22:00pm	
White Plains	7:00am-7:00pm	
Yonkers	Mon-Fri 7:00am-9:00pm	

L_{eq}(1): Time-average sound energy level during a time period of 1 hour. For the purposes of this document, all $L_{eq}(1)$ levels are expressed in dB(A).

L_{10}: The sound level exceeded for 10% of the specified time period.
L_{90}: The sound level exceeded for 90% of the specified time period.

© 1998-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

ATTACHMENT 2

Effective July 1, 2007, the NYCDEP Noise Code is updated to include additional construction requirements. A section of the new code specifically exempts utility-related streetwork and similar utility maintenance work from many of the requirements, but Con Edison and its contractors and subcontractors will still have several new requirements (NOTE: vendors should use same form as Con Edison but enter their name and contact number and cross out ours). Existing requirements will likely receive new emphasis. A posted Noise Mitigation Plan will be required on construction sites.

A compilation of construction noise requirements follows.

1) Most of our streetwork will be construction work, with the exception of routine manhole entries and other activities that do not involve construction tools or equipment. **Routine manhole work where the only devices utilized are a blower for atmospheric ventilation and/or an electric water pump inside the structure would not be considered construction work.**

2) The most current version of the attached form "Utility Noise Mitigation Plan" must be filled out and posted with the permit or elsewhere at the site, and presented to an inspector during a visit.
   NOTE: Post as soon as possible for emergencies.

3) Job briefing and/or tailboard talks should include this page and the Mitigation Plan.

4) The form includes lines for company name, contact number, and work schedule. Copies of the form have had contact information filled out already, and the schedule is usually on the permit. Emergencies and short-duration work will not require a schedule.

5) The form needs to indicate whether certain equipment will be used, and for jackhammers what type we are using. Check off or circle anything to be used for the job. "Backup" is not applicable at this time.

6) Portable pumps, compressors, and generators must be placed to minimize noise on nearby residents. Watch exhaust direction, as noise is louder in the direction of the exhaust.

7) As is currently required, all equipment/devices must have the manufacturer mufflers and other noise reduction parts in place, and be in good working order.

8) If NYCDEP concludes in response to a noise complaint that **properly used and maintained** equipment /devices are too loud, we will have 5 days to provide quieter models, alter our work, or file a variance.

9) When work is adjacent to **sensitive receptors**, such as schools, places of worship, retirement housing, or hospitals, attempt to contact and coordinate with the facility to minimize noise impact on activities.

10) When work extends past 3 days in the same location, the schedule must be posted conspicuously to inform nearby residents within 200 feet, or contact building owner(s).

11) Report all contact with NYCDEP noise enforcement to your supervisor or EH&S immediately.

12) As is currently required, minimize vehicle idling and ensure road plates are secure.

Utility Noise Mitigation Plan

v.2 7/31/12

I. Contact Information

Name of Responsible Party as defined in 15RCNY §28-109(a) (Utility and/or Contractor and/or Sub):

Consolidated Edison -or-_____

Contact Phone Number 1-800-75CONED -or-_____

Work Schedule_____

DOT Permit (if needed)_____

Unless work duration is undetermined or anticipated to be only one shift, then fill in work in I above. For variances from permit or long-term emergencies, fill in work location/schedule above if known.

Permits need not be posted for emergency response and for routine manhole work in accordance with NYC DOT and NYC DEP rules and regulations. Emergency work may commence immediately and within 3 days, a permit and copy of this Plan shall be posted.

II. Site-Specific Information

Hours of Work are to be in accordance with NYC DOT Permit Stipulations and/or NYC DOT Highway Rules. Additional mitigation techniques for receptors within 200 feet may be required by the DEP for hours between 10 PM and 7 AM during weekdays and 7PM and 7 AM during weekends.

Residents within 200 feet of a construction site shall be given notice when work is scheduled for longer than 3 days. Conspicuous posting of such information, or where necessary notification of building managers/owners, shall satisfy this requirement.

The owner/operator of **sensitive receptors**, adjacent to this site, shall be contacted when practicable to coordinate work to minimize impact on the property.

Vehicle **engine idling** shall be prevented in accordance with NYC Ad. Code §24-163.

All **street plates** at this site, shall be installed and properly secured in accordance with 34RCNY §2-11(10)(e)

All corrective actions, at this site, shall be taken within **24 hours** of notice by the DEP or its agent.

All rules of 28RCNY §106 apply.

III. Construction Devices

This Plan certifies that all equipment indicated in this Mitigation Plan is maintained to operate in accordance with the manufacturer's operating specifications and has been equipped with appropriate manufacturer's noise reducing devices.

Check applicable boxes below:

When the specific devices listed in next column are utilized, the use of barriers is not required unless the Dept. of Environmental Protection receives complaints. NOTE: All devices must have manufacturer's noise reduction device installed and properly functioning. NOTE: Small electric sump pumps inside structures and blowers for atmospheric ventilation are safety devices, not construction devices.

☐ **JACKHAMMERS (including chisel hammer attached to a vehicle like a backhoe)**
- ☐ Copco model TEX P90S with elongated muffler casing or bellows > 15 inches in length (or equivalent)
- ☐ **Chicago Pneumatic CP1240 with a model F-814004 muffler (or equivalent)**
- ☐ Other _____

☐ BACKHOES _____ method of mitigating device

☐ GENERATORS (Noise mitigation required – noise insulating fabric or other such techniques)

☐ COMPRESSORS (Noise mitigation required – noise insulating fabric or other such techniques)

☐ PUMPS (Noise mitigation required – noise insulating fabric or other such techniques)

☐ OTHER_____

IV. Specialized Equipment: Circle applicable device

The vehicles listed below and other vehicles with internal combustion motors shall require noise mitigation measures as specified by the DEP, such as the use of noise-insulating material or other such techniques that do not interfere with engine operation. The location of receptors should be considered in the placement and use to minimize noise impact.

Rodding or Cable Truck **Flush / Vac Truck**

Pavement Core Drilling Truck **Vacuum Excavator Truck**

Indicate method(s) of mitigating any of the above devices:_____

☐ BACKUP ALARMS (Required January 2008)
- ☐ Preco Model 45AA (or equivalent)
- ☐ Ecco Model 820 (or equivalent)
- ☐ Preco Model 1048 (or equivalent)
- ☐ Ecco Model SA907 (or equivalent)
- ☐ Grote Model 73100 (or equivalent)
- ☐ BBS-TEK Brigade Model BBS-92 (or equivalent)

Version 2, July 3, 2007

You must use the latest version available. Please check the website: http://www.nyc.gov/html/dep/html/airnoise.html

Utility Noise Mitigation Plan

v.2 7/31/12

I. Contact Information

Name of Responsible Party as defined in 15RCNY §28-109(a) (Utility and/or Contractor and/or Sub):

_____

Contact Phone Number_____

Work Schedule_____

DOT Permit (if needed)_____

Unless work duration is undetermined or anticipated to be only one shift, then fill in work in I above. For variances from permit or long-term emergencies, fill in work location/schedule above if known.

Permits need not be posted for emergency response and for routine manhole work in accordance with NYC DOT and NYC DEP rules and regulations. Emergency work may commence immediately and within 3 days, a permit and copy of this Plan shall be posted.

II. Site-Specific Information

Hours of Work are to be in accordance with NYC DOT Permit Stipulations and/or NYC DOT Highway Rules. Additional mitigation techniques for receptors within 200 feet may be required by the DEP for hours between 10 PM and 7 AM during weekdays and 7PM and 7 AM during weekends.

Residents within 200 feet of a construction site shall be given notice when work is scheduled for longer than 3 days. Conspicuous posting of such information, or where necessary notification of building managers/owners, shall satisfy this requirement.

The owner/operator of **sensitive receptors**, adjacent to this site, shall be contacted when practicable to coordinate work to minimize impact on the property.

Vehicle **engine idling** shall be prevented in accordance with NYC Ad. Code §24-163.

All **street plates** at this site, shall be installed and properly secured in accordance with 34RCNY §2-11(10) (e)

All corrective actions, at this site, shall be taken within **24 hours** of notice by the DEP or its agent.

All rules of 28RCNY §106 apply.

III. Construction Devices

This Plan certifies that all equipment indicated in this Mitigation Plan is maintained to operate in accordance with the manufacturer's operating specifications and has been equipped with appropriate manufacturer's noise reducing devices.

Check applicable boxes below:

When the specific devices listed in next column are utilized, the use of barriers is not required unless the Dept. of Environmental Protection receives complaints. NOTE: All devices must have manufacturer's noise reduction device installed and properly functioning. NOTE: Small electric sump pumps inside structures and blowers for atmospheric ventilation are safety devices, not construction devices.

☐ **JACKHAMMERS (including chisel hammer attached to a vehicle like a backhoe)**
- ☐ Copco model TEX P90S with elongated muffler casing or bellows > 15 inches in length (or equivalent)
- ☐ **Chicago Pneumatic CP1240 with a model F-814004 muffler (or equivalent)**
- ☐ Other _____

☐ BACKHOES _____ method of mitigating device

☐ GENERATORS (Noise mitigation required – noise insulating fabric or other such techniques)

☐ COMPRESSORS (Noise mitigation required – noise insulating fabric or other such techniques)

☐ PUMPS (Noise mitigation required – noise insulating fabric or other such techniques)

☐ OTHER _____

IV. Specialized Equipment: Circle applicable device

The vehicles listed below and other vehicles with internal combustion motors shall require noise mitigation measures as specified by the DEP, such as the use of noise-insulating material or other such techniques that do not interfere with engine operation. The location of receptors should be considered in the placement and use to minimize noise impact.

Rodding or Cable Truck **Flush / Vac Truck**

Pavement Core Drilling Truck **Vacuum Excavator Truck**

Indicate method(s) of mitigating any of the above devices: _____

☐ BACKUP ALARMS (Required January 2008)
- ☐ Preco Model 45AA (or equivalent)
- ☐ Ecco Model 820 (or equivalent)
- ☐ Preco Model 1048 (or equivalent)
- ☐ Ecco Model SA907 (or equivalent)
- ☐ Grote Model 73100 (or equivalent)
- ☐ BBS-TEK Brigade Model BBS-92 (or equivalent)

Version 2, July 3, 2007

You must use the latest version available. Please check the website: http://www.nyc.gov/html/dep/html/airnoise.html

ATTACHMENT 3
CONSTRUCTION MITGATION PLAN

The most recent form may be downloaded at

http://www.nyc.gov/html/dep/html/noise/index.shtml

ATTACHMENT 4
NOISE REGULATIONS FOR OPERATIONS UNDERTAKEN OUTSIDE OF PERMISSIBLE TIME

CITY, TOWN, or VILLAGE	Regulations	DETAILS
Bedford	EXEMPT	
Airmont (Village of)	EXEMPT	
Chestnut Ridge (Village of)	EXEMPT	
Clinton (Town of)	EXEMPT WITH APPROVAL	Granted by Zoning Enforcement Officer and the Zoning Board of Appeals
Croton-on-Hudson	EXEMPT	
Dover (Town of)	ONLY FOR TEMPORARY CONDITIONS	
Fishkill (Town of)	BY TEMPORARY PERMIT	Granted by Town Clerk upon recommendation of Zoning Enforcement Officer
Hastings-on-Hudson	EXEMPT	
Hyde Park (Town of)	EXEMPT	
LaGrange (Town of)	EXEMPT	
Mamaroneck (Town of)	ONLY WITH EXCEPTION	Issued by Town of Mamaroneck
Mamaroneck (Village of)	SPECIAL PERMIT REQUIRED	Issued by Building Inspector
Millbrook (Village of)	EXEMPT	
Montebello (Village of)	EXEMPT	
Mount Pleasant	SPECIAL PERMIT REQUIRED	Issued by Building Inspector
Mount Vernon	SPECIAL PERMIT REQUIRED	Issued by Commissioner of Buildings
New Castle	VARIANCE REQUIRED	Issued by Zoning Board of Standards and Appeals
New Hempstead (Village of)	EXEMPT	
New Rochelle	PERMIT FOR RELIEF REQUIRED	Issued by City Clerk
New York City	VARIANCE REQUIRED	Within 12 hours, Variance Required. Variance Valid for 3 days, and must be renewed as required. Mitigation Plan required.
North Castle	SPECIAL PERMIT REQUIRED	Issued by Building Inspector
Nyack (Village of)	EXEMPT	
Pawling (Village of)	EXEMPT	
Piermont (Village of)	VARIANCE REQUIRED	Issued by Village Board
Poughkeepsie (City)	SPECIAL PERMIT REQUIRED	Issued by Building Inspector, valid for up to 3 days. May be renewed for an additional 3 days.
Poughkeepsie (Town of)	EXEMPT	
Ramapo (Town of)	EXEMPT	
Scarsdale	EXEMPT	
Sleepy Hollow	EXEMPT	
Spring Valley (Village of)	SPECIAL	Exempt for 24 hours
Suffern (Village of)	EXEMPT	
Wappingers Falls (Village of)	EXEMPT	
West Haverstraw (Village of)	SPECIAL PERMIT REQUIRED	Issued by Building Inspector for periods of 3 days. May be renewed.
Yonkers	EXEMPT	

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
CORPORATE ENVIRONMENTAL, HEALTH AND SAFETY PROCEDURE

CEHSP S05.03 – Personal Protective Equipment: Protective Clothing
Revision 11: 06/30/2015 Effective Date: 07/31/2015

CONTENTS

SECTION 1.0 – PURPOSE
SECTION 2.0 – APPLICABILITY
SECTION 3.0 – INTRODUCTION
SECTION 4.0 – COMPLIANCE REQUIREMENTS
- 4.1 – HAZARD ASSESSMENT AND GENERAL GUIDELINES FOR SELECTION AND USE OF PPE
- 4.2 – CON EDISON PPE REQUIREMENTS
- 4.3 – PPE INSPECTION AND MAINTENANCE
- 4.4 – TRAINING AND TESTING
- 4.5 – RECORDKEEPING

SECTION 5.0 – DEFINITIONS
SECTION 6.0 – RESPONSIBILITIES
SECTION 7.0 – REFERENCES
- ATTACHMENT 1 – GUIDELINES FOR SELECTION OF PROTECTIVE CLOTHING
- ATTACHMENT 2 – PERSONAL PROTECTIVE CLOTHING

1.0 PURPOSE

IT IS THE POLICY OF CON EDISON TO COMPLY WITH FEDERAL, STATE, AND LOCAL REGULATIONS PERTAINING TO THE SELECTION OF PROTECTIVE CLOTHING FOR THE BODY (ARMS, LEGS, AND TORSO). The purpose of this procedure is to ensure that appropriate ***personal protective equipment (PPE)*** is selected and worn to protect Con Edison workers, contractors, and visitors at Con Edison facilities and work sites from chemical and physical hazards to the ***body***.

2.0 APPLICABILITY

This Environmental, Health and Safety Procedure (CEHSP) applies to any Con Edison activity that presents work hazards to the body that require the use of PPE.

3.0 INTRODUCTION

Many hazards can threaten the body, including heat, splashes from hot metals during welding, splashes from hazardous liquids (acids, bases, solvents), impacts, cuts, electrical hazards (arc, flame), and radiation. Based on the results of ***hazard assessments*** performed in each facility in accordance with CEHSP S 05.01, *Hazard Assessment and Personal Protective Equipment*, protective clothing must be identified that provides the correct protection.

Where hazards are determined to be present that can cause injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact, it is necessary to select PPE to adequately protect affected employees. A variety of protective clothing is available to protect against these hazards, including vests, jackets, aprons, coveralls, and full-body suits. In

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

addition, the OSHA Electrical Maintenance Standard, 29 Code of Federal Regulations (CFR) 1910.269 and Subpart V, requires generation, transmission, and distribution workers who may be exposed to flame or electric arc to wear clothing that will provide enough protection to prevent burns exceeding first degree.

This procedure presents requirements for selecting and maintaining protective clothing to control work hazards to the body, specifically the arms, legs, and torso.

4.0 COMPLIANCE REQUIREMENTS

4.1 HAZARD ASSESSMENT AND GENERAL GUIDELINES FOR SELECTION AND USE OF PPE

Con Edison must perform a hazard assessment to determine the ***proper*** personal protective equipment required for each job task performed by employees. The hazards, physical requirements of the operation, resistance of clothing to work-related destructive factors (chemicals, abrasion, etc.), and worker comfort must be considered when selecting required clothing. The PPE hazard assessment is performed to ensure that PPE is correctly identified and that implementation is consistent with workplace conditions. The assessment must be reviewed when new PPE or new chemicals are introduced into the workplace or when operations change. A ***hazard assessment certification*** must be maintained by personnel and the facility to provide a record of workplace reviews. [1] R

The following paragraphs identify guidelines for the selection and use of protective clothing.

4.1.1 Arc or Flame Protection

OSHA standard 29 CFR 1910.269 and Subpart V requires that all electric power generation, transmission, and distribution workers who may be exposed to arc or flames wear clothing that will provide enough protection to prevent burns exceeding first degree.

4.1.2 Fit and Appearance

Clothing of all kinds must meet certain safety requirements when there is a potential for it to catch on moving parts of machinery (gears, pulleys, rotating shafts, etc.). Clothing, whenever practical, must not have loose parts, such as sleeve tabs, pant cuffs, pocket flaps, etc. Sleeves or pant legs must fit closely to the wearer.

When appropriate, the color of the garment selected must be chosen to show stains that could indicate contact with a hazardous substance or to make a worker conspicuous. Also, persons working in areas near traffic must wear fluorescent yellow/reflective vests as specified in the Con Edison Work Area Protection and Traffic Control Field Manual. [3] R/P

4.1.3 Laundering

Maintenance and laundering are needed when clothing is soiled due to ***incidental contact*** with substances typically found in the workplace. In the event an employee's uniform or coveralls are contaminated with a hazardous substance (as outlined in this CEHSP) the employee will turn the clothing over to supervision for proper cleaning or disposal as required. All clothes must be laundered in accordance with manufacturer's instructions. See section 4.2.2 for laundering of reusable clothing. [4] R/P

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

4.2 CON EDISON PPE REQUIREMENTS

4.2.1 Selection of Protective Clothing

Decisions regarding the appropriate garment to wear including hard hats in and around structures must be made on a daily basis according to existing field conditions. The following conditions or materials may be encountered during daily duties:

- Potential for flame or electric arc.
- Presence of oil - non-PCB and PCB-containing.
- Presence of asbestos-containing material (ACM).
- Work with or on lead-containing material.
- Work with hazardous chemicals.

Attachment 1 is a flowchart that provides guidelines for the selection of protective clothing for these hazards. Attachment 2 identifies types of protective clothing.

Based on the potential exposure of the employees, natural fiber clothing may be acceptable. However, in any situation where employees may be exposed to the hazards of electric arc or flame these employees must wear appropriate flame-retardant clothing. These situations will be documented on the appropriate hazard assessment form for the task being conducted.

Requirements for Flame-Retardant Clothing

Employees and contractors must wear flame retardant (FR) clothing when performing tasks that may expose them to the hazards of flame or electric arc. Employees who are potentially exposed to flame or electric arc must wear Nomex, Indura, Ultrasoft, Ultrasoft AC or other FR materials approved by EH&S. A single layer of FR clothing is required as a minimum for all workers who perform work on energized electrical systems 50V and greater, but if the estimated arc flash energy exceeds 8 cal/cm^2 a second layer of FR clothing is required. Two layers will typically consist of FR coveralls worn over the FR shirt and FR pants.

In situations where employees and contractors are required to wear FR clothing, all layers of clothing underneath the FR clothing must be either FR or 100% natural fiber (wool or cotton), including undergarments. The outermost layer of clothing must be FR. Employees and contractors are prohibited from wearing clothing containing polyester, nylon, rayon, and acetate, alone or in blends, when performing tasks that may expose them to flames or electric arc.

In situations that present the potential for flame or electric arc exposure and the possibility that the garments may become soiled with oil, PCB-containing oil, or other liquid, limited-use FR/ **Chemical Resistant (CR)** disposable outerwear must be worn over the FR clothing. **These disposable FR/CR garments must not be worn without FR clothing.**

Clothing Requirements for Oil and PCB-Containing Oil

If oil is present and there is no reasonable likelihood for a flame or electrical arc to occur, employees must use garments that protect against the oil hazard. Depending on the amount of oil present and the potential for contact with oil, either disposable polycoated or Saranex coveralls must be worn. The selection of garment is independent of the PCB content of oil.

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

- Saranex coveralls provide greater protection against oil breakthrough and ***penetration*** than do polycoated coveralls. For this reason Saranex coveralls must be worn when the amount of oil present may result in substantial contact.

- In situations where potential contact with oil is minimal, polycoated coveralls can be used.

If a situation has the potential for flame or electric arc exposure and possible soiling of garments with oil, limited-use FR disposable outerwear must be worn over FR clothing. **These disposable FR garments must not be worn without the FR clothing**.

After work involving potential contact with oil is completed, the disposable coveralls must be removed. If the garments have been in direct contact with oil containing 50 parts per million (ppm) or greater PCBs, the coveralls must be disposed of in accordance with CEHSP E06.12, *Disposal*. If the garments have been in direct contact with oil containing less than 50 ppm PCBs, the coveralls must be disposed of as general waste.

Clothing Requirements for Asbestos-Containing Materials

If asbestos-containing material (ACM) is present and there is reason to expect that a flame or electrical arc will not occur, employees must use garments that protect against the asbestos hazard. In this situation, a Con Edison-approved disposable coverall (Tyvek) must be worn during asbestos removal. This coverall may be worn alone or over FR coveralls.

If there is reason to expect that a flame or electrical arc may occur during asbestos work and there is a potential chemical or oil exposure, such as during the removal of arc-proofing tape in a manhole, the limited-use, chemically resistant FR disposable garments (polycoated Sontara) must be worn in place of the asbestos coverall. If there is reason to expect that a flame or electrical arc may occur during asbestos work and there is no potential chemical or oil exposure, the limited-use FR disposable garments (uncoated Sontara) must be worn in place of the asbestos coverall. In these situations, the limited-use FR disposable outerwear must be worn over the FR coveralls. **These disposable FR garments must not be worn without the FR coveralls**.

Upon completion of asbestos work, the asbestos coverall or limited-use FR garment must be removed and disposed of in accordance with the Asbestos Management Manual, Chapter 11 - Storage, Transfer, Transportation and Disposal.

Clothing Requirements for Work with Hazardous Liquid Chemicals

The proper selection of protective clothing depends on the nature of potential hazard (routes of entry, physical characteristics, toxicological properties, etc.), the type of work to be done, ergonomic constraints, and the chemical and physical performance or resistance characteristics required by the protective clothing. Both polycoated and Saranex Tyvek coveralls are chemical resistant to a wide range of chemicals. If a hazardous chemical splashes onto the coveralls, remove the chemical first by washing it off and then remove the coveralls. Saranex coveralls must be worn when the amount of acid, bases, solvents or other hazardous liquids present may result in substantial contact.

- In situations where potential contact with acids, bases, solvents and other hazardous liquid material is minimal, polycoated Tyvek must be worn.

- The PPE for battery maintenance activities includes a rubber apron and vinyl sleeves.

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

Clothing Requirements for Welding and Burning

Employees exposed to the hazards created by welding, cutting or brazing operations, including assistants and fireguards, must wear flame-retardant coveralls. Employees performing welding or cutting activities must also don the following equipment:

- Flame-resistant gauntlet gloves.
- Flame-retardant coveralls.
- Flame-resistant aprons or leather vests, jackets, leggings, sleeves and spats worn over the flame-retardant coveralls when additional protection against sparks and radiant energy is needed.
- 100% natural fiber undergarments
- A flame-retardant skullcap with ear covers for overhead work.

Clothing Requirements for Lead Splicing Work

Persons performing lead splicing work must wear FR coveralls. If the job will result in soiling of the FR coveralls, limited-use FR garments must be worn over the FR coveralls. This should protect and extend the life of the FR coveralls. **The limited-use FR garment must not be used without the FR coveralls.**

Clothing Requirements for Working with Hazardous Materials

Clothing for all tasks where there is a potential for exposure to hazardous materials must be approved by EH&S. [5] R/P

Clothing Requirements for Working Near or Over Water

U.S. Coast Guard approved personal flotation devices must be worn by an employee whenever the danger of drowning exists. This condition may exist whenever an employee is working near or over water and could be pulled or pushed or fall into the water.

Each personal flotation device must be maintained in a safe condition and inspected frequently enough to ensure that it does not have rot, mildew, water saturation, or any other condition that could render the device unsuitable for use. An employee may cross streams or other bodies of water only if a safe means of passage, such as a bridge, is provided. [6] R/P

4.2.2 Reusable Clothing Maintenance and Laundering

Most reusable work garments require periodic laundering to clean them of general debris and material that accumulates on them at the work location due to incidental contact. The vendor will maintain those clothes that are part of the rental contract. All other clothes must be laundered according to manufacturer's specifications.

When ***accidental contact*** occurs and reusable clothing becomes soiled or contaminated with materials such as ACM or PCBs, appropriate precautions must be taken.

PCB-Contaminated Reusable Clothing

Reusable clothing that has been in direct contact with oil containing 50 ppm or greater PCBs must be disposed of in accordance with CEHSP E06.12, *Disposal*.

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

Reusable clothing that has been in direct contact with oil containing 1 ppm or more PCBs, but less than or equal to 49 ppm PCBs, must be collected and bagged at the work location for vendor pickup.

Friable ACM-Contaminated Reusable Clothing

Reusable clothing that has been in direct contact with friable ACM must be wet down to minimize fiber release, placed in a sealed container, and collected from the employee. The contaminated garment must be removed and disposed of in accordance with the Asbestos Management Manual, Chapter 11 - Storage, Transfer, Transportation and Disposal.

Laundering of 100% Cotton Clothing

The laundering instructions for 100% cotton garments are as follows:

- Machine wash in warm water with similar colors.
- Use only non-chlorine bleach, when needed.
- Tumble dry at low to medium temperature.
- Iron on a low to medium temperature, if required.

Laundering Cotton FR Clothing

Cotton FR (e.g. Ultrasoft, Ultrasoft AC) has been treated to make them fire retardant. When washed properly, the fire-retardant treatment should last the life of the garment. The manufacturer's instructions for laundering treated fabrics must be adhered to, including the following washing instructions:

- Wash clothing inside out to minimize edge and surface abrasion.
- Use a water level sufficient for the quantity of clothing to be washed, preferably the high tide level on the washer.
- Use a quality detergent, such as Tide, All, Era, Yes, or Wisk. Follow the detergent manufacturer's instructions.
- Use a temperature that is as low as possible but that still cleans the garment. When using a quality detergent, the warm or cold setting may be sufficient.
- Do not use chlorine (sodium hypochlorite) bleach such as Clorox as this can affect the fire-retardant properties of these garments.
- When drying garments, use the minimum setting required to dry the clothing in a practical time
- Dry garments inside out.
- To minimize shrinkage, immediately remove garments from the clothes dryer when they are dry or slightly damp.

Laundering Nomex Garments

Nomex garments are made of flame-retardant aramid fibers. The flame-retardant property is "built into" the fiber; it is not applied to a fabric as a treatment or additive, as in the case of the Indura and Proban coveralls. The manufacturer's instructions for laundering Nomex garments must be adhered to, including the following washing instructions:

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

- Nomex garments must be sorted and washed separately from other garments to prevent flammable fibers/lint from being transferred to the Nomex garment.
- Heavily soiled or stained garments must be pre-treated as soon as possible with a full-strength heavy-duty liquid detergent.
- The wash load size must allow the garment to move freely throughout the wash and rinse cycles.
- Normal wash water setting (approximately 140^{o} Fahrenheit) is adequate for moderately soiled garments. Higher temperatures may be required for heavily soiled or stained garments.
- A synthetic heavy-duty liquid laundry detergent, such as liquid Tide, All, Era, Yes, and Wisk, is recommended for cleaning Nomex garments.
- Chlorine bleach must not be used. Bleach will not degrade the flame-retardant properties of the garment, but it may cause strength and color loss over time.
- Nomex garments must be tumble-dried on medium or high temperature settings.
- Iron on medium setting, if necessary. [7] R/P

4.3 PPE INSPECTION AND MAINTENANCE

This information will help to ensure that equipment is maintained in a satisfactory condition and provides the required protection when used. The following minimum requirements for inspection and maintenance will be followed.

- PPE must be properly inspected prior to use. Damaged or missing items like holes in gloves or protective clothing, missing side shields on glasses, and broken laces or cracked soles on shoes can significantly impact the effectiveness of the PPE. Signs of wear, such as smooth soles on shoes that can cause slipping or scratches on goggles that limit vision, can present new hazards. PPE that is damaged, missing items, or shows signs of wear, jeopardizing the protection afforded by the equipment, will be removed from service and repaired or replaced.
- PPE must be cleaned and properly decontaminated in accordance with manufacturer recommendations.
- PPE must be properly stored to protect it from exposure to conditions that can damage or compromise its effectiveness. Specific locations acceptable for the storage of PPE will be identified.
- Employees must be familiar with methods for obtaining new PPE in the event that testing and inspection identify unacceptable equipment.

Con Edison maintains a supply of PPE that can be used by facility personnel when needed. The equipment is specific to the tasks performed by Con Edison personnel. [9] R/P

4.4 TRAINING AND TESTING

Refer to CEHSP S05.01, *Hazard Assessment and Personal Protective Equipment*, Section 4.4 for detailed training and testing requirements. [10] R/P

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

4.5 RECORDKEEPING

In accordance with CEHSP S05.01, *Hazard Assessment and Personal Protective Equipment,* the Training Coordinator for each operating organization must retain training records for three years. Additionally, OSHA 1910.269(a)(2)(vii) requires that training records associated with FR clothing be maintained for the duration of the employee's employment. The Safety Administrator must maintain hazard assessment documentation for all job types currently performed within the organization. [11] R/P

5.0 DEFINITIONS

***Accidental Contact*:** An unexpected event where a substantial amount of a substance spills, splashes, sprays, or otherwise comes into contact with a worker. It is not a typical occurrence for the duties/job being performed.

Body: Arms, legs, and torso.

Hazard Assessment: A systematic review performed to identify exposure hazards and appropriate PPE for specific work operations. This assessment includes a review of the work activities, equipment, and materials used, and end products and by-products to evaluate the potential for physical contact, noise hazards and/or respiratory hazards.

Hazard Assessment Certifications: Written verification that identifies a completed exposure assessment, including the evaluated tasks/processes and areas, the person who performed the assessment, and the date(s) of the assessment.

Incidental Contact: Materials that an employee may contact during the performance of his daily duties. For example, an auto mechanic contact with lube oil while replacing a part or a troubleshooter brushing up against equipment in a vault during an inspection that results in a smudge on their clothing.

Penetration: Flow of chemicals through clothing discontinuities, such as zippers, seams, and pinholes.

***Personal Protective Equipment (PPE)*:** Clothing and equipment worn by personnel to prevent contact with hazards present in the work area. PPE includes safety glasses, face shields, gloves, safety shoes, hearing protection, hard hats, etc.

Proper: Approved, certified, or suitable, within acceptable guidelines set forth by governing codes and standards, as well as recognized safe work practices.

6.0 RESPONSIBILITIES

Employees: The PPE user is responsible for following the requirements of the PPE procedure, including: wearing required PPE; attending required training; caring for, cleaning, and maintaining PPE; and submitting equipment for repair or replacement.

Environment, Health, and Safety (EH&S): EH&S performs the following functions:

- Reviews applicable regulations and ensures that procedures meet all regulatory requirements.

© 2000-2015 Consolidated Edison Co. of New York, Inc.

- Revises procedures as applicable.
- Reviews/approves controlled documents prior to release.
- Distributes updates and changes.
- Reviews training prepared by the Learning Center.
- Provides technical assistance to Safety Administrators.

Facility or Site Manager Responsible for Compliance: The Con Edison designated individual within each operating organization who is responsible for ensuring compliance with federal, state, and local regulations and this procedure.

Law Department: The Law Department assists and provides guidance to EH&S by reviewing changes to these procedures in light of all applicable statutes and regulations to ensure that the procedures meet all legal requirements.

Operating Organizations: Unless otherwise indicated, operating organizations are responsible for compliance with federal, state, and local regulations and this procedure.

Safety Administrator: Responsible for performing hazard assessments, selecting PPE, and maintaining hazard assessment certifications.

Supervisors: Responsible for ensuring that personnel wear proper PPE and for performing necessary training.

Training Coordinators: Enters PPE training records into the Training Registration System.

7.0 REFERENCES

4.1 HAZARD ASSESSMENT AND GENERAL GUIDELINES FOR SELECTION AND USE OF PPE

[1] 29 CFR 1910.132(d) (hazard assessment, including written certification requirement); 29 CFR 1910.132, Appendix B (non-mandatory compliance guidelines for hazard assessment, including Section 7, reassessment of hazards). NOTE: The OSHA regulations do not specifically require reassessment of hazards, although the issue is addressed in the Appendix B non-mandatory guidelines).

[2] 29 CFR 1910.137 (electrical protective equipment); 29 CFR 1910.269(l)(6) (apparel for electrical power generation, transmission, and distribution).

[3] USDOT Federal Highway Administration, *Manual on Uniform Traffic Control Devices,* Section 6D.03, Worker Safety Considerations (2003 Edition) (clothing requirements when working near traffic). The manual can be found at: http://mutcd.fhwa.dot.gov/HTM/2003/html-index.htm. The remaining requirements in this section relating to fit and appearance are required by Con Edison as a matter of policy.

[4] See Note 6 below regarding laundering.

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

4.2 CON EDISON REQUIREMENTS

[5] 29 CFR 1910.132 (general PPE requirements); 29 CFR 1910.137 (electrical protective equipment); 29 CFR 1910.252(b)(3) (protective clothing for welding, cutting and brazing); 1910.269(l)(8)(v) (PPE requirements for potential arc flash during electrical distribution, transmission or generation). The specific clothing identified in this section has been determined to meet OSHA requirements relating to proper PPE which require sufficient protection to limit burns to first degree or less.

[6] 29 CFR 1910.269(w)(5)(i)-(iii) (requiring personal flotation device when danger of drowning exists). NOTE The cited provision applies only to the operation and maintenance of electric power generation, control, transformation, transmission and distribution lines and equipment. Con Edison applies this requirement to all activities that involve the potential for drowning as a matter of policy.

[7] 29 CFR 1910.132(a) (general PPE maintenance requirement); 29 CFR 1910.132(e) (prohibiting use of damaged/defective PPE); 29 CFR 1910.132, Appendix B, Sec. 12 (non-mandatory: cleaning and maintenance); 29 CFR 1910.137(b) (in service use and care of electrical protective equipment). NOTE: Con Edison has developed the specific procedures in this section relating to maintenance and laundering of particular types of clothing to ensure that the clothing continues to provide proper protection to Con Edison employees.

[8] 29 CFR 1910.269 and Subpart V. (operation and maintenance of electric power generation, control, transformation, transmission and distribution lines and equipment) NOTE: Con Edison achieved compliance for arc flash protection through use PPE, increased distance from arc sources, remote operation, faster trip times, and/or procedure changes.

4.3 PPE INSPECTION AND MAINTENANCE

[9] 29 CFR 1910.132(a) (general PPE maintenance requirement); 29 CFR 1910.132(e) (prohibiting use of damaged/defective PPE); 29 CFR 1910.132, Appendix B, Sec. 12 (non-mandatory: cleaning and maintenance); 29 CFR 1910.137(b) (in service use and care of electrical protective equipment). NOTE: Con Edison has developed the specific procedures in this section relating to inspection and maintenance to ensure that protective clothing is maintained in a satisfactory condition.

4.4 TRAINING AND TESTING

[10] See CEHSP S05.01, *Hazard Assessment and Personal Protective Equipment*, for training and testing requirements.

4.5 RECORDKEEPING

[11] 29 CFR 1910.132(d)(2) (written hazard assessment certification); 29 CFR 1910.132(f)(4) (training records); 29 CFR 1910.269(a)(2) (electric power generation, transmission and distribution training recordkeeping). NOTE: the OSHA regulations do not specify a retention period for training records under 29 CFR 1910.132(f)(4). Con Edison has adopted a three-year record retention period as a matter of policy. 29 CFR

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

1910.269(a)(2) requires training records to be retained for the duration of the employee's employment**.** This training covers PPE, including FR clothing.

National Safety Council - Accident Prevention Manual for Business and Industry, 10th edition.

8.0 REVISION HISTORY

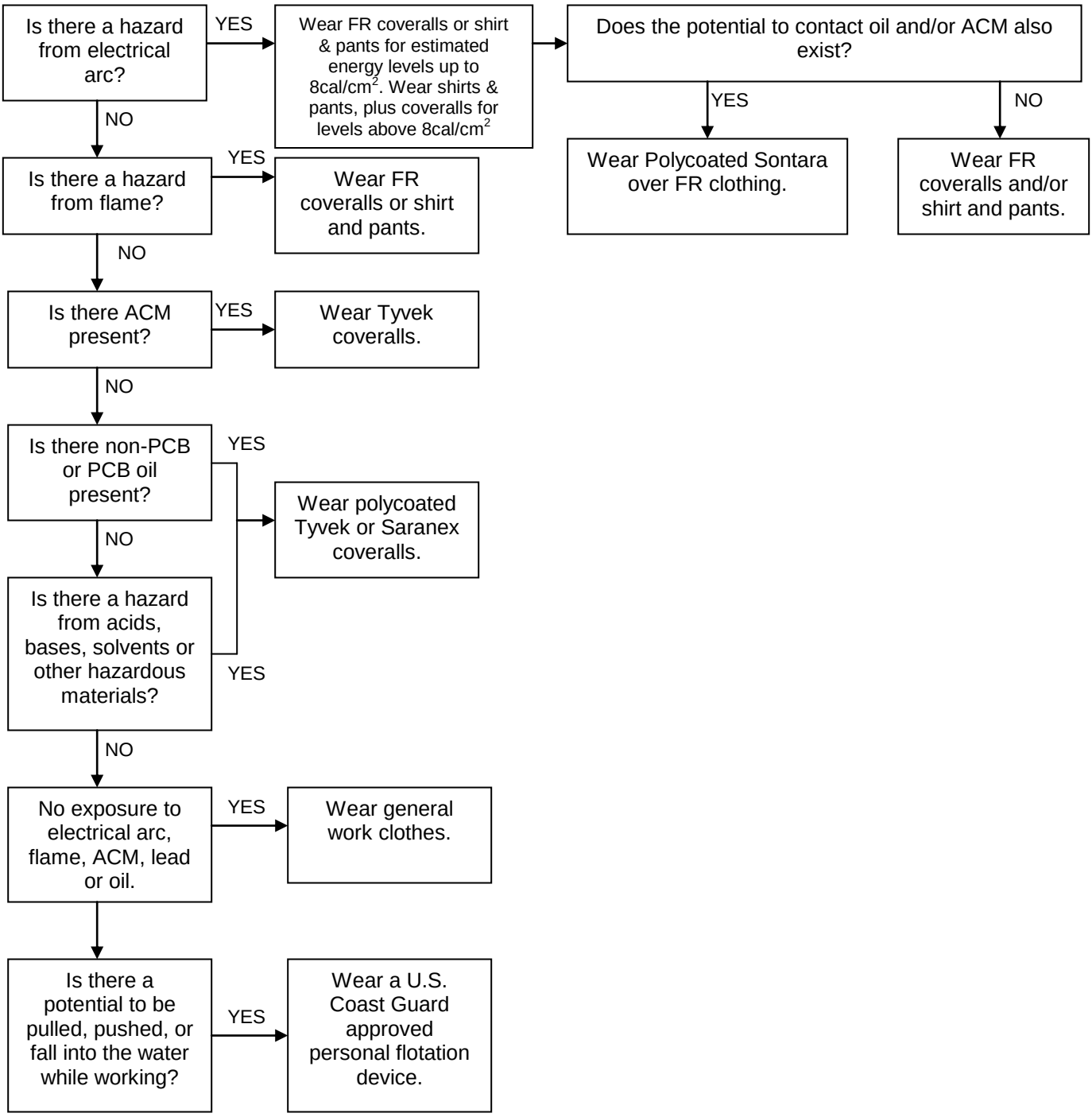
Revision Date	Revision #	Summary of Change	Author
6/28/2013	9	Periodic review by SME and addition of Induara, Ultrasoft, Ultrasoft AC or any other FR clothing approved by Corporate EH&S for Gas Operations. Added revision history section. Assign new revision #, revision and effective date to reflect review of this CEHSP.	P. Kothari, S. Ng
8/27/2013	10	Updated section 4.2.1 to include statement pertaining to the use of hard hats in and around structures; Updated various hyperlinks and title of other CEHSPs referenced throughout this document; Updated revision date and number to reflect these changes	B. Suggs S. Ng
6/16/2015	11	Included new Arc Flash PPE requirements as required by OSHA 269 standard.	W. Capune

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

ATTACHMENT 1

GUIDELINES FOR SELECTION OF PROTECTIVE CLOTHING



© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

ATTACHMENT 2
PERSONAL PROTECTIVE CLOTHING

PROTECTIVE CLOTHING	USE	GROUP/OPERATION
Flame Retardant (FR)	• Worn when there is potential exposure to flame or electric arc. • Worn when performing lead splicing.	Steam, Powerhouse, Electrical Welding, Hotwork Gas Operations Welding, Hotwork
U.S. Coast Guard Approved Personal Flotation Device	Worn when the potential of drowning exists.	Steam, Powerhouse, Electrical, Spill Response Team Members
Tyvek	Worn when potential for contact with asbestos-containing materials (ACM).	Maintenance, Spill Response Team Members
Kleenguard Ultra (Tyvek equivalent)	Worn for general utility, asbestos, bloodborne pathogens, lead dust, bulk chemical delivery, and short-term, incidental contact with oil, including polychlorinated biphenyls (PCB).	Maintenance, Spill Response Team Members
Disposable Polycoated / Saranex	• Polycoated is worn when there is minimal potential for contact with PCBs. Saranex is worn where there is greater potential for contact with PCBs.	Maintenance, Spill Response Team Members
Disposable Polycoated/ Saranex	• Polycoated is worn when there is a minimal potential for contact with acid, bases, solvents and other hazardous liquid materials. • Saranex is worn where there is a greater potential for contact with acids, bases, solvents and other hazardous liquid materials	Acid Deliveries, Maintenance of Acid Systems, solvents
Polycoated Sontara	• Polycoated Sontara is worn when there is both a potential for arc or flame and a potential for exposure to an oil contaminant or asbestos. This garment protects normal FR clothing.	Operations where there is an exposure to arc or flame and where there is an exposure to oil and/or asbestos
Uncoated Sontara	Uncoated Sontara is worn when there is a potential for arc or flame and no potential for exposure to an oil contaminant. This garment protects normal FR clothing.	Operations where there is an exposure to arc or flame and where there is an exposure to asbestos (no oil)
Rubber Apron Vinyl Sleeves	Rubber apron bib style and vinyl sleeves are worn over work clothes to protect against acids.	Battery Maintenance and acid handling

© 2000-2015 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
CORPORATE ENVIRONMENTAL, HEALTH AND SAFETY PROCEDURE

CEHSP S12.00 – Lockout/Tagout Procedures
Revision 4: 11/17/2014 Effective Date: 01/01/2015

CONTENTS

SECTION 1.0 – PURPOSE
SECTION 2.0 – APPLICABILITY
SECTION 3.0 – INTRODUCTION
- 3.1 – PROCEDURE
- 3.2 – PERSONNEL

SECTION 4.0 – COMPLIANCE REQUIREMENTS
- 4.1 – LOCKOUT PROCEDURE
- 4.2 – LOCKOUT/TAGOUT PROCEDURE SEQUENCE
- 4.3 – GROUP LOCKOUT OR TAGOUT
- 4.4 – SHIFT OR PERSONNEL CHANGES
- 4.5 – ANNUAL INSPECTION
- 4.6 – PROTECTIVE HARDWARE AND MATERIAL
- 4.7 – TRAINING

SECTION 5.0 – DEFINITIONS
SECTION 6.0 – REFERENCES
- ATTACHMENT 1 – EXAMPLE SITE PROCEDURE
- ATTACHMENT 2 – LOCKOUT/TAGOUT PERIODIC INSPECTION

1.0 PURPOSE

IT IS THE POLICY OF CON EDISON TO COMPLY WITH ALL FEDERAL REGULATIONS RELATING TO *LOCKOUT/TAGOUT*. The purpose of this procedure is to ensure that before any employee performs any servicing or maintenance on a machine or equipment where the unexpected energizing, startup or release of stored energy could occur and cause injury, the machine or equipment is isolated from the ***energy source*** and rendered inoperative.

This document does not supersede Con Edison's General Instructions Governing Work on System Electrical Equipment (i.e., Bluebook) or any other existing corporate documents (i.e., COP 5-1-2, Processing & Controlling Operating Orders and Work Permits).

2.0 APPLICABILITY

This Corporate, Environmental and Safety Procedure (CEHSP) applies to all Con Edison facilities, each of which is responsible for establishing and documenting site-specific lockout/tagout procedures for each piece of equipment, machinery or system under that site's supervision. Procedures may be established for classes of equipment or machinery if their function and operation are similar and the procedure can collectively account for the control of all hazardous energy sources.

© 2002-2015 Consolidated Edison Co. of New York, Inc

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please EH&S Connect for the current version prior to use.

This CEHSP also applies to all outside contractors performing work on Con Edison equipment within the facility. It is the responsibility of the Facility's Manager to ensure compliance. Failure to comply may result in immediate termination of such outside contractor's services.

Procedures must be developed, documented and utilized by each Con Edison site for the control of potentially hazardous energy when employees are engaged in the activities covered by this section.

Exception: The site does not need to document the required procedure for a particular machine or equipment, when **all** of the following elements exist:

(1) The machine or equipment has no potential for stored or residual energy or re-accumulation of stored energy after shut down which could endanger employees;

(2) The machine or equipment has a single energy source which can be readily identified and isolated;

(3) The isolation and locking out of that energy source will completely de-***energize*** and deactivate the machine or equipment;

(4) The machine or equipment is isolated from that energy source and locked out during ***servicing and/or maintenance***;

(5) A single ***lockout device*** will achieve a locked-out condition;

(6) The lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance;

(7) The servicing and/or maintenance does not create hazards for other employees; and

(8) The employer, in utilizing this exception, has had no accidents involving the unexpected activation or re-energization of the machine or equipment during servicing and/or maintenance.

3.0 INTRODUCTION

3.1 PROCEDURE

This procedure applies to any job task that may expose workers to potentially hazardous energy. There are several qualified exceptions:

- Anytime a guard is removed. Minor tool changes and adjustments and/or other minor servicing activities that are routine, repetitive, and integral to the use of the equipment and that occur during ***normal production operations***, are not covered by the lockout/tagout standard, provided the work is performed using alternative measures that provide effective protection.

- While servicing or maintaining cord and plug connected electrical equipment, provided that the equipment is unplugged from the energy source; and the plug remains under the exclusive control of the employee performing the servicing and/or maintenance.

© 2002-2015 Consolidated Edison Co. of New York, Inc

- Exposure to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations when employees are properly trained and protected from the hazards.

- ***Hot tap*** operations that involve transmission and distribution systems for gas, steam, water, or petroleum products when they are performed on pressurized pipelines provided that continuity of service is essential, shutdown of the system is impractical, and employees are provided with alternative protection that is equally effective. [1] R

3.2 PERSONNEL

Authorized Employees

An authorized employee is one who is able to initiate these procedures, and to employ all parts of the procedures to ensure the safe completion of work. Authorized employees are selected on the basis of their formal training, on the job experience, licenses held and familiarity with mechanical and electrical work and associated hazards related to this work. All authorized employees must meet the training requirements stated in section 4.7 of this procedure.

Affected Employees

Individuals whose jobs requires them to operate a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires them to work in an area in which such servicing or maintenance is being performed.

All other company and outside contract employees whose work operations are or may be in an area where lockout/tagout procedures may be utilized are also deemed affected employees. [2] R

4.0 COMPLIANCE REQUIREMENTS

4.1 LOCKOUT PROCEDURE

Except under conditions noted in Section 4.4, the only authorized employee that can remove a lock and tag is the authorized employee who installed the lock and tag.

- The authorized employee who performed all the steps in Section 4.2, A-B-C-D-E, may apply a sequentially numbered padlock to equipment capable of accommodating a padlock for the purpose of preventing the normal operation of an ***energy isolating device*** such as a switch, valve, etc.

- The authorized employee will continue the procedure in Section 4.2 steps F and G to completion, and return the padlock along with all Stop Tags.

- The authorized employee will update log entries as stated in 4.2 E. [3] R/P

4.2 LOCKOUT/TAGOUT PROCEDURE SEQUENCE

A. Notification

© 2002-2015 Consolidated Edison Co. of New York, Inc

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please EH&S Connect for the current version prior to use.

The authorized employee will notify the supervisor of the facility and any affected employee in the facility that a lockout/tagout procedure will be put into effect, the location of the equipment to be taken off-line, and the reason for the procedure.

The authorized employee will issue the appropriate amount of Stop Tags, and enter data into a logbook consisting of:

- Date and time
- ID number of tag(s) issued
- Equipment removed from service
- Authorized employee name(s)
- Date and time tags were returned (equipment returned to service).

The authorized employee is to acknowledge understanding the procedure, and the importance of adhering to the procedure.

B. Identification and Location of Devices

After receiving a job briefing on the hazards associated with the work assignment and required personal protective equipment, the authorized employee will make a survey to locate and identify all energy isolating devices (i.e., which switch(s) valve(s) or other isolating devices apply to the equipment) to be locked out.

Note: More than one energy source may be involved.

C. Shut Down of Equipment

The authorized employee must shut the machinery or equipment down in the operational method described by departmental procedure, or stop and obtain an operating procedure from his/her supervisor before shutting down the equipment.

D. Isolation - Dissipation

The authorized employee will operate the switch, valve, or other energy-isolating device, or multiple combinations thereof, so that the equipment is isolated from all of its energy sources. Stored energy between the isolating device and the equipment must be dissipated. Energy such as spring-loaded components, rotating components, pressurized hydraulic, water, steam, gas, air pressure, or potential stored energy (i.e., capacitors) must be relieved of potential hazard by blocking, restraining, re-positioning or bleeding down as required.

E. Lockout/Tagout Procedure Sequence

Lockout is the preferred method of isolating machines or equipment from energy sources, and must be used when the energy isolating device is ***capable of being locked out***.

A tagout procedure may be used on those energy isolating devices that are incapable of being locked out after all available methods and means have been exhausted and no satisfactory alternative is available.

The authorized employee will apply Stop Tags to each energy isolating device, in accordance with an associated procedure.

© 2002-2015 Consolidated Edison Co. of New York, Inc

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please EH&S Connect for the current version prior to use.

The authorized employee will record the following information on each tag affixed:
1. Name of employee invoking the procedure
2. Date procedure initiated
3. Reason for procedure
4. Warning legend

When the equipment is returned to operation, the authorized employee will remove all Stop Tags and log each stop tag removed, completing the procedure.

F. Verification

The authorized employee will verify that all energy has been isolated by going back to the original device and verifying by testing that an unexpected release of stored energy will not occur (i.e., electrical, hydraulic, pneumatic, pressurized liquids and gases etc.). After ensuring that personnel are not exposed to any hazards from the release of stored energy, the authorized employee will follow written procedures for performing the assigned task.

G. Restoring Machine or Equipment to Normal Operation

After the assigned task is completed and the equipment is ready for return to normal operation, the authorized employee will perform the following sequence:

1. Check area around the equipment to be sure no other personnel are exposed to danger. Notify all affected employees of the intent to restore energy.
2. Remove all tools and supplies from immediate vicinity.
3. Check to make certain all protective guards, covers, casings, etc. are in place, and that all moving parts are unrestricted.
4. Check position of local starting mechanism, valves, controls, etc. to ensure against premature or unwanted action leading to a hazardous condition.
5. Remove, in reverse sequence of application, all Stop Tags.
6. Re-position valves, switches, etc. in compliance with operating procedures.
7. Operate the energy isolating devices to restore energy to the equipment.
8. Notify the supervisor of the facility and affected employees of the restoration of energy to the equipment.
9. Operate the equipment in the normal manner to detect any discrepancies. Repeat procedures as found necessary.
10. Return Stop Tags and update the log in accordance with step 4.1 E. [4] R/P

4.3 GROUP LOCKOUT OR TAGOUT

When work is performed on machinery or equipment involving more than one person, each employee in the group is responsible for adhering to all provisions of the procedures for lockout or tagout.

In the event a group of employees require the procedure to be used, the following actions must be followed:

© 2002-2015 Consolidated Edison Co. of New York, Inc

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please EH&S Connect for the current version prior to use.

1. A single authorized employee will be designated by the supervisor of the facility as having primary responsibility for a set number of persons working under the protection of a group procedure.

2. This authorized employee will be the individual designated to coordinate with the affected employees and ensure continuity of protection.

3. Each employee working on the unit must review with the authorized employee designated by the supervisor of the facility, placement of Stop Tag or padlock device on each energy isolating device de-energized under the procedure.

4. All affected employees must receive a job briefing by an authorized employee. [5] R

4.4 SHIFT OR PERSONNEL CHANGES

Shift Changes

When work on a machine or piece of equipment will continue into the next work shift, protection must be continued. The oncoming authorized employee must be satisfied that the procedure is properly in effect and it is safe to transfer lockout or ***tagout devices***.

- The oncoming authorized employee will be given a job briefing, and will accompany the off-going authorized employee to the location of each Stop Tag or padlock device.

- The off-going authorized employee will point out the location of all Stop Tags and padlocks applied during his/her shift.

- The oncoming authorized employee will record the number of Stop Tags and padlocks applied.

- The oncoming authorized employees must ensure that they are familiar with the existence and reason for the lockout or tagout procedure, and the number of Stop Tags and padlock devices recorded.

- The authorized employees will review the number of Stop Tags and padlock devices for discrepancies, and then record the transfer of responsibility from the off-going to the oncoming employee in the log.

Personnel Changes

Each Stop Tag or padlock device must be removed from each energy isolating device by the authorized employee who applied them.

If the employee who initiated the procedure is not available to remove the Stop Tag or padlock device, they may be removed by a ***qualified employee*** provided the following conditions are completely satisfied:

1. The qualified employee must be trained in all aspects of this procedure.

2. The qualified employee has complied with all parts of this procedure prior to removing the device.

© 2002-2015 Consolidated Edison Co. of New York, Inc

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please EH&S Connect for the current version prior to use.

3. The qualified employee verifies that the employee who initiated the procedure is unavailable. All reasonable attempts must be made to contact the employee and inform the employee of the intended action.

The employee will be informed that the above action was taken before the employee begins work again at the location.

Special Circumstances

In situations where a lockout device must be removed by someone other than the person who installed it, the following steps must be taken:

- A qualified employee on site must personally verify that no affected employees are exposed to danger from re-energizing or reactivating equipment.

- The lockout device(s) may be removed by cutting or similar method only after the qualified employee has verified that no affected employee exposure exists. [6] R

4.5 ANNUAL INSPECTION

The operating organization must conduct, on at least an annual basis, an inspection of the requirements and compliance with this procedure. This inspection must:

- Be performed by an authorized employee other than those using the procedure.

- Correct any inadequacies or deficiencies found.

- Include a review of the employee's responsibilities between each authorized employee and the inspector.

- Be certified to include the machine or equipment, the date of the inspection, the employees included, and the person performing the inspection.

Attachment 2 must be used for these inspections.

These annual inspections are intended to assure that the energy control procedure continues to be implemented properly and that the employees involved are familiar with their responsibilities under that procedure. The inspection must be able to determine whether the:

- Steps in the energy control procedure are being followed;

- Employees involved know their responsibilities under the procedure;

- Procedure is adequate to provide the necessary protection, and what changes, if any, are needed.

When lockout is used, the inspection must include:

- A review with all authorized employees for the procedure being inspected,

- Their responsibilities under that procedure.

© 2002-2015 Consolidated Edison Co. of New York, Inc

- Group meetings between the authorized employee and affected employees.

When tagout is used, this review must be performed with all affected employees, as defined in the standard, as well as with all authorized employees, for the procedure being inspected.

The site's senior manager must certify that the annual inspections have been performed. The certification must identify:

- The machine or equipment on which the energy control procedure was being utilized,
- The date of the inspection,
- The employees included in the inspection,
- And the person performing the inspection.

The results of the audit will be forwarded to the manager of maintenance, for recordkeeping. [7] R

4.6 PROTECTIVE HARDWARE AND MATERIAL

Lockout and tagout equipment must be provided in sufficient quantity to satisfy the requirements of this procedure. Such hardware and material must be capable of safely tagging, isolating, securing or blocking machines and equipment from energy sources.

Lockout and tagout devices must be singularly identified, must be the only devices used for controlling energy, and must not be used for other purposes.

Whenever replacement or major repair, renovation or modification of a machine or equipment is performed, and whenever new machines or equipment are installed, energy isolating devices for such machine or equipment must be designed to accept a lockout device

Durable

Lockout and tagout devices must be capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected.

Tagout devices must be constructed and printed so that exposure to weather condition or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible.

Tags must not deteriorate when used in corrosive environments such as areas where acid and alkaline chemicals are handled and stored.

Standardized

Lockout and tagout devices must be standardized within the facility where used in at least one of the following criteria - color, shape, or size. Additionally, on tagout devices, print and format must be standardized.

Substantial

© 2002-2015 Consolidated Edison Co. of New York, Inc

Lockout devices must be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or other metal cutting tools.

Tagout devices, including their means of attachment, must be substantial enough to prevent inadvertent or accidental removal. Tagout device attachment means must be of a non-reusable type, attachable by hand, self-locking, and non-releasable with a minimum unlocking strength of no less than fifty (50) pounds and having the basic characteristics of being at least equivalent to a one-piece, all-environment-tolerant nylon cable tie.

Identifiable

Lockout and tagout devices must indicate the identity of the employee applying the devices.

Tagout devices must warn against hazardous condition if the energy isolating device is not operated, and must include a legend such as the following - Do Not Open, Do Not Close, Do Not Start, Do Not Energize, Do Not Operate. [8] R

4.7 TRAINING

The company will provide training to ensure that employees understand the purpose and function of the lockout/tagout procedure and that the knowledge and skills required for the safe application, usage and removal of lockout/tagout controls are acquired by authorized employees.

The company must certify that employee training has been accomplished and is up to date. The certification must contain each employee's name and dates of training.

Equipment-Specific Training

Each authorized employee must receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control.

Each affected employee must be instructed in the purpose and use of the lockout/tagout procedure.

All other employees whose work operations are or may be in an area where lockout/tagout procedures may be utilized must be instructed about the procedure and about the prohibition relating to attempts to restart or reenergize machines or equipment that are locked out or tagged out.

Specific instructions will include the proper procedure for locking out and tagging out of devices. Specific training will be given regarding the limitations of tags. Attachment 1 must be utilized for this purpose.

Training will be done through The Learning Center, or by the safety administrator or by the responsible shop operating supervisor. The tracking and recording of this training will be the responsibility of the department training Coordinator. [9] R/P

Retraining

© 2002-2015 Consolidated Edison Co. of New York, Inc

Retraining must be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in machines, equipment or processes that present a new hazard, or when there is a change in the energy control procedure.

Additional retraining must be conducted whenever a periodic inspection reveals, or local EH&S has reason to believe, that there are deviations from, or inadequacies in the employee's knowledge, or use of the energy control procedures.

The training must reestablish employee proficiency and introduce new or revised control methods and procedures, as necessary. [10] R

5.0 DEFINITIONS

Affected Employee: An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized Employee: A person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee becomes an authorized employee when that employee's duties include performing servicing or maintenance covered under this section.

Capable of Being Locked Out: An energy isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed, or it has a locking mechanism built into it. Other energy isolating devices are capable of being locked out, if lockout can be achieved without the need to dismantle, rebuild, or replace the energy isolating device or permanently alter its energy control capability.

Energized: Connected to an energy source or containing residual or stored energy.

Energy Isolating Device*:* A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: a manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.

Energy Source: Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Hot Tap: A procedure used in the repair, maintenance and services activities which involves welding on a piece of equipment (pipelines, vessels or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.

Lockout: The placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

© 2002-2015 Consolidated Edison Co. of New York, Inc

Lockout Device: A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.

Normal Production Operations: The utilization of a machine or equipment to perform its intended production function.

Qualified Employee: A qualified person is a person who has been trained and has demonstrated proficiency, in compliance with 29 CFR 1910.147(c)(7), to perform servicing and maintenance on the machine or equipment to be inspected.

Servicing and/or Maintenance: Workplace activities such as constructing, installing, ***setting up***, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or un-jamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Setting Up: Any work performed to prepare a machine or equipment to perform its normal production operation.

Tagout: The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout Device: A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

6.0 REFERENCES

3.0 INTRODUCTION

3.1 PROCEDURE

[1] 29 CFR 1910.147(a)(2)(ii)-(iii) (applicability and exceptions).

3.2 PERSONNEL

[2] 29 CFR 1910.147(b) (definitions).

4.0 COMPLIANCE REQUIREMENTS

4.1 LOCKOUT PROCEDURE

[3] 29 CFR 1910.147(c)(1) (energy control program generally). See 29 CFR 1910.147, Appendix A (non-mandatory guidelines: typical minimal lockout procedure).

4.2 LOCKOUT/TAGOUT PROCEDURE SEQUENCE

© 2002-2015 Consolidated Edison Co. of New York, Inc

[4] 29 CFR 1910.147(c)(2) (preference for lockout); 29 CFR 1910.147(c)(3) (full employee protection); 29 CFR 1910.147(c)(4) (energy control procedure); 29 CFR 1910.147(c)(9) (notification of employees); 29 CFR 1910.147(d)(1)-(6) (preparation for shutdown, machine or equipment shutdown; machine or equipment isolation; lockout or tagout device application; stored energy; verification of isolation); 29 CFR 1910.147(e)(1)-(3) release from lockout or tagout). See 29 CFR 1910.147, Appendix A (non-mandatory guidelines: typical minimal lockout procedure).

4.3 GROUP LOCKOUT OR TAGOUT

[5] 29 CFR 1910.147(f)(3) (group lockout/tagout).

4.4 SHIFT OR PERSONNEL CHANGES

[6] 29 CFR 1910.147(c)(8) (requiring lockout/tagout to be performed only by authorized employee performing servicing and/or maintenance); 29 CFR 1910.147(f)(4) (shift changes).

4.5 ANNUAL INSPECTION

[7] 29 CFR 1910.147(c)(6).

4.6 PROTECTIVE HARDWARE AND MATERIAL

[8] 29 CFR 1910.147(c)(5) (protective materials and hardware).

4.7 TRAINING

[9] 29 CFR 1910.147(c)(7)(i), (iv) (training and recordkeeping). NOTE: This section includes Con Edison-specific procedures relating to training and recordkeeping.

[10] 29 CFR 1910.147(c)(7)(iii) (retraining).

© 2002-2015 Consolidated Edison Co. of New York, Inc

REVISION HISTORY

Revision Date	Revision #	Summary of Change	Author
11/17/14	5	Periodic Review. Inserted exception for work conducted under Subpart S	M. McFarland

© 2002-2015 Consolidated Edison Co. of New York, Inc

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please EH&S Connect for the current version prior to use.

ATTACHMENT 1
EXAMPLE SITE PROCEDURE

GENERAL

The following simple lockout procedure is provided to assist employers in developing their procedures so they meet the requirements of this standard. When the energy-isolating devices are not lockable, tagout may be used, provided the employer complies with the provisions of the standard that require additional training and more rigorous periodic inspections. When tagout is used and the energy-isolating devices are lockable, the employer must provide full employee protection (see 29 CFR 1910.147 (c)(3)) and additional training and more rigorous periodic inspections are required. For more complex systems, more comprehensive procedures may need to be developed, documented, and utilized.

Lockout Procedure for

_____

(Name of Company for single procedure or identification of equipment if multiple procedures are used).

Purpose

This procedure establishes the minimum requirements for the lockout of energy isolating devices whenever maintenance or servicing is done on machines or equipment. It must be used to ensure that the machine or equipment is stopped, isolated from all potentially hazardous energy sources and locked out before employees perform any servicing or maintenance where the unexpected energization or start-up of the machine or equipment or release of stored energy could cause injury.

Compliance With This Program

All employees are required to comply with the restrictions and limitations imposed upon them during the use of lockout. The authorized employees are required to perform the lockout in accordance with this procedure. All employees, upon observing a machine or piece of equipment which is locked out to perform servicing or maintenance, must not attempt to start, energize, or use that machine or equipment.

_____

Type of compliance enforcement to be taken for violation of the above.

Sequence of Lockout

(1) Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance.

_____

Name(s)/job title(s) of affected employees and how to notify.

(2) The authorized employee must refer to the company procedure **for the particular machine or equipment** to identify the type and magnitude of the energy that the machine or equipment

© 2002-2015 Consolidated Edison Co. of New York, Inc

utilizes, must understand the hazards of the energy, and must know the methods to control the energy.

Type(s) and magnitude(s) of energy, its hazards and the methods to control the energy.

(3) If the machine or equipment is operating, shut it down by the normal stopping procedure (depress the stop button, open switch, close valve, etc.).

Type(s) and location(s) of machine or equipment operating controls.

(4) De-activate the energy isolating device(s) so that the machine or equipment is isolated from the energy source(s).

Type(s) and location(s) of energy isolating devices.

(5) Lock out the energy isolating device(s) with assigned individual lock(s).

(6) Stored or residual energy (such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure, etc.) must be dissipated or restrained by methods such as grounding, repositioning, blocking, bleeding down, etc.

Type(s) of stored energy - methods to dissipate or restrain.

(7) Ensure that the equipment is disconnected from the energy source(s) by first checking that no personnel are exposed, then verify the isolation of the equipment by operating the push button or other normal operating control(s) or by testing to make certain the equipment will not operate.

Caution: Return operating control(s) to neutral or "off" position after verifying the isolation of the equipment.

Method of verifying the isolation of the equipment.

(8) The machine or equipment is now locked out.

Restoring Equipment to Service

When the servicing or maintenance is completed and the machine or equipment is ready to return to normal operating condition, the following steps must be taken.

(1) Check the machine or equipment and the immediate area around the machine to ensure that nonessential items have been removed and that the machine or equipment components are operationally intact.

© 2002-2015 Consolidated Edison Co. of New York, Inc

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please EH&S Connect for the current version prior to use.

(2) Check the work area to ensure that all employees have been safely positioned or removed from the area.

(3) Verify that the controls are in neutral.

(4) Remove the lockout devices and reenergize the machine or equipment. Note: The removal of some forms of blocking may require re-energization of the machine before safe removal.

(5) Notify affected employees that the servicing or maintenance is completed and the machine or equipment is ready for use.

© 2002-2015 Consolidated Edison Co. of New York, Inc

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please EH&S Connect for the current version prior to use.

ATTACHMENT 2
LOCKOUT/TAGOUT PERIODIC INSPECTION

Facility Name _____ Date _____
Address _____
Equipment Name _____ I.D. No. _____
Authorized Inspector (Print) _____ I.D. No. _____

The identified equipment requires a periodic inspection of the energy control procedures according to §1910.147(6) The Control of Hazardous Energy (Lockout/Tagout). Check (✓) or complete all elements of this form that apply to the Periodic Inspection. Note deficiencies in comments section.

ENERGY SOURCES

☐ Electrical ☐ Hydraulic ☐ Chemical ☐ Other _____
☐ Mechanical ☐ Pneumatic ☐ Thermal _____

ENERGY ISOLATING DEVICES

☐ A manually operating electrical circuit breaker.
☐ A disconnect switch
☐ A manually operated switch by which the circuit's conductors can be disconnected from all underground supply conductors (no pole can be operated individually).
☐ A line valve
☐ A block
☐ A similar device used to block or isolate energy.
☐ Other _____

Note: Push buttons, selector switches, and other circuit type devices are not energy-isolating devices.

	YES	NO	COMMENTS
Do authorized employees understand the energy control procedures for this equipment?			
Do the authorized employees understand the requirements of the standard for this equipment?			
Do the authorized employees understand which locks/tags are to be used on this equipment?			
Are the lockout/tagout procedures being followed?			
Do employees understand their responsibilities in the energy control procedure?			
Have any deviations or inadequacies been identified during this inspection that require attention? If so, list.			
Have tagout procedures been reviewed when tagout alone is the only means of energy isolation?			
Have you reviewed the removal of an isolating circuit breaker?			
Have you reviewed blocking of a controlling switch?			
Have valve handle removal procedures been reviewed?			
Have you reviewed the opening of an extra disconnect switch?			

The items checked above have been reviewed with/explained to the authorized employees at the time of the periodic inspection.

Authorized Employee (Signature)	Date	Authorized Employee (Signature)	Date

I hereby certify that the periodic inspection for compliance with lockout/tagout standards on the equipment as specified by OSHA 29 CFR §1910.147 has been satisfactorily completed with the authorized employees identified above.

Inspector _____ _____ _____
Signature Title Date

© 2002-2013 Consolidated Edison Co. of New York, Inc

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

© 2002-2013 Consolidated Edison Co. of New York, Inc

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

CORPORATE ENVIRONMENTAL, HEALTH AND SAFETY PROCEDURE

CEHSP S17.01 – Electrical Enclosed Spaces

Revision 19: 04/23/2014 Effective Date: 07/01/2014

CONTENTS

SECTION 1.0 – PURPOSE
SECTION 2.0 – APPLICABILITY
SECTION 3.0 – INTRODUCTION
SECTION 4.0 – COMPLIANCE REQUIREMENTS
- 4.1 – JOB BRIEFINGS
- 4.2 – VEHICULAR OR PEDESTRIAN TRAFFIC
- 4.3 – PRE-ENTRY PROCEDURE
- 4.4 – ATMOSPHERIC TESTING
- 4.5 – MONITORING AND VENTILATION
- 4.6 – OPEN FLAMES
- 4.7 – ACCESS
- 4.8 – COMMUNICATIONS
- 4.9 – LOWERING EQUIPMENT
- 4.10 – DUCT RODS
- 4.11 – CABLES
- 4.12 – USE OF EQUIPMENT BY CON EDISON EMPLOYEES AND/OR CONTRACTORS
- 4.13 – TRAINING
- 4.14 – ELECTRICAL ENCLOSED SPACE RESCUE

SECTION 5.0 – DEFINITIONS
SECTION 6.0 – RESPONSIBILITIES
SECTION 7.0 – REFERENCES
- ATTACHMENT 1 – SAMPLING PROCEDURE FOR ELECTRICAL ENCLOSED SPACES

1.0 PURPOSE

IT IS THE POLICY OF CON EDISON TO ENSURE THE HEALTH AND SAFETY OF EMPLOYEES AND CONTRACTORS WORKING IN ELECTRICAL ENCLOSED SPACES. This procedure discusses entry into ***electrical enclosed spaces***, including requirements for testing the atmosphere, training, ventilation, and monitoring.

2.0 APPLICABILITY

This Corporate Environmental, Health and Safety Procedure (CEHSP) applies to all Con Edison employees and contractors working under Con Edison oversight (defined as “contractors” for this CEHSP), who work in electrical enclosed spaces used for the operation and maintenance of electric power generation, transmission, and distribution lines and equipment, including fiber-optic equipment associated with these electrical systems.

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

For outside agencies such as public improvement, that are not under contract with Con Edison, the Con Edison organization serving as the primary contact must inform the agency's project supervision of the relevant safety precautions to be taken when working in Con Edison facilities that meet the definition of an electrical enclosed space under Occupational Safety and Health Act (OSHA) regulations. The communication of the potential hazards and relevant safety precautions to the agency must be documented.

3.0 INTRODUCTION

This CEHSP identifies the procedures for inspection, entry and work in electrical enclosed spaces. Spaces that are not designed for entry under normal operating conditions are not considered to be electrical enclosed spaces for the purposes of this procedure. In addition, spaces that are expected to contain a ***hazardous atmosphere*** are not considered to be electrical enclosed spaces. These spaces are instead addressed as ***permit-required confined spaces***.

This procedure does not address practices in permit-required confined spaces, ***gas enclosed spaces*** (working spaces such as gas manholes) and similar structures not associated with electric power generation, transmission, and distribution. Entry into these spaces must be performed in accordance with applicable CEHSPs. Permit-required confined spaces are addressed in CEHSP S16.00, *Permit-Required Confined Space Program,* and gas enclosed spaces are addressed in CEHSP S17.02, *Gas Enclosed Spaces.*

4.0 COMPLIANCE REQUIREMENTS

4.1 JOB BRIEFINGS

The lead or more knowledgeable employee must conduct a job briefing with the employees involved before they start the job. The briefing must cover: the hazards associated with the job; work procedures involved; special precautions; energy source controls; and personal protective equipment (PPE) requirements. The procedures covered will include personal escape and rescue plans based on the configuration of the enclosed space and address proper emergency contacts Additional briefings must be held if significant changes that might affect the safety of the employees occur during the course of the work. For example, the arrival of other personnel to perform work that could affect an ongoing job at a given location triggers the requirement for additional briefings. Job briefings must be documented [1] R

4.2 VEHICULAR OR PEDESTRIAN TRAFFIC

Prior to the performance of work, protection of enclosed space entry work areas must be planned, using the current Con Edison *Work Area Protection and Traffic Control Field Manual,* to avoid vehicular and pedestrian traffic hazards. [2] R

4.3 PRE-ENTRY INSPECTION

4.3.1 Evaluation of Potential Hazards

Before an entrance cover to an enclosed space is removed, it must be determined that removal can be done safely and that the condition of the electrical facilities contained therein is sufficient to allow unrestricted access and emergency rescue. The initial inspection must be conducted by a ***qualified*** Con Edison employee or equivalently trained individual and must include:

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

1) Testing for stray voltage on the frame, cover, or grating, in accordance with OJT ELE0020.

2) Checking whether the cover is above “normal”, expected temperature.

3) Gradually loosening the cover if it is fastened in place, to release any residual pressure.

4) Determining whether there might be a hazardous atmosphere in the space, or whether conditions at the site could cause a hazardous atmosphere, such as an oxygen deficient or flammable atmosphere to develop within the space. This includes the oxygen level, presence of a flammable atmosphere, carbon monoxide levels, and if applicable, other toxic contaminants. Where vented manholes are present, the vent holes must be used to test the atmosphere. If an atmosphere is potentially in the flammable range or above the upper explosive limit and if it is determined that the cover must be removed, it must be done without creating a spark.

Any conditions making it unsafe to remove the cover must be eliminated before the cover is removed (that is, reduced to the extent that it is no longer unsafe). [3] R/P

4.3.2 Removal/Opening of the Cover

Appropriate tools (manhole hooks, bars, etc.) must be used to remove covers from subsurface structures. Removed covers must be place in locations that will not hinder traffic or pose a tripping hazard. When covers are removed from electrical enclosed spaces, a manhole guard consisting of a railing with appropriate toe guards, temporary cover or other barrier must be installed promptly to prevent an accidental fall through the opening and protect employees working in the space. [4] R

> **NOTE:** If, fire, smoke, explosion, or other abnormalities indicative of cable/component failure are observed, see Section 4.4.8 before approaching the trouble structure.

4.3.3 Defective Primary Cable

Where a cable in a manhole has one or more abnormalities that could lead to or that could be an indication of an impending fault, the defective cable must be de-energized before an employee may enter the manhole. This is indicated by a D-Fault tag hung in the chimney of the structure. The latest version of EO-1184, *Identifying Cable And Splice Abnormalities On Distribution Feeders* or CE-TI-6832, *Procedure For A Quick Visual Inspection (QVI) on the 69 KV and 138 KV Low and Medium Pressure Insulating Fluid Filled Cable Systems*, must be followed in all cases involving D-Faults. Abnormalities, such as oil or compound leaking from cables or joints, broken cable sheaths or joint sleeves, hot localized surface temperatures of cables or joints, or joints that are swollen beyond normal tolerance are presumed to lead to or be an indication of an impending fault. [5] R

4.4 ATMOSPHERIC TESTING

Atmospheric testing is required prior to space entry for the following reasons:

- To evaluate the hazards and verify that acceptable conditions for entry exist.
- To ensure that acceptable conditions are maintained during the entry work.

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

4.4.1 Initial Instrument Checks

An atmospheric monitor must be available at the site with a functioning pump or pump adapter and sufficient length of tubing to reach the bottom of the structure. Prior to testing the atmosphere of the structure, the following steps are required:

- Condition Check - Turn on the monitor to confirm working condition, and to confirm sufficient charge for the scheduled work (or confirm that a charger is available and can be used to ensure continuous monitoring during entry period(s).

- Fresh Air Check - Check the atmospheric reading in clean air (not inside the structure, and away from any vehicle exhaust or smoke) for each sensor. Confirm that the readings fall within the tolerances of

  Oxygen – 20.6% to 21.2%
  Carbon Monoxide - -5 ppm to 5 ppm
  LEL - -3.0% to 3.0%
  H2S (if installed) - -2.0 to 2.0 ppm

  If not, secure a different instrument or recalibrate that instrument, and recheck.

- Pump Integrity Check - With the pump running and hose attached, block the end of the hose with your thumb or finger. Within a few seconds the "pump flow fault" alarm should trigger, indicating that no air can flow as your pump and hose have no leaks. You must confirm that this triggers the pump flow fault before proceeding.

4.4.2 Order of Testing

All structures must be tested according to Attachment 1 prior to entry.

The internal atmosphere must be tested using an approved, properly calibrated Atmospheric Testing Device, in the following sequence:

- Oxygen (acceptable criteria between 19.5 and 23.0%). Oxygen monitoring equipment must be set to alarm if the oxygen content falls below 19.5 percent, or increases above 23.0 percent.
- Flammable gases and vapors (acceptable criteria less than 10% of the lower explosive limit (LEL), i.e., a reading of less than 0.5% as calibrated against methane.
- Carbon monoxide (CO) (acceptable criteria less than 35 parts per million [ppm]).
- Tests for toxic vapors and gases, if necessary. Entry level for toxic substances must not exceed the associated OSHA Permissible Exposure Limit (PEL), regardless of the anticipated length of entry. If hydrogen sulfide (H2S) is present, follow GEHSI S17.01.02.

The readings will be documented including the time and results.

For entry into pipe type feeder manholes that are connected to sulfur hexafluoride (SF_6) equipment or manholes containing sulfur hexafluoride (SF_6) switches, the ChemLab must be contacted to perform the monitoring if there has been a fault on the feeder or equipment (as per GEHSI S17.01.03, *Entry Into Subsurface Structures Containing SF6 Potheads*, 17.01.04, *Entry*

© 2000-2014 Consolidated Edison Co. of New York, Inc.

into SF6 Switch Structures, and 17.01.05*, Testing, Ventilation, and Monitoring Subsurface Structures*).

Where hazardous atmospheres are suspected, it is permissible to "pre-test" the space with an instrument not approved per section 4.4.3 for one or more concerns. Pre-testing is desirable to minimize the potential for damaging a space entry gas detector through overexposure. Regardless of the results and actions of any such pretest, proper testing for all concerns using an approved instrument must be performed prior to actual space entry. [6] R/P

4.4.3 Stratified Atmospheres

Following initial testing from outside the space, the atmosphere must be tested a distance of approximately four feet in the direction of travel and to each side during descent. If a sampling probe is used, the entrant's rate of progress must be slowed to accommodate the sampling speed and detector response. [7] R

4.4.4 Space Entry Gas Detector Requirements

Pre-entry atmospheric testing, and any required during-entry atmospheric testing, must only be performed using a gas detector approved by Corporate EH&S for space entry testing in accordance with CEHSP S09.03, *Preliminary Assessment and Approval of New EH&S-Related Equipment, Supplies and R&D Services*. Approved instruments must be initially calibrated by Technical Services, and must be recalibrated at least once every 90 days. Instruments with remote calibration procedures accepted by Safety & Industrial Hygiene and Technical Services can be calibrated locally; Technical Services must calibrate all other instruments. All gas detectors must have the calibration due date clearly indicated and must not be used if this date is not clearly visible. Calibration due date may be indicated by a sticker attached by Technical Services or displayed on the instrument's screen where possible.

Only personnel who have current training on the use of space entry gas detectors may use them in the field or be assigned duties that may require their use in emergency situations. Contractors must use instrumentation that meets the OSHA requirements they must also calibrate the equipment in accordance with the manufacturers instructions. [8] R/P

4.4.5 Approved Equipment

Company personnel must use EH&S-approved atmospheric monitoring equipment for compliance with the testing requirements of this CEHSP. The Drager Miniwarn and Xam-7000 units are approved for use by company personnel. Contractors may use equipment of their choosing provided the devices are appropriate for meeting the testing requirements of this CEHSP, in proper working order, and calibrated in accordance with the manufacturer's instructions. [9] P

4.4.6 Hazardous Atmosphere

Employees must not enter any enclosed space that contains a hazardous atmosphere, unless the entry is performed in accordance with CEHSP S16.00, *Permit-Required Confined Space Program.* [10] R

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

4.4.7 Con Edison Initial Entry and Visual Inspection

Once the structure is initially entered, a visual inspection must be conducted for exposed live conductors, improperly sealed cable ends, visual burnouts, structural damage, D-Fault tags, environmental tags, and excessively long cable ends that could contact the structure cover/grating or metal frame. The visual inspection must be documented. In addition, abnormalities, such as oil or compound leaking from cable or joints, broken cable sheaths or joint sleeves, hot localized surface temperatures of cables or joints, or joints that are swollen beyond normal tolerance are presumed to lead to or to be an indication of an impending fault. EO-1184, *Identifying Cable And Splice Abnormalities On Distribution Feeders* or CE-TI-6832, *Procedure For A Quick Visual Inspection (QVI) on the 69 KV and 138 KV Low and Medium Pressure Insulating Fluid Filled Cable Systems,* must be followed to determine when a cable must be de-energized for work in a manhole. If personnel note a "D" Fault, they must exit the structure immediately and report their findings in accordance with EO-1184 or CE-TI-6832. If a D-Fault tag, environmental tag, or any unsafe condition is found, further steps may only be taken with consent and advice of the control center and/or field supervisor. Cable inspections are not required for enclosed spaces where electrical equipment has not been previously tied into the system or for service boxes with no primary cable. [11] P

4.4.8 Entry by Con Edison Personnel Not Qualified for Electrical Work, Contractors, or Public Improvement Personnel

If entry takes place immediately after the initial inspection (see Section 4.4.6) a follow-up inspection is not required provided that the Con Edison Inspector or the contractor supervisor were on location during the initial inspection by the qualified electrical worker. If entry by non-qualified personnel (i.e., Con Edison employees not qualified for electrical work, contractors, and public improvement personnel) is not immediate but takes place within 72 hours of the initial inspection, a "follow-up inspection" must be conducted prior to each entry. The follow-up inspection must be conducted by a qualified person (Con Edison or contractor trained by Con Edison) involved in the work and include:

1) Verification that the initial inspection was performed in the specified time frame.

2) Testing for stray voltage by a qualified Con Edison employee or qualified contractor.

3) Completion of atmospheric testing as outlined in this section

4) Determination that it is safe to enter the space.

5) A visual inspection for any abnormalities previously defined.

6) Communication of inspection results and hazards to the Con Edison inspectors and the contractor supervisor.

If entry is delayed past the 72 hours, the initial inspection must be repeated per Section 4.4.6. Qualified telecommunication employees and their contractors accompanied by qualified Con Edison personnel do not need to repeat the initial inspection until 30 days has expired. Con Edison personnel not qualified for electrical work may only enter after the "follow-up" inspection is conducted by qualified personnel. Follow-up inspections must be documented. Service boxes without primary service are exempt from the initial inspection (Section 4.4.6), however, they must have the equivalent of the "follow-up inspection". This section does not apply to enclosed

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

spaces or trenches where electrical equipment has not been previously tied into the system. [12] P

4.4.9 Burnouts or Electrical Failure

Only Con Edison qualified employees are authorized to complete the work identified in this paragraph. If evidence is present of cable or component failure, fire, smoke, explosion, or other abnormalities, additional PPE in the form of protective hood (C/S 684-0755) and goggles (C/S 689-3952) must be worn prior to approaching the cover and subsequent work until the burnout has been cleared. Employees responding to burnouts may remove the cover if it can be done safely. After removal of the cover, the employees must remain a safe distance away for a period of 10 minutes in the absence of a flare-up. If a flare-up occurs, the employee must remain a safe distance away until the burning stops. The hose of a power ventilator may be directed into the opening if the hose can be placed safely. After a burnout has been cleared (burnt apart or cut), the structure must be ventilated to remove gases and odors created by the burnout. [13] P

If the trouble exposure is associated with damaged primary components or cable, the hood and goggles are required at all times while in proximity to the structure until the component/cable is grounded.

4.4.10 Attendants

While work is performed in an electrical enclosed space, an attendant must always be available within oral and/or visual contact of personnel in the structure in order to render emergency assistance. The attendant is not precluded from performing other duties outside the electrical enclosed space if these duties do not distract the attendant from monitoring employees within the space. The duties of the attendant are outlined in the applicable OJT. The attendant must not be distracted from his/her duties by engaging in such activities as speaking on a cell phone, text messaging or use of other handheld devices. Other than for performing a rescue, one person must be present outside the structure to perform the attendant duties. This does not preclude more than one person entering the structure. An attendant is not precluded from reaching into an underground structure to hand an entrant tools or other job materials so long as only the hands/arms break the entry plane.

Prior to an attendant entering the space to perform rescue, he/she must notify emergency rescue support. Attendants must be trained in first aid, cardiopulmonary resuscitation (CPR), and rescue. [14] R

4.4.11 Personal Protective Equipment

The minimum personal protective equipment for Con Edison employees, contractors, and visitors for work covered in the scope of this procedure are safety shoes, hardhat, eye protection, and FR clothing (where electrical flash hazards exist, or hot work operations are conducted). If working to clear a burnout or electrical failure, see the personal protective equipment requirement in Section 4.4.8. The FR clothing requirements are outlined in CEHSP S05.03, *Personal Protective Equipment: Protective Clothing*. Entrants and attendants are required to wear a retrieval harness at all times during entry activities in underground electric distribution structures. For work in excavations that exceed 48 inches in depth and contain energized conductors (either direct buried or in ducts), entrants and attendants must wear harnesses if the work task has the potential to contact energized conductors (i.e. breaking out a manhole/service box or breaking out a concrete encased duct bank containing live electrical

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

facilities). Harnesses are not required in underground electric distribution structures when the cables are not connected to the system (i.e., newly installed and not having been connected to the system yet). [15] R

4.5 MONITORING AND VENTILATION

4.5.1 Monitoring

If flammable gases or vapors or CO are detected at the alarm level or if oxygen increases/decreases beyond alarm levels, forced-air ventilation must be used during the entire period of entry to maintain oxygen at a safe level (between 19.5% and 23.0% oxygen), ensure that the concentration of combustible gases and vapors at less than 10% of the LEL (0.5% as calibrated against methane) and concentrations of CO at less than 35 ppm. If combustible gases are vapors are detected, the local control center must be notified immediately.

Continuous monitoring must be conducted to ensure that any increase in the concentration of flammable gases or vapors and/or CO that occurs is detected. This monitoring shall be conducted at a height of approximately 4 feet above the entrant(s) respective walking/working surface (s). If the structure (such as a service box) is less than 4 feet deep monitoring shall be conducted at approximately one foot below street level.

Monitoring results at the time of initial entry into the structure must be documented. Under no circumstances will a monitor be left in the structure when employees exit. Should the enclosed space be exited during the shift there is no need to repeat the initial entry monitoring and document the results provided continuous atmospheric monitoring is performed the entire shift, and the entrant and/or attendant do not leave the work zone. If continuous monitoring inside the structure is stopped for any reason during the shift (e.g. to replace battery, device removed from structure when employee exits), initial entry monitoring must be repeated and documented.

Structures must be re-tested for safe atmosphere after de-watering.

Continuous forced-air ventilation is required during hot work while making/breaking lead cable splices. For additional information on Con Edison procedures for addressing these hazards, refer to CEHSP S10.00, *Lead Management Program,* and CEHSP S15.00, *Welding, Cutting And Other Hot Work Operations.* [16] R/P

4.5.2 Ventilation

Ventilation with forced air may be necessary to eliminate or control hazardous gases or fumes that may be present in electrical enclosed spaces and to maintain an adequate supply of oxygen. The use of power ventilation, however, does not eliminate the need to perform continuous atmospheric monitoring. Personnel who enter electrical enclosed spaces for cable identification, inspection, or other minimal time periods must first perform initial atmospheric monitoring and maintain continuous monitoring throughout the entry to ensure that an enclosed atmosphere is safe.

If at any time a test indicates an unsatisfactory atmosphere, leave the manhole or vault at once. Operate the power ventilator for 10 minutes and then take a second test. (For more guidance on proper ventilation techniques refer to ELE1010). Take this test away from the output of the power ventilator. If this test indicates a satisfactory condition, the subsurface enclosure may be

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

entered. If the unsatisfactory condition persists, report the matter to the supervisor or local control center. Only Con Edison-approved power ventilation equipment may be used. [17] R/P

Specific Ventilation Requirements

If continuous forced-air ventilation is used, operation of the system must begin before entry is made, and operation must be maintained to ensure that a safe atmosphere exists before employees are allowed to enter the work area. The forced-air ventilation must be directed to deliver air into the immediate area where employees are present within the electrical enclosed space and must continue until all employees leave the enclosed space. [18] R

Air Supply

The air for the continuous forced-air ventilation must be supplied from a clean source and must not increase the hazards in the electrical enclosed space. [19] R

4.6 OPEN FLAMES

If open flames are used in electrical enclosed spaces, a test for flammable gases and vapors must be made immediately before the open flame device is used (Continuous monitoring satisfies this requirement). In New York City, a certificate of fitness is required as outlined in CEHSP S14.03, *FDNY Certificates of Fitness*. [20] R

4.7 ACCESS

Employees must not climb into or out of manholes or vaults by stepping on cable or hangers. Only approved ladders that extend three feet above the surface may be used (except for fixed ladders found in vault type structures). [21] R A ladder must be placed in the electrical enclosed space at all times during work in the space, unless it is impractical due to the position of the ladder in relation to the work tasks in the structure. If impractical, then the ladder must be positioned within reaching distance of the attendant at the entrance into the space.

Note: Rack arms, stanchions, and cable hangers are designed to support the weight of cable and joints only. These items must not be used for any other load-bearing purposes.

4.8 COMMUNICATIONS

Reliable communications (visual, voice, signal line, or two-way radio) must be maintained among all employees involved in the job. If reliable communications cannot be maintained, the entry must be discontinued. The entry may continue when a reliable communication mechanism is established. [22] R

4.9 LOWERING/LIFTING EQUIPMENT

Equipment used to lower/lift materials and tools into manholes or vaults must be capable of supporting the weight to be lowered and must be checked for defects before use. Before tools or materials are lowered into a manhole or vault, employees working in the space must be clear of the area directly under the opening. [23] R

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

4.10 DUCT RODS

If duct rods are used, they must be installed in the direction presenting the least hazard to employees. An employee must be stationed at the far end of the duct line being rodded to ensure that the required minimal approach distances are maintained from exposed energized parts. [24] R

4.11 CABLES

Energized cables must be carefully inspected for defects before they are moved. Energized primary cable must only be inspected/handled/moved by qualified Con Edison employees or qualified contractors. Energized joints must only be handled by Con Edison personnel or contractors fully qualified by 29 CFR 1910.269. Energized secondary cable must only be inspected/handled/moved by or under the direction of qualified Con Edison employees, or qualified contractors. Refer to EO-10130 (distribution cable) for cable moving procedures.

When multiple cables are present in a work area, the cable to be worked must be identified by electrical means, unless its identity is obvious by reasons of distinctive appearance or location or by other readily apparent means of identification. Cables other than the one being worked must be protected from damage.

When work is performed on buried cable or on cable in manholes metallic sheath bonding must be maintained or the cable sheath must be treated as energized. [25] R/P

4.12 USE OF EQUIPMENT BY CON EDISON EMPLOYEES AND/OR CONTRACTORS

Con Edison employees may use the contractor's ladders or rescue device, if visually inspected before use, and found to be in proper working order. Only Con Edison atmospheric monitoring equipment may be used by or for Con Edison employees. Contractors may use Con Edison equipment with prior approval from Con Edison personnel supervising the work. [26] P

4.13 TRAINING

Con Edison employees and contractors who enter electrical enclosed spaces for the purpose of conducting physical work, or who serve as attendants, must be trained as required for the reason for entry, including the following:

- Applicable work procedures
- First aid/CPR (SAF 0021)
- Electrical enclosed space entry procedure
- Electrical enclosed space rescue
- The hazards of electrical enclosed space entry
- The proper use of forced-air ventilation for manholes, vaults, or similar structures
- Procedures for clearing underground structures of flammable gas and vapors

All of the above topics (except first aid/CPR) are covered in OJT ELE1010, Enclosed Space Entry and Rescue and in various skill courses.

Employees subject to entering manholes where SF_6 may be present must receive the following additional training:

- Properties of SF_6
- Nature and composition of the solid and gaseous decomposition products
- Appropriate precautions to be taken. [27] R/P

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

4.14 ELECTRICAL ENCLOSED SPACE RESCUE

Examples of situations that may require rescue or resuscitation include but are not limited to:

- Illness (of a degree to preclude self-rescue).
- Injury (burns or fractures).
- Unconsciousness (physical blow, electric shock, or heart attack).

Retrieval equipment must be inspected to ensure proper function, and be available outside of the truck at the job site prior to the start of work. Before the actual work tasks begin, the retrieval device must be set up at the space entrance, or nearby so that employees can be promptly and safely extracted from the space. The placement of the retrieval device will be determined during the job briefing, based on potential hazards in the space and around the work area. For structures less than 48" in depth, the retrieval device does not have to be set up. When placing grounds on a transformer where the top of the transformer is within 48" of the grating, the retrieval device does not have to be set up.

The preferred placement of the self-supporting extraction device is always at the structure opening, in position to facilitate immediate use for rescue. If the work area cannot be configured to support this placement, the device may be positioned elsewhere inside the work area, but personnel must ensure that they have identified the location where the device would be set up to facilitate rescue, and maintain that area free of material/equipment.

A ladder must be placed in the electrical enclosed space at all times during work in the space, unless it is impractical due to the position of the ladder in relation to the work tasks in the structure. If impractical, then the ladder must be positioned within reaching distance of the attendant at the entrance into the space.

For multiple entrants in an enclosed space, the same rescue method shall be employed for each person. If both entrants are simultaneously injured, the rescue priority will be based upon first aid training.
[28] R

5.0 DEFINITIONS

Attendant: An individual authorized by the management of his/her department who is stationed outside an enclosed or other space to monitor the authorized entrants and perform all duties assigned in this program, including providing assistance to employees inside the space.

Confined Space: A space that:

- Is large enough and so configured that an employee can bodily enter and perform assigned work, and
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry), and
- Is not designed for continuous employee occupancy.

Confined spaces include, but are not limited to pits, sumps, sewers, manholes, wells, tanks/tankers, boilers and pressure vessels, other vessels, and equipment.

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Electrical Enclosed Space: A working space, such as a manhole, vault, tunnel, service box, or shaft, used for the operation and maintenance of electric power generation, transmission, and distribution lines and equipment. An electrical enclosed space has a limited means of egress or entry, and is designed for periodic employee entry under normal operating conditions. Under normal conditions, an electrical enclosed space does not contain a hazardous atmosphere, but may contain a hazardous atmosphere under abnormal conditions.

Gas Enclosed Space: A working space used solely for the maintenance and distribution of natural gas lines and equipment, such as a manhole, vault, tunnel, or shaft. A gas-enclosed space has a limited means of egress or entry, and is designed for periodic employee entry under normal operating conditions. Under normal conditions, a gas-enclosed space does not contain a hazardous atmosphere, but may contain a hazardous atmosphere under abnormal conditions.

Hazardous Atmosphere: An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, unaided from an enclosed space), injury, or acute illness from one or more of the following causes:

- Flammable gas, vapor, or mist in excess of 10% of its ***lower explosive limit [LEL]*** (0.5% as calibrated against methane).
- Atmospheric oxygen concentration below 19.5% or above 23.0%.
- Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in The Occupational Safety and Health Administration General Industry Standard (29 CFR 1910.1000) and which could result in employee exposure in excess of its dose or permissible exposure limit.
- Any other atmospheric condition that is ***immediately dangerous to life or health (IDLH).***

Immediately Dangerous to Life or Health (IDLH): Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a dangerous atmosphere.

Lower Explosive Limit (LEL): The lower limit of flammability of a gas or vapor at ordinary ambient temperatures expressed by a percentage of the gas or vapor in air by volume.

Permit-Required Confined Space: A confined space that has one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere.
- Contains a material that has the potential for engulfing an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section.
- Contains any other recognized serious safety or health hazard.

Qualified: Qualified is defined in this CEHSP with respect to employees, workers, or contractors as being trained and knowledgeable in the procedures, potential hazards, and appropriate safety measures relevant to the work the person is required to perform.

© 2000-2014 Consolidated Edison Co. of New York, Inc.

6.0 RESPONSIBILITIES

Chem Lab: The Chem Lab is responsible for providing clearances for entering an enclosed space that may contain SF_6 gas or SF_6 by-products.

Electric Construction Group: The Electric Construction Group is responsible for installing and maintaining caution signs for SF_6 enclosed spaces.

Employees: Con Edison employees working in subsurface structures are responsible for following the requirements of this CEHSP and for attending required training.

Environment, Health, and Safety (EH&S): EH&S performs the following functions:

- Reviews applicable regulations and ensures that procedures meet all regulatory requirements.
- Revises procedures as applicable.
- Distributes updates and changes.
- Reviews training prepared by The Learning Center.
- Provides technical assistance to line management and the field.

In addition, the Director of EH&S Safety and Industrial Hygiene provides advice and counsel on this procedure.

Facility, Site, EHS; or Field Manager Responsible for Compliance: The Con Edison designated individual within each operating department who is responsible for ensuring compliance with federal, state, and local regulations, and this procedure.

Law Department: The Law Department assists and provides guidance to EH&S by reviewing changes to these procedures in light of all applicable statutes and regulations to ensure that the procedures meet all legal requirements.

Operating Departments: Unless otherwise indicated, operating departments (Customer Operations, Electric, Gas, Purchasing and CFS, Steam, and Systems & Transmission Operation [S&TO]) are responsible for compliance with federal, state, and local regulations, and this procedure.

Supervisors: Supervisors are responsible for ensuring that personnel follow proper procedures and for performing necessary training.

7.0 REFERENCES

4.1 JOB BRIEFINGS

[1] 29 CFR 1910.269(c) (job briefing). NOTE: The cited regulation does not require that completion of job briefings be documented. Con Edison requires such documentation as a matter of policy.

4.2 VEHICULAR OR PEDESTRIAN TRAFFIC

[2] 29 CFR 1926.200 (accident prevention signs and tags).

© 2000-2014 Consolidated Edison Co. of New York, Inc.

4.3 PRE-ENTRY INSPECTION

[3] 29 CFR 1910.269(e)(4) (evaluation of potential hazards). NOTE: The cited regulation discusses potential hazards relating to atmospheric pressure, temperature differences, and hazardous atmosphere generally. Con Edison included additional evaluation measures as a matter of policy to enhance employee safety.

[4] 29 CFR 1910.269(e)(5) (removal of covers). NOTE: The cited regulation addresses the removal of covers generally; Con Edison requires the use of appropriate tools as a matter of policy.

[5] 29 CFR 1910.269(t)(7) (defective cables). NOTE: The cited regulation includes exceptions to the requirement that defective cable be de-energized before employees enter a manhole. Con Edison does not allow these exceptions as a matter of policy. Also, the CEHSP identifies Con Edison-specific procedures addressing D-Faults.

4.4 ATMOSPHERIC TESTING

[6] 29 CFR 1910.269(e)(8) (calibration of test instruments); 1910.269(e)(9) (testing for oxygen deficiency); 29 CFR 1910.269(e)(10) (testing for flammable gases); 29 CFR 1910.269(x) (definition of hazardous atmosphere). NOTE: The cited regulations address atmospheric testing generally. Con Edison has adopted additional testing requirements, including a requirement that test results be documented, as a matter of policy.

[7] 29 CFR 1910.146, Appendix B, Sec. 4 (testing stratified atmospheres).

[8] NOTE: The electrical enclosed space regulations do not address use of space entry gas detectors except as identified in Note 6 above. Con Edison has developed these procedures for calibration and use of gas detectors as a matter of policy.

[9] NOTE: The electrical enclosed space regulations do not address approval of space entry gas detectors and use of detectors for survey purposes. Con Edison has developed these procedures as a matter of policy.

[10] 29 CFR 1910.269(e)(6) (hazardous atmosphere).

[11] NOTE: The electrical enclosed space regulations do not require documented visual inspections once personnel enter an electrical enclosed space. Con Edison has developed these procedures to ensure the safety of its employees.

[12] NOTE: The electrical enclosed space regulations do not contain specific procedures addressing entry of nonqualified personnel. Con Edison has developed these procedures to ensure the safety of Con Edison personnel not qualified for electrical work, contractors and public improvement personnel entering such spaces.

[13] NOTE: The electrical enclosed space regulations do not contain special procedures to address burnouts or electrical failures. Con Edison has developed these procedures to ensure the safety of employees responding to such incidents.

[14] 29 CFR 1910.269(e)(2) (attendant training); 1910.269(e)(7) (attendants generally); 1910.269(t)(3) (attendants for manholes).

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

[15] 29 CFR 1910.269(g) (requires PPE to meet requirements of 40 CFR Part 1910, subpart I).

4.5 MONITORING AND VENTILATION

[16] 29 CFR 1910.269(e)(11) (ventilation and monitoring); 1910.269(e)(12) (specific ventilation requirements). NOTE: The cited regulations address ventilation and monitoring generally. Con Edison has adopted additional requirements, including a requirement that monitoring be documented, as a matter of policy.

[17] See Note 16 above.

[18] 29 CFR 1910.269(e)(12) (specific ventilation requirements).

[19] 29 CFR 1910.269(e)(13) (air supply).

4.6 Open Flame

[20] 29 CFR 1910.269(e)(14) (open flames). See CEHSP S14.03, *FDNY Certificates of Fitness* for additional requirements.

4.7 ACCESS

[21] 29 CFR 1910.269(h)(1) (ladders, platforms, step bolts, and manhole steps); 1910.269(t)(1) (access).

4.8 COMMUNICATIONS

[22] 29 CFR 1910.269(t)(3)(iv) (reliable communication).

4.9 LOWERING EQUIPMENT

[23] 29 CFR 1910.269(t)(2) (lowering equipment into manhole).

4.10 DUCT RODS

[24] 29 CFR 1910.269(t)(4) (duct rods).

4.11 CABLES

[25] 29 CFR 1910.269(t)(5) (multiple cables); 1910.269(t)(6) (moving cables); 1910.269(t)(8) (sheath continuity). NOTE: The CEHSP includes Con Edison-specific details regarding cable moving.

4.12 USE OF EQUIPMENT BY CON EDISON EMPLOYEES AND/OR CONTRACTORS

[26] NOTE: These procedures clarify when Con Edison employees and contractors can use each other's equipment.

4.13 TRAINING

[27] 29 CFR 1910.269(a)(2) (training generally); 1910.269(e)(2) (enclosed space training, including attendants). NOTE: The training outlined in the CEHSP was developed to

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

satisfy the requirements of 29 CFR 1910.269 and other regulations applicable to employees entering electrical enclosed spaces.

4.14 ELECTRICAL ENCLOSED SPACE RESCUE

[28] 29 CFR 1910.269(e)(3) (rescue equipment).

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

REVISION HISTORY

Revision Date	Revision #	Summary of Change	Author
1/3/2014	18	Clarified personal protective requirements for individuals that will be in proximity to underground structures containing faulted primary equipment. (see 4.3.2, and 4.4.8) Updated atmospheric monitoring requirements to reflect addition of the Drager Xam-7000 as an approved device, and clarified existing contractor requirements (see 4.4.4) Added a specific example to illustrate a requirement for additional job briefings during ongoing work. (see 4.1)	G. Slintak
4/23/2014	19	Added (Section 4.4.1 Initial Instrument Checks) the requirement for a fresh air test as well as an integrity test on the sampling hose to the procedure.	K. Reinhart

© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

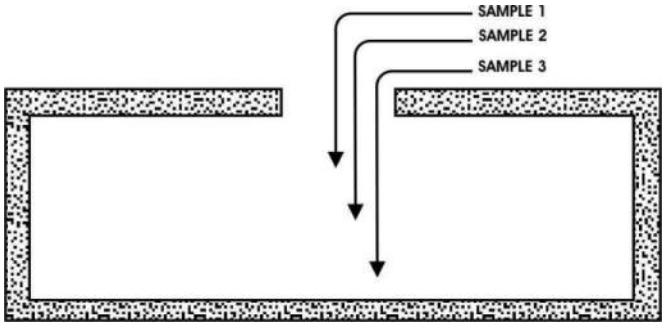
ATTACHMENT 1

SAMPLING PROCEDURE FOR MANHOLE ATMOSPHERES

Detector must first be operated in fresh air. Initial test is for oxygen deficiency followed by a gas detection test.

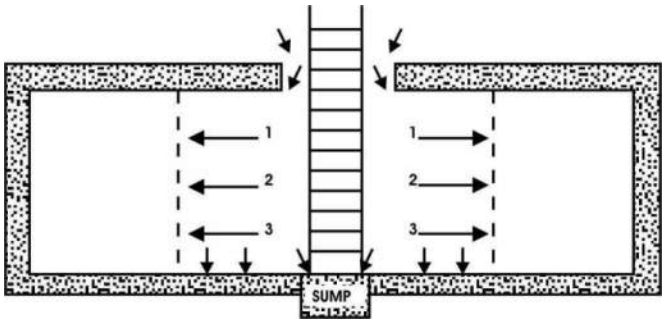
STEP 1

Observations of the atmosphere in the manhole shall be made at a level approximately two feet from the top, near the middle of the manhole, and at a level near the bottom. If water is present in the manhole, the latter observation must be made at a level just above the surface of the water. Care must be taken not to immerse the end of the sampling hose in water. When exposed to water, the filter at the end of the sampling hose will automatically close to prevent any material or gas from entering the instrument. This action will also render the instrument inoperable until the filter is replaced. To prevent erroneous readings, operating difficulties and maintenance problems, always use the probe and filter supplied with each gas detector.



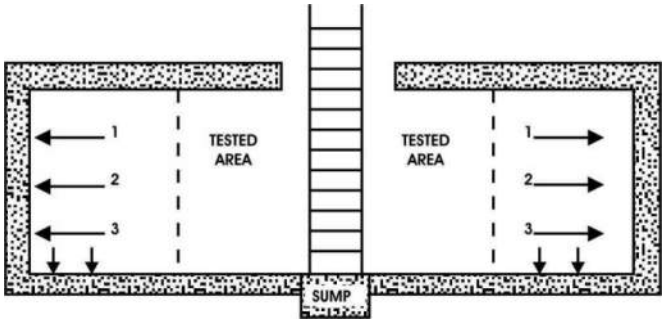
STEP 2

Insert ladder into structure and take sample around casting and chimney. While descending the ladder, take samples to the right and left for three levels



STEP 3

Check the remainder of the manhole from the tested area

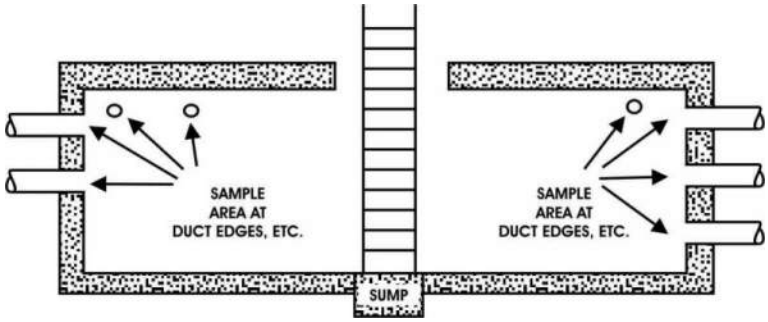


© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

STEP 4

Check the remaining interior of the structure at corners, cracks, and other irregularities. Duct edges shall also be checked without removing duct seal, foam, cement, or other packing materials. If possible, readings shall also, be performed up the ducts a distance of approximately 2 inches past the plane of the manhole wall.



© 2000-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

ENVIRONMENTAL, HEALTH AND SAFETY PROCEDURE

CEHSP A28.00 – Calling A Time Out
Revision 5: 11/11/2014 Effective Date: 01/01/2015

CONTENTS

SECTION 1.0 – PURPOSE
SECTION 2.0 – APPLICABILITY
SECTION 3.0 – INTRODUCTION
SECTION 4.0 – COMPLIANCE REQUIREMENTS
- 4.1 – CALLING A TIME OUT
- 4.2 – RESOLVING A TIME OUT
- 4.3 – TIME OUT SAFETY TALK
- 4.4 – TIME OUT CARD

SECTION 5.0 – DEFINITIONS
SECTION 6.0 – RESPONSIBILITIES
SECTION 7.0 – REFERENCES

1.0 PURPOSE

IT IS THE POLICY OF CON EDISON TO MINIMIZE ENVIRONMENTAL, HEALTH AND SAFETY (EH&S) CONCERNS WHENEVER POSSIBLE. This procedure outlines the process for calling a ***Time Out*** or work stoppage due to a safety, health and/or an environmental concern and resolving the Time Out before proceeding with work.

2.0 APPLICABILITY

This Environmental, Health and Safety Procedure (EHSP) applies to all Con Edison employees and contractors.

3.0 INTRODUCTION

The company's commitment to EH&S excellence requires that all work proceed only if it is safe and environmentally sound. The responsibility for fulfilling this requirement rests with every employee and contractor. Success depends on open communication between individuals and their supervisors prior to beginning work, and – in certain cases – after EH&S issues are identified.

4.0 COMPLIANCE REQUIREMENTS

4.1 CALLING A TIME OUT

All work shifts must begin with a job briefing in which safety, health, and environmental issues are discussed. If an employee has an EH&S concern, he/she must discuss it with his/her supervisor before proceeding with the job. Work cannot not start until both supervisor and employees agree that all EH&S concerns are resolved.

When a safety, health, and/or environmental concern arises on a job, the concerned employee must stop the work in question and immediately contact his/her supervisor to provide

© 2004-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

information regarding the nature of the hazard or EH&S-related concern. The supervisor must discuss the concern with the employee, either in person or on the phone, and attempt to resolve it. If the concern is resolved to the satisfaction of the employee and the supervisor and if there is certainty that all safety, health, and environmental procedures are being followed, the work may continue. If the concern is not resolved to the satisfaction of the employee and/or supervisor, work is to remain stopped and the employee must call a Time Out. In order to call a Time Out, the employee must clearly state the words "Time Out." The employee does not need to have a Time Out card in their possession in order to call a Time Out. The Time Out applies only to the location and the work related to EH&S Concern; there are no system-wide or company-wide Time Outs.

4.2 RESOLVING A TIME OUT

Once a "Time Out" is called, the following process must be followed to resolve the concerns:

- The local EH&S representative is to be contacted to obtain assistance in resolving the concern. For support groups working in the field, their organization's contact person must also be notified. The local EH&S representative will act as the authority (expert) related to health, safety, and environmental rules, regulations, and procedures and either make a determination on the merits of the concern or contact an appropriate Subject Matter Expert (SME) from other areas of the company, including, but not limited to Engineering, Corporate EH&S, or Operations. In general, the number of people involved in the Time Out must be kept to the minimum required to resolve the issue. If the local EH&S representative understands all of the issues involved in the Time Out and all EH&S concerns are addressed, the local EH&S representative's determination is final and the Time Out is concluded.

- When the local EH&S representative determines that support is needed from a company SME, the SME will serve as the final arbiter of the Time Out. In this instance, once all EH&S concerns are addressed, the SME's decision is final and the Time Out is closed.

- In either case, whether the local EH&S representative or the SME is called, once the EH&S concern is evaluated and either it is determined that no safety, health or environmental issue exists or that the EH&S concern has been mitigated, the employees are expected to return to work.

- If the local EH&S representative cannot be reached, the job cannot continue until EH&S intervention is obtained. The EH&S Control Desk can be used either to directly resolve the issue or to reach another EH&S representative who can. Furthermore, any person listed on the ***Time Out card*** may be called to resolve the issue.

- Pending resolution of the Time Out, in emergency and other situations where extensive job and procedural reviews are necessary to resolve the concerns, an alternate work plan (where practical) approved by the responsible SME will be implemented to complete the job. Before proceeding with any work prior to the resolution of the "Time Out," the Operating Supervisor and the local EH&S representative must ensure that the work will be performed in full accord with EH&S procedures, that all rules and regulations will be followed, and that safety, health, and environmental risks will be minimized.

At the conclusion of all "Time Out" situations, it must be clearly stated to all those involved that the "Time Out" is over.

 © 2004-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

When an EH&S concern has been raised, the employee and supervisor have resolved the issue themselves, and work has proceeded, the supervisor must notify the local EH&S representative if the concern was significant or could recur. In all Time Out situations, the EH&S representative will review the incident in a timely manner, determine if the Time Out has implications outside the organization/area where it occurred, and take appropriate steps to prevent its recurrence.

4.3 TIME OUT SAFETY TALK

To ensure that all employees are familiar with and understand the Time Out Program, a safety talk (SAF7240) must be provided.

4.4 TIME OUT CARD

Each organization must issue a Time Out card to all of its employees. An employee does not need to have a card in their possession to call a Time Out. All cards must be green and white, approximately 3-1/2 inches by 2 inches, and include the following information, at a minimum:

SIDE 1	SIDE 2
You Can Always Call a Time Out	Operating Area Location/Organization
If you have a safety, health, and/or environmental question and/or concern, we are available 24 hours a day for assistance.	No job proceeds until it is made safe and environmentally sound
Con Edison Picture of "Referee"	List names and telephone numbers of local EH&S staff or Call the Control Center at (xxx) xxx-xxxx, to reach a Safety or Environmental Specialist to assist you

5.0 DEFINITIONS

Time Out: Mechanism for any company employee to stop a job if he or she is unsure of how to proceed because of a safety, health or environmental concern. A Time Out can only be called if the concern cannot be resolved to the satisfaction of the employee and supervisor.

Time Out Card*:* A green and white card, approximately 3-1/2 inches by 2 inches, issued to all company employees for the purpose of calling a Time Out.

6.0 RESPONSIBILITIES

Employees**:** Employees are responsible for discussing EH&S concerns with their operating supervisors and calling a Time Out, when appropriate.

Local EH&S Representative: The local EH&S representative is the operating department's EH&S manager or one of his/her staff members. The local EH&S representative is responsible for:

- Determining the merits of EH&S issues identified by operating supervisors and resolving Time Outs, if possible.

 © 2004-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

- Contacting the appropriate SME if additional guidance is needed.

Operating Supervisor: The operating supervisor is a supervisor in an operating department with that title or any other supervisor in another department. The operating supervisor is responsible for:

- Attempting to resolve EH&S concerns raised by employees.
- Contacting the local EH&S representative if the employee EH&S concern cannot be resolved.
- Assessing the significance of any EH&S concerns raised and notifying the local EH&S representative of concerns that are significant or are likely to recur.

Subject Matter Expert: The SME is an individual who has detailed, specific knowledge on a particular subject by the nature of his/her education, training and experience. The SME is responsible for:

- Providing assistance to the local EH&S representative in resolving Time Outs.
- Serving as final arbiter of Time Outs.
- Approving alternate work plans, where necessary

EH&S Control Desk If the local EH&S representative cannot be reached, the EH&S Control Desk is responsible for directly resolving the Time Out or reaching another EH&S representative who can.

7.0 REFERENCES

This CEHSP was developed by Con Edison as a matter of policy to ensure open communication about, and prompt resolution of EH&S issues arising on the job.

 © 2004-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

REVISION HISTORY

Revision Date	Revision #	Summary of Change	Author
11/11/2014	5	Periodic review with the following minor changes: • Updated ERTs to EH&S Control Desk; • Added statement "Work cannot not start until both supervisor and employees agree that all EH&S concerns are resolved"; • Removed 'Corporate' from Corporate Environmental Health and Safety Procedures.	W.K Capune

 © 2004-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

REVISION HISTORY

Revision Date	Revision #	Summary of Change	Author

 © 2004-2014 Consolidated Edison Co. of New York, Inc.

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult EH&S Connect for the current version prior to use.

CORPORATE ENVIRONMENTAL, HEALTH AND SAFETY PROCEDURE

CEHSP A32.00 – Rules We Live By
Revision Date: 12/31/2015 Effective Date: 01/31/2016

CONTENTS

SECTION 1.0 – PURPOSE
SECTION 2.0 – APPLICABILITY
SECTION 3.0 – INTRODUCTION
SECTION 4.0 – COMPLIANCE REQUIREMENTS
- 4.1 – RULES WE LIVE BY IDENTIFICATION, TRAINING AND REPORTING
- 4.1.1 – IDENTIFICATION
- 4.1.2 – TRAINING AND COMMUNICATION
- 4.1.3 – REPORTING AND INVESTIGATION
- 4.2 – VIOLATION OF A RULE WE LIVE BY
- 4.3 – DEFINITIONS

RULES WE LIVE BY TABLE

1.0 PURPOSE

This procedure establishes a consistent approach to communicating and reinforcing the importance of following critical safety work practices designed to protect employees, contractors, and the public.

2.0 APPLICABILITY

This Environmental, Health and Safety Procedure (CEHSP) applies to all Con Edison employees (management and union) and contractor employees working for Con Edison.

3.0 INTRODUCTION

There are safety and operational procedures specifically designed to protect against the potential for significant injury due to the energy (electricity, gas, steam, or falling from elevation) that must be controlled. Operating groups that work with these sources of energy have identified Rules We Live By. At The Learning Center, the RWLB associated with a given activity of an operating department apply. This is defined as a work procedure or safety requirement that, if not followed, could result in a severe injury or fatality, or place other individuals (employees or members of the public) at significant risk.

4.0 COMPLIANCE REQUIREMENTS

4.1 RULES WE LIVE BY IDENTIFICATION, TRAINING, AND REPORTING

4.1.1 IDENTIFICATION

Where work tasks require the safe control of electricity, gas, steam, or work at elevation, the operating organization must identify key procedures required to control the energy or mitigate the

© 2002-2016 Consolidated Edison Co. of New York, Inc.

effect or impact onto the employee, fellow employees, contractor employees or the public. Lessons learned from previous incidents must be included in the identification process.

An organization must notify Corporate EH&S of any change to a Rule.

4.1.2 TRAINING AND COMMUNICATION

An organization's Rules We Live By and associated procedures must be reinforced in applicable skills training.

Each employee in the organization must receive OJT training on the Rules We Live By identified by the organization.

Rules We Live By must be reinforced, when applicable, in job briefings.

Rules We Live By must be incorporated into the scope of safety field observations and inspections.

Where contractor work practices involve Rules We Live By, contractor employees will be trained on the applicable Rules We Live By, reporting procedure, and consequences. The operating organization must communicate the applicable Rules to contractor management and ensure the Rules are incorporated in the HASP. The contractor supervisor will be required to train their affected employees and subcontractor employees before they begin work.

4.1.3 REPORTING AND INVESTIGATION

If a supervisor observes a Rule We Live By being violated, the work must be stopped immediately.

If an employee, not a supervisor, believes a Rule We Live By may have been violated, he/she must stop the work immediately and report the situation to the supervisor of the employee who committed the alleged violation.

Resolution of the alleged violation must follow the Time Out process as defined in CEHSP A28.00 – Calling a Time Out.

4.2 VIOLATION OF A RULE WE LIVE BY

A violation of a Rule We Live By will result in significant consequences.

Any employee who witnesses a violation of a Rule We Live By and does not stop the work and report the violation will also be considered to have violated the Rule.

A violation by a contractor company or by a sub-contractor must be reported via an action line by the operating organization with contractor oversight.

The organization must notify EH&S after action has been taken as a result of the violation.

4.3 DEFINITIONS

Con Edison employee: This includes all management and union employees.

© 2002-2016 Consolidated Edison Co. of New York, Inc.

Contractor employee: This includes all per-diem contractor employees and those employees working for a contractor company hired by Con Edison.

© 2002-2016 Consolidated Edison Co. of New York, Inc.

REVISION HISTORY

Revision Date	Revision #	Summary of Change	Author
1/21/14	2013 Annual Review	*CEHSP A32.00.01 RWLB - Table*: Permits, Electric Ops – Added language to clarify that entry for work in structures containing d-faulted feeders is permissible after associated source equipment has been de-energized.	G. Slintak
4/23/14	2013, Revision 1	*CEHSP A32.00.01 RWLB - Table*: Adjusted high hazard PPE rule as applied to Gas Operations in response to 4/22 request. Change clarifies the attachment point for use of PPE (previously associated with "blowing gas," a subjective term).	G. Slintak
5/16/14	2	Combined 'CEHSP A32.00 – Rules We Live By' and 'CEHSP A32.00.01 – Rules We Live By Table' into one document. The table will be an attachment to the procedure.	S. Ng
12/31/14	2014 Annual Review Rev. 3	Edits to reflect organization changes. Minor changes to clarify rules.	W. Capune
12/21/15	2015 Annual Review Rev. 4	Edits to reflect organizational changes in Shared Services. Customer Operations adopted the same language as Electric Operations for High Hazard PPE.	W. Capune

© 2002-2016 Consolidated Edison Co. of New York, Inc.

RULES WE LIVE BY 2016

Hazard	Electric Operations	Central Operations	Gas Operations	Customer Operations	Utility Shared Services
Verify Dead/Lockout-Tag Out	Properly test or spear to ensure that electric equipment, cable, or wire is "dead" as required regardless of voltage, before beginning dead work activities.	Properly test or verify that equipment is de-energized, isolated and protected prior to initiating dead work activities.			Properly lock out/tag out equipment before beginning work on the equipment. (when not intentionally live and PPE is required)
Permits (Operating, D-faults)	Enter D-Fault tagged structures only when authorized by the operating authority to perform feeder processing, or to perform work after all D-faults have been identified and de-energized.	• Only perform work that is within the authorized scope of work as listed on the work permit. • Do not change the status of a piece of equipment that has a Stop Tag applied to it. • Follow the sequence of an operating order.		Do not enter a structure that has been classified and tagged as a D-fault.	Only perform work that is within the authorized scope of work as listed on the work permit
Atmospheric Testing	• Perform air monitoring and ventilate as required for entry and work in an enclosed space or a permit-required confined space. • For excavations greater than 4 feet in depth the atmosphere shall be tested prior to entry or when the excavation is not already occupied.	• Perform air monitoring and ventilate as required for entry and work in an enclosed space or a permit-required confined space. • For excavations greater than 4 feet in depth the atmosphere shall be tested prior to entry or when the excavation is not already occupied.	• Perform air monitoring and ventilate as required for entry and work in an enclosed space or a permit-required confined space. • For excavations greater than 4 feet in depth the atmosphere shall be tested prior to entry or when the excavation is not already occupied.	Perform air monitoring and ventilate as required for entry and work in an enclosed space or a permit-required confined space.	Perform air monitoring and ventilate as required for entry and work in an enclosed space or a permit-required confined space.
Rescue/Retrieval	Entrant and attendant are required to wear rescue harness when working in enclosed spaces.	Entrant and attendant are required to wear rescue harness when working in enclosed spaces.	Entrant and attendant working in enclosed spaces shall wear rescue harnesses, when required.	Entrant and attendant are required to wear rescue harness when working in enclosed spaces.	Entrant and attendant are required to wear rescue harness when working in enclosed spaces
High Hazard Energy PPE	• Use fall protection equipment as required. • Use appropriate rubber gloves with protective gauntlets, rubber sleeves, fire retardant clothing and eye/protection face shield as required for the electrical hazard.	• Use fall protection equipment as required. • Use appropriate rubber gloves, rubber sleeves, fire retardant clothing, and eye protection/face shield as required for the electrical hazard. • In Steam Distribution, use appropriate water resistant coveralls and face shields before disconnecting any piping from the dead side of the trap valve up to and including the trap inlet valves and trap bypass valve. These coveralls and face shields must be worn until all piping is reconnected.	• Use fall protection equipment as required. • Wear airline respirator, FR coveralls, Fr hood & FR gloves or liners as required by IP-42	• Use fall protection equipment as required. • Use appropriate rubber gloves with protective gauntlets, rubber sleeves, fire retardant clothing, and eye protection/face shield as required for electrical hazard. • Do not come into contact or move a downed or low hanging utility wire while performing Site Safety or Damage Assessment work.	• Use fall protection equipment as required • Use the appropriate rubber gloves, rubber sleeves, fire retardant clothing, and eye protection/face shield as required for the electrical hazard
Sheeting/Shoring		Ensure that excavations five feet or deeper are properly sheeted and shored before anyone enters.	Ensure that excavations five feet or deeper are properly sheeted and shored before anyone enters.		
Gas Piping Integrity Test			Perform an integrity test before a customer turn-on.	Perform an integrity test before a customer turn-on.	
Securing Loads					Reels over 5,000lbs (individually or when bundled together) are secured per NYS Metal Coil requirements

Please note: At The Learning Center, the RWLB associated with a given activity of an operating department apply.

UTILITY CLEARANCE PROCESS FOR INTRUSIVE ACTIVITIES
E H&S REMEDIATION PROGRAM

1.0 INTRODUCTION

This document outlines a process to identify, locate and clear subsurface utilities as part of all Environmental Health and Safety (EH&S) Department's Remediation Section intrusive site investigations. The various activities that comprise this process are specified in efforts to eliminate or substantially reduce the risk of encountering a subsurface utility while performing intrusive activities. Where appropriate, reference is made to other existing *Con Edison and or industry* safety procedures that should also be considered. **Note that modifications and additions to the text in this version of the process, relative to the topics outlined in Section 2.0, are italicized.**

Due to the potential presence of subsurface utilities and the inherent variable of their size, depth and layout, it is not possible to address all situations and circumstances that may be encountered during intrusive activities. However, adherence to the steps outlined here will effectively minimize physical impacts to subsurface utilities and prevent associated health, safety *and environmental* risks that might otherwise result from field investigation activities. The activities prescribed below should not be blindly followed. Rather, it is the intent of this document that **ALL FIELD PERSONNEL**:

1) Understand the terms of this process including all revised or added provisions;

2) Develop an awareness and be mindful of, the potential and actual risks associated with utilities and other related hazards at a site;

3) Become familiar with the location(s) and configuration(s) of all subsurface utilities at the site, *which will include surrounding/adjacent facilities and or buildings*, as marked out and as delineated on available drawings;

4) Develop an awareness and understanding of the potential uncertainties associated with utility locations as marked out;

5) Maintain a high level of vigilance while implementing all components of intrusive fieldwork.

ALL FIELD PERSONNEL, including the Con Edison Project Manager (PM), Construction Management (CM), consultants and contractors should, *at a minimum,* be familiar with the fundamental provisions of this utility clearance process PRIOR to engaging in any field activities.

The process described in the remainder of this document consists of the three (3) primary components summarized below. These components are designed for use in an integrated manner.

Process Narrative – The narrative provides detailed descriptions of the specific steps that should be taken prior to and during intrusive activities to minimize the potential of encountering subsurface utilities.

Utility Clearance Flow Chart: The key steps of the utility clearance process, as outlined in the narrative, are shown graphically on the flow chart provided in **Attachment A**. The flow chart serves as a guide and should not replace the narrative for developing an understanding of and/or implementing the process.

Utility Clearance Checklist - A key component of this process is the completion of the checklist provided in **Attachment B**. The checklist shall, be completed by the Con Edison PM *or their designee, such as consultant or Con Edison Construction Management Inspector.* The intent of the checklist is to ensure that all appropriate steps of the process described herein have been completed. Secondly, it will be used to document that all reasonable steps were taken to prevent conditions that may be potentially harmful to the on-site workers and the surrounding community at large, and that might otherwise adversely impact the physical integrity of, or cause damage to, the utility. The completed checklist will be incorporated in the project files maintained by the Con Edison PM *or their designee*.

2.0 REVISIONS FROM PREVIOUS VERSION

This version (**Revision 2**) *contains modifications to Revision 1 and includes additional provisions and or guidance based on lessons learned during implementation of the previous versions* for intrusive activities at various sites. The key topics that have been added or modified are listed below and described in greater detailed in the referenced sections of this protocol.

- *Considerations for potential presence of fiber optics;*
- *Accessing manholes and other utilities during field inspection and utility mark out;.*
- *Considerations for potential presence of traffic control electric lines; and*
- *Considerations for potential presence of unmapped non-routine utilities or subsurface utilities, such as drainage pipes, etc.*

Modifications and additions to the text relative to the introductory sections of this document and the topics listed above are *italicized.*

3.0 APPLICABILITY

The utility clearance process shall be performed prior to and/or during the intrusive site investigation activities listed below.

- Excavation of Soil Borings

- Installation of Monitoring Wells
- Installation of Soil Gas Sampling Probe Points
- Excavation of Exploratory Test Pits/Trenches

4.0 SUBSURFACE UTILITY CLEARANCE PROCESS

The key activities that comprise the process are listed below and a detailed description of each is provided in the remainder of this document in the order in which they should be completed (as shown in the Utility Clearance Flow Chart in **Attachment A**).

- Obtain Plates, Drawings and Maps
- Notification to Con Edison Operating Groups and Submission of Site-Specific HASP for review and approval
- Code 753 Utility Mark-Out
- Site Walk
- Utility Clearance - Sample Location Confirmation
- Checklist Completion

It is noted that completion of some steps may not be warranted for all intrusive activities at all sites. The process is designed to be flexible and, thus, allows the Con Edison PM to incorporate those utility clearance activities that are appropriate for a set of site-specific conditions, knowledge of the site, previous work completed at a site, etc. Exceptions are summarized in Section 5.0 of this document. The key premise is that any deviations and the rationale for each are well documented and reflect sound judgment on the part of the Con Edison PM and other project personnel.

4.1 Obtain Plates, Drawings and Maps

Hard copies of available utility plates, drawings and/or maps should be obtained by the Con Edison PM *or their designee.* Drawings, plates, etc. should be reviewed as a preliminary step to determine the type and approximate size and location of utilities in the vicinity of the work site. . *When working at, adjacent to or in the immediate vicinity of a Con Edison facility ("Facility"), such as substation or gas regulator station, the Con Edison PM or their designee shall also obtain and review the Facility-specific plates. These shall include all utilities (both Con Edison and non-Con Edison) on and/or entering or leaving the Facility. Regardless of who obtains the requisite utility plates and or drawings, the Con Edison PM shall ensure that the job package is complete and includes ALL required such drawings and or plates of sub-surface facilities in the*

area(s) of intrusive activity, such as excavation or drilling. The drawing title, most recent revision date shown on the drawings, approximate scale and source shall be documented in the appropriate space(s) on the Utility Clearance Checklist (**Attachment B**).

The source of the drawings may vary depending on whether the site is a Con Edison owned/operated facility, private/public property, or extends into a public street/sidewalk. The various sources for substation utility drawings are discussed below and listed in **Table 1**. Drawings for private properties and facilities, such as apartments, schools, churches, residences, etc., can typically be reviewed at, and/or obtained from, the property/facility manager and Department of Public Works and/or Department of Buildings in the municipality where the property is located.

NOTE: Fiber optics at Con Edison facilities are not routinely identified on utility drawings. Therefore, when conducting intrusive work at Con Edison facilities, the facility engineer should be contacted in advance of the site walk to determine if fiber optic cables are known to be present and, if so, what is their layout. Fiber optic lines generally cannot be detected using routine geophysical methods accordingly, at sites with known fiber optics every effort should be made to determine their location or confirm their absence in the work area.

NOTE: Copies of all drawings obtained during this step should be available at the site during all site walks/inspections and at all times during subsequent intrusive activities. The drawings should be reviewed immediately prior to implementing intrusive activities at each new site location where intrusive activities are to be performed.

Steam, Gas and Electric
All electric and gas plates are available on Con Edison's intranet by searching for 'maps' or accessing the Advanced Mapping System website listed below.

http://maps/AdvancedMappingHomePage.htm

Similarly, steam plates can be obtained by selecting "Active" and "Archived" Steam Plates from the website:

http://maps/steam.htm

Based on agreement between Transmission Operations and EH&S, Remediation personnel may access these intranet sites and print the plates using the plotter located in the 2nd floor of Building 138. In addition, a large format photocopier, which is also located in Building 97, is available for use by EH&S remediation. A log book, which is stored at the facility, should be completed each time the facilities (i.e., computer, and or photocopier) are used.

Conduit and Duct Occupancy (C&DO) utility plates can also be obtained from the appropriate Con Edison engineering group(s) including, electric (e.g., distribution lines, transmission feeders, etc.) steam and gas by the Con Edison PM.

AFTER accessing the website and obtaining the required drawings, the appropriate party listed in **Table 1** may be contacted with inquiries regarding electric and steam plates or for questions regarding use of the Advanced Mapping System.

Sewer and Water

Drawings showing water and sewer utilities should be obtained from the New York City Department of Environmental Protection (NYCDEP) *or, if in Westchester, then the drawings and or plates should be obtained from the local authority, such as the County Health Department or municipal Departments of Public Works (DPW) and or Buildings (DOB).* Drawings can be requested from the NYCDEP by completing the form provided in **Attachment C** and faxing or mailing it using the appropriate contact information listed on the request form. If you have questions you should contact the NYCDEP personnel at the telephone number listed in **Table 1**.

Subterranean Tunnels

Drawings showing locations and depths of tunnels including subways and automobile tunnels and related subsurface infrastructure should be obtained as appropriate by contacting the Metropolitan Transportation Authority as listed in **Table 1**. It is noted that if intrusive activities will be performed in the immediate vicinity of subsurface MTA structures, such as subway or automobile tunnels, a letter submitted to the MTA may be required to request a work permit from MTA. The letter should include a brief summary of the work and a map(s)/drawing(s) of the proposed work and will be submitted to:

Mr. Rajen Ydeshi
Outside Projects
New York City Transit
2 Broadway, 7th Floor
New York, New York 10004

Fiber Optics

As noted above, fiber optic lines are typically not shown Con Edison's utility drawings. Accordingly, the facility engineer should be consulted regarding the presence,and if present, their location as discussed above.

Traffic Control Cables

Drawings and or plates for subsurface traffic control facilities should be requested from New York City Department of Transportation (NYCDOT) or the local/ municipal DPW or DOT.

Miscellaneous

Con Edison generally does not maintain plates and drawings showing detailed information of utility distribution on private property. However, as discussed above, facility managers, property owners, Department of Public Works and/or Department of Buildings of the municipality where the site is located, should be contacted in efforts to obtain available utility drawings for the facility. Contact information (e.g., telephone numbers, e-mail addresses, etc.) for municipalities

can typically be obtained by accessing the municipality's website. The name, address and telephone numbers for the Department of Buildings in New York City are listed in **Table 1**.

4.2 Complete Utility Markouts

Due to the diversity and nature of sites investigated by the EH&S Remediation Group and the potential utilities at these sites, an effective mark out *will require a Code 753 utility survey with supplemental M-scope survey by Con Edison and or a subsurface utility survey by a private utility-locating contractor*. The applicability of each of these surveys is discussed below.

4.2.1 Overview of Utility Markout Methods

Code 753

The Con Edison PM should instruct their consultant and/or contractor to request a Code 753 utility mark out as per the 16 New York City Rules and Regulations (NYCRR) Part 753. Consistent with the One-Call (also called Dig Safe New York) criteria, the request should be made at least 72 hours prior to initiating fieldwork. The telephone numbers of the various one-call systems are listed by region below.

New York City / Long Island:	(800) 272-4480
Westchester	(800) 962-7962

Confirmation that mark outs completed under Code 753, and as received by facsimile or telephone from the participating utility companies, should be documented on spaces provided on the Utility Clearance Checklist (**Attachment B**). The markouts should be maintained by the Con Edison PM or designated representative. If the physical markings on the street/sidewalk become faint or obscure they should be refreshed by over-painting with new paint as needed. When the utility markouts are being refreshed, typically by consultant, contractor, or other project personnel, a Con Edison representative or their designee **MUST** be present and observe this activity.

Con Edison M-Scope Survey

Con Edison engineering groups (see below for contacts) can conduct utility surveys using a 'M-Scope' on a case-by-case basis and will be limited to the engineering group' availability. This tool uses the magnetic susceptibility of subsurface features such as electrical conduits, electric cables, pipes, etc. This method of survey can be subject to interference by other conductive bodies at grade or in the subsurface, such as buried pieces of metal, rebar in concrete, iron-rich soil, etc., and may be ineffective or produce misleading results in these types of conditions. A utility survey using an M-Scope can be requested by contacting the appropriate party listed below. Note for markouts inside substations contact Mark Rimler at (212) 460-3921.

County	Contact Name	Telephone Number
Manhattan	Jane Shin	(212) 894-9345
Brooklyn & Queens	John Haas	(718) 348-6725
Bronx	Greg Kasbarian	(718) 904-4659
Westchester	Faney Bantin	(914) 789-6715
Staten Island	Joseph Nappi	(718) 890-6231

Private Utility Contractor

Prior to mobilizing to the site the following information MUST be provided to and reviewed by the Con Edison PM:

- the name of the contractor;
- the name of technician(s) who will perform the utility surveys;
- for each technician, a summary of experience and training in conducting surveys in a setting similar that at the site (e.g., urban, inside buildings, etc.); and
- Summary of experience and training of each instrument.

When using a private utility location contractor, the Con Edison PM shall diligently attempt to arrange for the facility or property manager and or engineer, who is most familiar with the utility layout and distribution in the building or on the property to participate in the site walk with the private utility locating contractor during on the first day of conducting the on-site utility survey.

Private utility contractors employ a variety of utility detection and location techniques, which may include:

- Ground Penetrating Radar (GPR)
- Magnetometer *(M-Scope) [for locating metallic **and** non-metallic pipes and cables]*
- Radio Frequency Induction (RFI) *[for locating non-metallic pipes and cables]*
- Electrical Conductivity
- Electrical Resistance
- Acoustics

Use of multiple methods may permit the detection and surveying of conductive and non-conductive buried utilities.

The utility location contractor **SHALL** specify which utility detection tool/techniques they plan to bring **AND** use at the site. In addition, they **SHALL** bring **ALL** support tools and equipment necessary to allow them access to manholes, vaults, circuit boxes, pipe clean-outs, etc.

At the commencement of a utility survey using a private utility location contractor **AND** prior to them deploying any survey equipment, the utility location contractor **SHALL**, *in cooperation with the Con Edison PM and or their designee:*

1) Review **ALL** utility drawings

2) Reconcile **ALL** drawings with markouts identified by the Code 753 survey at the property perimeter.

3) Determine presence, type and nature of sub-slab utilities and diligently attempt to confirm their configuration during the utility survey.

4) Inspect the site to identify*/reconcile* where **ALL** utility service(s) enters and or leaves the property and or building. This **SHALL** include a thorough inspection of building basement(s); boiler and or machine room(s); externally-exposed utility infrastructure including manholes; vaults; electrical, gas, water valves and or meters; etc.

5) For work at or adjacent to Con Edison Facilities, conduct the site walk and review the facilities drawings with key Facility Management personnel.

6) Visually identify, open and inspect **ALL** relevant utility access-ways including manholes, vaults, gas and or water valves boxes and telephone, *fiber optic* cable, *traffic control lines* and communication boxes.

NOTE: Only circular manholes shall be opened. If opened improperly, rectangular manhole covers can fall into the underlying vault and damage the contained utility (e.g., transformer). If it isa anticipated that manholes will need to be opened, Con Edison Transmission and Service Operations (T&SO) shall be contacted prior to conducting the site walk and or utility clearance survey using a private locator.

7) Identify and document **ALL** apparent uncertainties such as manholes containing service lines that apparently go to the building or property, but that cannot be located within the basement of the building or on site.

NOTE: In **ALL** cases, the private utility contractor shall diligently attempt to 'hook-onto' or 'tone' each conduit source (e.g., pertinent electrical conduits in basement, water and or gas valves in valve box, *sewer and or drain pipes,* distribution lines in manhole, *telecommunication lines,* etc.). This may require opening manholes circuit electrical distribution 'trunk' boxes, moving equipment or stored materials at the facility or property to allow access. No project personnel shall enter a manhole or vault unless they are certified and trained in confined space

access, have and know how to use **ALL** pertinent safety equipment, and approved by the Con Edison PM.

In some situations, multiple metallic conduits may be in direct contact in the subsurface. In this circumstance the signal of the locating tool may be transferred from the conduit being 'toned' to an adjacent conduit(s) and may produce a 'secondary' signal. In efforts to understand and identify this occurrence, the location of each apparent signal shall be visually/physically marked using pieces of tape, paint or similar method. The sources being 'toned' shall be numbered and the corresponding signals associated with each signal source shall be marked with the corresponding number at each location where the signals from each source is detected. Accordingly, the resulting mark outs will show apparent multiple conduits for a single source.

4.2.2 Applicability of Utility Clearance Resources

The use of the various utility markout resources that may be employed at various sites is summarized in the table below and discussed in the remainder of this section.

Site Setting	**Utility Survey by Con Edison**	**Utility Survey by Private Contractor**	**Code 753 (1)**
Con Edison Facility	X	X (optional)	X[1]
Street / Sidewalk	X (optional)	X (optional)	X
Private Property	X (optional)	X	X[1]

(1) At larger Con Edison Properties (e.g., Astoria) or large private or publicly owned properties, a Code 753 survey may not be warranted.

Con Edison Facility

Utility markouts at Con Edison facilities should be coordinated by the Con Edison PM with support from the Construction Management (CM) inspector assigned to the project (if any) and/or *key Facility Management personnel*, as appropriate. At a minimum, an M-Scope survey should be completed. In some circumstances, an independent utility locating contractor should also be used. The decision to use a utility contractor will be made by the Con Edison PM. The use of an independent utility mark-out contractor is strongly recommended at sites where a variety of utilities are known or suspected to be present and which may not be readily identified or mapped using M-Scope alone. A benefit of using a utility locator contractor is that, as described above, they can provide a greater array of tools to locate a variety of subsurface utilities that are non-conductive, such as concrete sewer lines, PVC pipes, etc. in addition to identifying/confirming the presence and location of conductive utilities.

Private Property (including Soil Gas Sampling Probes)

An independent utility locator should be used for utility markouts on private properties. It is noted that utility mark-outs in basements or slab-on-grade constructed buildings may be

inconclusive due to the presence of rebar or welders-mesh commonly used as reinforcement in concrete. Accordingly, a thorough inspection of the basement floor and walls should be performed to identify where utilities enter and leave the building, as well as how the utility (elctric, water gas, steam, etc.) are distributed in the vicinity of the sample locations. Sub- or in-floor utilities often enter along the perimeter of the floor, at support columns, and/or along dividing walls. The observation of utilities entering the floor may indicate utilities that lie within or immediately beneath the concrete basement slab. If the location of the utility layout of any such sub- or in-floor utility cannot be effectively determined, then any intrusive work must be discussed with the Con Edison PM and may require that no intrusive activities be performed at that location. *However, this action should only be considered after all applicable survey tools and methods have been diligently deployed and or implemented.*

Public Street / Sidewalk

A combination of Con Edison utility survey staff and independent utility locator contractors may be used for work areas located in and along roadways. Since Con Edison maintains utilities in streets and along sidewalks, in addition to the mark outs performed through the Code 753 survey, an M-scope survey may also be requested within a 10 foot radius of each proposed sample location. It is noted that due to often heavy work loads of the M-Scope survey staff, this option may not always be available or practicable and should be considered optional.

4.3 Site Walk

After completion of the activities outlined above, a site walk shall be conducted by the Con Edison PM with participation from Construction Management (if it will be providing field oversight), contractors (drillers, soil gas, excavators, private utility location contractor, etc.), Con Edison *Facility Managers,* NYSDEC (as deemed appropriate by the Con Edison PM), private facility managers/property owners *and or owners/operators/representatives of private utilities, such as NYCDOT, municipal DPWs, Westchester Department of Sewer, Westchester County Department of Health, etc.* A list of the names and phone numbers of each participant at the site walk will be maintained by the Con Edison PM. The key objectives of the site walk are to:

- Review the all planned locations where invasive activities will be performed,
- Adjust the positions of the locations away from utilities as marked out (as necessary)
- Collectively determine the appropriate utility clearance activities (e.g., test pits, etc.) that will be performed at each location (as described in Section 3.4) and document all decisions and /or concerns using the Utility Clearance Checklist (as described in Section 4.0) and in **Table 2**.

Other site conditions and project issues assessed during the site walk should include:

- Presence and location of overhead utilities and/or obstructions that might prevent the safe operation of drilling /excavating equipment;

- Presence of, or need for, appropriate grounding for electrical equipment at the site;
- Site access to equipment;
- Storage of equipment/supplies overnight (e.g., establish a staging area);
- Storage and management of investigative derived waste (IDW);
- Hours of on-site work;
- Permits needed, if any;
- Review roles and responsibilities of all project personnel who will be onsite;
- Review site and emergency contacts; and
- Review anticipated schedule of work *and contingency action as deemed appropriate.*

4.4 Utility Clearance - Sample Location Confirmation

The appropriate actions necessary to confirm the location and/or absence of utilities, which are agreed on during the site walk and as documented in the Utility Clearance Checklist and in **Table 2**, will be implemented at each sample location during the investigation. As discussed above, and as shown the Utility Clearance Process Flow Chart, the actions will generally include one or more of the following:

- Moving the location outside the **tolerance zone**, if possible. If no ***tolerance zone*** is marked out during the utility survey (i.e., only a utility center line is marked), the **tolerance zone** will be defined in the field as: **the distance of one-half of the known diameter of the utility plus two feet on either side of the centerline as marked out.**
- Performing a utility clearance test pit at each location where intrusive work will be performed; and/or
- Performing a utility clearance test pit using non-mechanical means to expose and physically verify the exact location and configuration of all nearby utilities.

Brief descriptions of the activities that will be completed during the various investigation activities are discussed below.

NOTE: When working within 25 feet of high pressure gas lines (i.e., 125 psig or greater), ***Gas Emergency Response Center (ERC)*** **shall be contacted** ***[718-319-2330] and notified of the planned activities at least two days prior to start of intrusive work. If working within 5 feet of a transmission main or within 10 feet of the tolerance zone of a main*** **the gas line will be**

carefully excavated by hand in accordance with the Gas Operations Standard G-11863, titled "Inspection and Maintenance Requirements Associated with the Excavation Activities Near Gas Pipelines Operating at 125 psig and Above".

Soil Borings / Monitoring Wells

All locations within the tolerance zone should be moved outside the zone, if possible. After moving the location, a utility clearance test pit should be excavated to a minimum of 5-feet below ground surface using non-mechanical methods, such as hand auger, post-hole digger and/or vacuum truck. The diameter of the test pit should be at least two inches wider than the outer diameter (OD) of the mechanized drilling equipment. The 5-foot depth is consistent with the concept that most utilities are typically installed within the top five feet of the subsurface.

NOTE: Utilities may be deeper than five feet due to buildup of surface grade on properties and or streets or right-of-ways. Although the original depth of utilities is anticipated to be within the upper five feet, utilities that are buried in areas that have been built up will presently be deeper by the thickness of the built-up material.

Intrusive investigation locations where physical space prohibits the relocation of proposed sample locations outside the tolerance zone, the adjacent utility(ies) will be exposed by excavating using non-mechanical methods to visually confirm its physical location and configuration. This confirmatory excavation will be completed in addition, a 5-foot excavation at the specific location being investigated (e.g., soil boring, monitoring well boring, etc.), as described above.

Soil Gas Sampling

At soil gas sample locations, test pits will also be excavated to one foot below grade or below the bottom of a concrete floor, if present, prior to installation of soil gas sample probes points. The one-foot depth specified is consistent with the concept that most utilities that could be impacted by the advancement and emplacement of the probe points, such as telephone lines, local electric (e.g., for outdoor lighting), cable television, in-ground sprinkler lines, etc., are typically installed from grade to a depth of one foot.

Basements / Indoor Soil Borings and Monitoring Wells

Prior to installing a soil boring, monitoring well or soil gas sample probe point in the concrete slab of a basement and after identifying that no utilities are present in the floor of the basement or foundation slab (as per Section 3.2.2), an electric powered diamond core drill, concrete saw or jack hammer will be used to advance through the concrete and expose the underlying soil. *If sub-slab utilities are suspected of being present, but not confirmed during the utility location survey, the concrete shall be cored or saw cut to an estimated depth of approximately 2/3 the thickness of the concrete (if known). If the thickness of the concrete thickness is not known, it shall be assumed to 8-inches thick. Coring shall proceed at 1-inch increments, with the removal of each one-inch 'plug' of concrete and visual inspection of the core hole to verify the absence of utilities. The remaining 1/3 of the concrete shall be broken using electric jackhammer,,*

hammer drill or using hand tools. Appropriate safety equipment shall be worn during concrete removal actions.

At each location where soil borings and/or monitoring wells will be installed, a hand excavated test pit will then be advanced to a depth of five feet below the bottom of concrete slab. This test pit should be excavated using hand auger, post-hole digger and/or vacuum truck in tandem with a non-conductive probe rod, which can be used to confirm the absence of utilities to a depth of five feet below the bottom of the concrete slab.

NOTE: The use of a jack-hammer to loosen compact soil during hand excavating a utility clearance test pit is strictly prohibited, except as noted above.

Exploratory Test Pit/Trench

Exploratory test pits/trenches will be performed to identify the presence or absence of subsurface structures related to former operating facilities at the site, such as gas holder foundations at former manufactured gas plant (MGP) sites, and should not be confused with **utility clearance test pits** discussed above. The **exploratory test pits** or **trenches** will typical have dimensions of approximately five feet wide by 10 feet deep by 10 to 20 long, accordingly, excavating them by hand is impracticable. The excavation of **exploratory test pits/trenches** must be approached with heightened awareness as the potential for damaging subsurface utilities, if present, is great.

In efforts to develop a reasonable degree of confidence that utilities will not be encountered during excavation of **exploratory test pits/trenche***s*, a focused utility survey will be conducted in the area immediately surrounding the test pit or the area defined by a boundary established by measuring two feet perpendicular from all sides of the proposed exploratory test pit boundaries. For example, if the surface dimensions of the exploratory test pit are 10 feet long by 5 feet wide, the surrounding area of the focused utility survey will have dimensions 14 feet long by nine (9) feet wide. It is suggested that the focused utility survey should be completed after all other on-site surveys have been completed. This will allow the surveyor(s) to develop a better understanding of the site-wide subsurface utility configuration.

Following completion of the focused utility survey, **utility clearance test pit***s* will be excavated by hand to confirm the presence of any and all utilities identified within five feet from the exploratory test pit/trench. After exposing the utilities, the excavator can proceed to excavate the **exploratory test pit/trench**, however, the operator should be experienced with digging in areas where underground utilities may be present and should use the utmost care when performing the excavation. Excavation should proceed slowly enough so that any obstruction/structure encountered can be evaluated and to confirm that the structure is not a utility.

5.0 CHECKLIST COMPLETION

The Utility Clearance Checklist (**Attachment B**), as well as the overall Utility Clearance Process to locate and clear utilities was designed to be dynamic. Accordingly the Utility Clearance Checklist should be updated throughout the process as each utility clearance activity is

completed. During the site walk and after all utility-related issues at each location have been identified and addressed to the satisfaction of all project personnel, the relevant portions of the Utility Clearance Checklist will be completed by the Con Edison PM. It is noted that the Utility Clearance Checklist will be considered complete only after all proposed utility clearance actions identified during the site walk have been successfully implemented and all pertinent information and activities have been documented.

6.0 EXCEPTIONS TO REQUIREMENTS OF THE UTILITY CLEARANCE PROCESS

Due to the inherent diversity and conditions present at project sites, some general exceptions to the utility clearance process are identified below.

- Sites where extensive utility mapping has been completed and/or where extensive intrusive activities have already been performed.

- Locations where facility layout is well documented and understood.

- Sites or portions of large sites (e.g., Astoria facility) where utilities are known not to exist currently or to not have ever existed throughout the life of the facility, property or site.

All circumstances where one or more steps of this process are not being implemented must be discussed with the Con Edison PM and must be duly documented. Regardless of whether or not exceptions are made during the utility clearance process, a Utility Clearance Checklist should always be completed for each site, in accordance with the terms outlined in Section 4.0 of this document.

Table 1 - Summary Table of Resources for Obtaining Subsurface Utility Plates and Drawings

Utility Type	County	Company	Organization	Name	Telephone Number
Electric	All	Con Edison	Electric Engineering	http://maps/AdvancedMappingSystem.htm(1)	
			For Questions contact:	John Ensemplare (Mgr. – B&Q)	(718) 802-5540
				Mike Mitchell (Mgr. – Manhattan)	(212) 460-1119
				Richard Mariani (Mgr. – Westchester)	(914) 925-6026
Gas	All	Con Edison	Gas Engineering	http://maps/steam.htm(1)	--
			For Questions contact:	Mike Verlizzo (Mgr.)	(718) 319-2357
Steam	All	Con Edison	Steam Engineering	http://maps/steam.htm(1)	--
			For Questions contact:	Tony Barbera	(212) 460-4843
Sewer /Water	NYC	NYC DEP /	Bureau of Water and Sewer Operations	Vincent Soriano/ Doug Greely	(718) 595-5330
Tunnels	Subway Crossing the East River	MTA	Outside Projects – Adjacent Work	Vasanth Battu/ Rajen Ydeshi / [If drilling in immediate vicinity of MTA structure, e.g., subway tunnel, car tunnel, etc., you will need submit a letter and plan drawing(s) to Mr. Ydeshi]	(646) 252-4473 (646) 252-3641
	Crossing the Hudson River	Port Authority of NY/NJ	Surveying	Richard Danko (rdanko@panynj.gov) Bill Kane (wkane@panynj.gov)	(201) 595-4841 (201) 595-4842

(1) "Maps" website listed is accessible on the Con Edison Intranet.

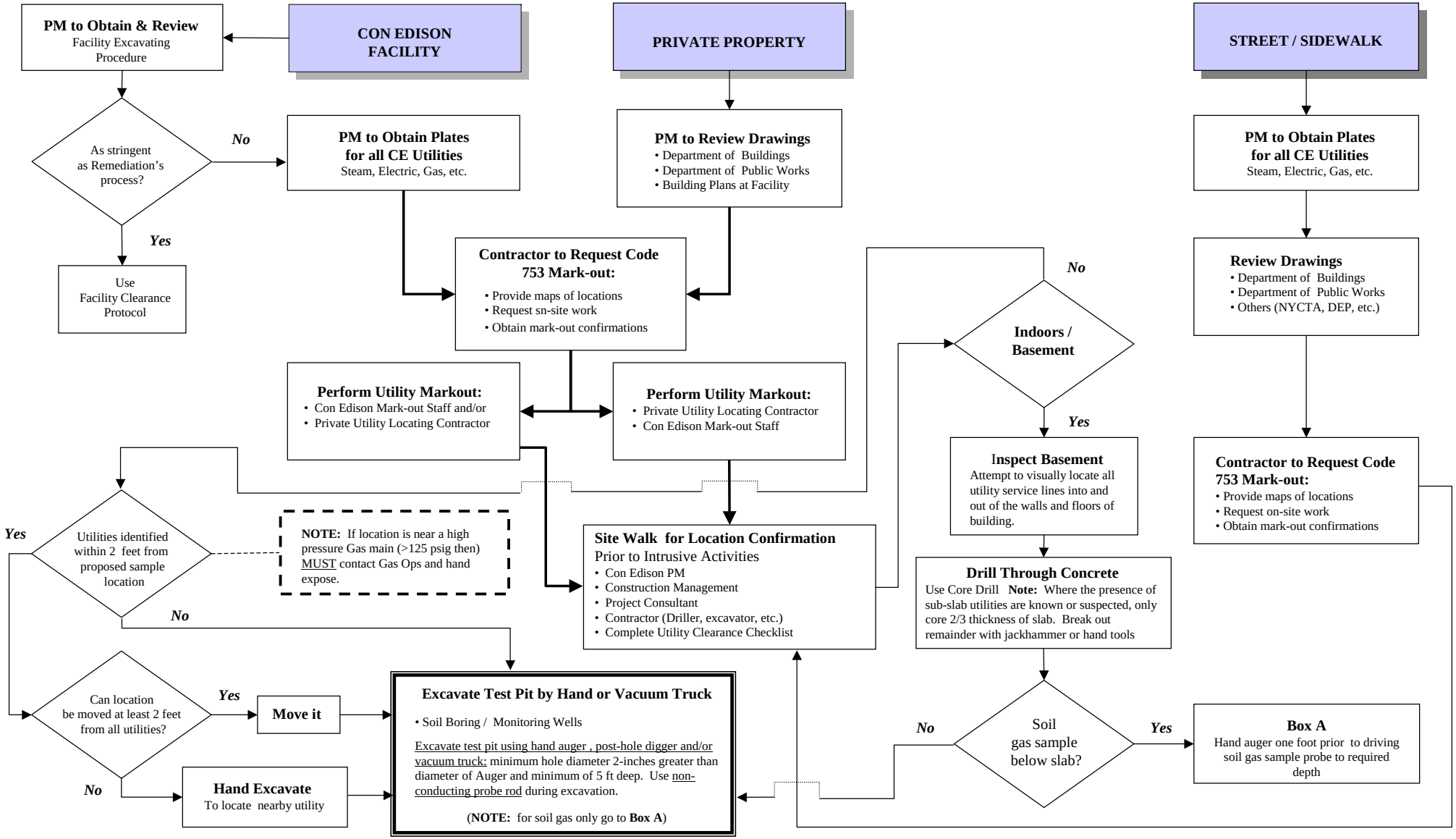
ATTACHMENT A

Utility Clearance Process Flow Chart

Utility Clearance Process During Intrusive Activities
E H & S – Remediation Group

10/08/03

Rev. 1



ATTACHMENT B

Utility Clearance Process Checklist

CHECKLIST FOR INTRUSIVE FIELDWORK

PROJECT BACKGROUND INFORMATION

Site Name: _____ **Job No.** _____

Site Address: _____

Con Edison Project Manager: _____ **Phone:** _____

Con Edison Site Manager: _____

Consultant Project Manager: _____ **Phone:** _____

Consultant Site Manager _____ **Phone:** _____

Subcontractor (driller, excavation, etc): _____

Subcontractor's Contact Person: _____ **Phone** _____

Meeting / Start Date _____ **Time** _____

HEALTH AND SAFETY PLAN REVIEW

Name: _____ **Organization:** _____ **Date:** _____

Name: _____ **Organization:** _____ **Date:** _____

Name: _____ **Organization:** _____ **Date:** _____

Health and Safety Form Completed: _____ **Date** _____

Site Drawings (yes/no/NA): _____ **(Attach site figure with proposed boring locations)**

CODE 753 UTILITY MARK-OUT REQUESTED? Y / N

Called by: _____ **Organization:** _____

Date: _____ **Time** _____ **Initials** _____

Reference # _____

Utility Drawings Received: _____ (Attach copy of utility maps)

UTILITY INVENTORY

Above Ground Services:

Utility	Utility Company Name	Depth (ft)	Phone	Date Notified	Notification Method	Marked
Electric		NA				Y / N
Telephone		NA				Y / N
Cable		NA				Y / N
Overhead Supports		NA				Y / N
Traffic light cables		NA				Y / N

Drawings/Plates Obtained (List) _____

Notes: _____

CHECKLIST FOR INTRUSIVE FIELDWORK

UTILITY INVENTORY (continued)

Below Ground Services:

Drawings/Plates Obtained (List) _____

Utility	Utility Company Name	Depth (ft)	Phone	Date Notified	Notification Method	Marked
Electric						Y / N
Telephone						Y / N
Cable						Y / N
Gas						Y / N
Water						Y / N
UST System						Y / N
Storm						Y / N
Sanitary						Y / N
Steam						Y / N
Pipeline Companies						Y / N
Other (Tunnels, etc.)						Y / N

PRIVATE UTILITY LOCATING SERVICE RETAINED? Y / N

Date _____ **Time** _____ **Initials** _____

Name of Locating Service: _____

Telephone #/ contact: _____

Name of Operator(s)/Type of sensing equipment used _____

METAL DETECTOR SURVEY

Drilling location cleared by _____ **(Consultant/Contractor) with a metal detecto**

Consultant / Contractor Name _____ **By (initials):** _____ **Date:** _____

INTRUSIVE SAMPLING LOCATIONS MARKED, M-SCOPED AND CLEARED

Locations Marked by: _____ Date(s): _____

_____ Date(s): _____

M-Scope performed by: _____ Date: _____

Conduct Site Walk and Complete Site Walk Table

ACKNOWLEDGEMENT

The parties listed on the attached Site Walk Sign-In Sheet have participated in a site walk at _____ to review proposed intrusive sampling locations and to evaluate the presence, configuration and identification of utilities at this site, as marked out. The parties have agreed with the proposed activities that will be completed prior to conducting intrusive work. The utility clearance activities will be completed as summarized in Table A (attached).

ADDITIONAL COMMENTS / NOTES: _____

CHECKLIST FOR INTRUSIVE FIELDWORK

Site Walk Sign-In Sheet

Project Name: _____

Date of Site Walk: _____

Name:	Organization:	Phone No.

ATTACHMENT C

Instructions for Obtaining Drawings for Sewer and Water Utilities

From the NYC DEP

Vincent J. Soriano, Chief
New York City Department of Environmental Protection
Bureau of Water and Sewer Operations
Central Mapping and Records
59-17 Junction Boulevard, 12th Floor
Corona, New York 11368

UPDATED PROCEDURES FOR REQUESTING INFORMATION

Effective immediately, the guidelines listed below are to be followed when requesting information pertaining to the water and sewer system. Water information pertaining to water main size and location is processed by this office. Sewer information pertaining to requests for drainage plans (used in sewer design work, drainage work, a drainage plan will **not** tell you the location of the sewer), interceptors and schematic Inflow/Infiltration (I/I) maps are processed through this office. **Requests for information pertaining to the locations of sewers, which are derived from as built drawings, sewer house connections, and water house (tap) connections will not be processed by this office. You must contact the specific borough Permitting and Connection office. Also requests for flow tests are not processed in this office.** Requests for information can be mailed to the above address or faxed to (718) 595-5781. **Information is not given nor are requests taken over the telephone.** A taped message of instructions can be heard by dialing (718) 595-5779. Please do not leave requests at the end of this tape, as they will not be processed.

1) **All** requests must clearly clarify the locations and work that is being done. Specific limits or a clear site plan must be provided. Project limits marked or highlighted on a Hagstrom map, or references to address or block/lot will **not** be processed. Hagstroms are often illegible and our records are not filed by address and block and lot. You **must** submit a separate request for each borough. With the increasing amount of work being processed by the Records Unit a completed request form (a blank is attached) **must be attached to each request and be completely filled out, especially the description of work being done.**

2) **All** corporate requests **must be submitted on official company or agency letterhead.** Copies of letterhead submitted via fax are acceptable.

3) **All requests must be submitted to this office at least ten days before the work is to be started by your company/agency.** Complexity of a request, DEP emergencies to name two situations can cause a slight backlog and a delay in response time. There is also closer scrutiny in the information that is requested and released. While it is understood each job is important to the individual asking for the information, requests are processed in the order in which they are received. This office will make every attempt to meet your needs, but labeling a request an "emergency" or "need it ASAP" will not help the processing, and it is unfair to the other clients.

4) If you are faxing your request to our office please do not follow up with a hard copy request later on. With the amount of work performed, there have been instances where staff time is used processing the same request twice.

5) If you request to have your records picked up after the research is done rather than have them mailed, please check off the appropriate box on the request form. Our office will hold the package for TWO business days only, and then it will be automatically mailed out. However it is stressed for you to wait for someone from the Records Unit to call and tell you the information package is ready before you come down. This will save you a needless trip if the information is not yet available.

6) **Walk in requests are no longer accepted.**
7) Requests covering large areas can no longer be processed. We ask that you break them down and submit them separately for an area no larger than eight blocks. If you have numerous locations please prioritize them and submit the requests to us in the order for the areas you need first.

Please pass this along to colleagues in your company that might also make requests to this office. I thank you in advance for your cooperation.

Vincent J. Soriano

Vincent J. Soriano, Chief
BW&SO Mapping/Records

REV 7/02

NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER AND SEWER OPERATIONS CENTRAL MAPPING AND RECORDS
59-17 JUNCTION BLVD. - 12TH FL. CORONA, N.Y. 11368 FAX: (718)595-5781

REQUEST FOR INFORMATION FORM

NAME _____

FIRM/AGENCY _____

ADDRESS _____

CITY _____ **STATE** _____ **ZIP** _____

TELEPHONE # _____ **FAX #** _____

BOROUGH (Check one)

BRONX ( )
BROOKLYN ( )
MANHATTAN ( )
QUEENS ( )
STATEN ISLAND ( )

PURPOSE OF REQUEST FOR WATER RECORDS(WORK BEING DONE)

DRILLING/BORING/EXCAVATION( ) SURVEY( )
DESIGN( ) PLANNING/ANALYSIS( ) OTHER( )_____

PURPOSE OF REQUEST FOR SEWER RECORDS

SEWER DESIGN( ) Provide latest adopted drainage plan unless otherwise noted for the following sewer type
STORM( ) SANITARY( ) COMBINED( )
INFLOW/INFILTRATION ANALYSIS( )
INTERCEPTOR INFORMATION( ) OTHER( )_____

IF YOU HAVE BEEN RETAINED BY A CITY, STATE OR FEDERAL AGENCY INDICATE NAME BELOW

_____

AGENCY CONTRACT NUMBER _____

PROVIDE A BRIEF DESCRIPTION OF THE PROJECT YOU ARE WORKING ON THAT REQUIRES THE ABOVE INFORMATION. For example, designing a new 10" sanitary sewer, excavation, drilling contract, etc. NO REQUEST WILL BE PROCESSED WITHOUT AN EXPLANATION.

_____

_____

IN HOUSE STAFF ONLY
PROJECT FOLDER_____ DATE LOANED_____ DATE RETURNED_____

LOCATION STREET NAME	FROM	TO

PLEASE CALL TO HAVE INFORMATION PICKED UP IN PERSON( )

FOR OFFICE USE ONLY
DATE IN_____ DATE OUT_____ ASSIGNED TO_____
RECORDS SENT:

conEdison

Work Area Protection and Traffic Control

Field Manual



THE WAY WE WORK IS SAFELY

To All Con Edison Field Forces:

This is your field manual on Work Area Protection and Traffic Control. It is designed to help you achieve a safe work area for our employees, with limited obstruction to traffic, through the use of uniform traffic control devices. In addition, it provides protection for pedestrians and motorists.

This edition has been updated to comply with the current *Manual on Uniform Traffic Control Devices* (MUTCD). It is based on three fundamental principles:

- Protection for you and your coworkers while you work.
- Protection for motorists and pedestrians;
- Safe and expeditious movement of traffic around your work area.

Not all work sites, traffic, or pedestrian situations can be illustrated in this manual. Employees must apply the principles and tools covered in this manual to set up work area protection and traffic control devices with all applicable traffic regulations in mind.

Table of Contents

1 Practical and Procedural Considerations

Basic Principles of Work Area Protection 4
Plan the Work and Work the Plan 4
Evaluate the Work Area 5
Work Space Considerations 6
Following Through: Setting Up the Street Work Area 7
Remobilization of the Job: Moving Out of the Work Area 9

2 Advance-Warning Signs and Equipment for Work Area Protection

Advance-Warning Signs 12
High-Level Warning Devices 15
Work Area Protection 16

3 Traffic Control and Work Area Protection Arrangements

Work Area Protection Diagrams 24
Excavation Operations 52
Sign Placement During Winter Months and the Winter Moratorium 52
Flagger at Work Sites 53
Stock Numbers and Descriptions 55

Practical and Procedural Considerations 1

Because of the vital nature of our jobs, we must gain access to areas where repair, maintenance, and construction are required. Providing a work area that is safe for everyone is of critical importance.

Basic Principles of Work Area Protection

Traffic conditions in our operating area make it necessary to plan protection for work areas to avoid vehicular and pedestrian traffic hazards, and safeguard the public and our employees.

The work area protection that you set up at the job site has two main goals:

- To provide suitable work area devices so pedestrians and drivers of vehicles are aware of work area boundaries;
- To protect you and your co-workers while you work.

In addition, when planning work area setups, an important company concern is to maintain good relations with the public while maintaining safety in the work area. Employees in the field help create goodwill by the way they conduct themselves, and by the way they arrange and maintain their work areas.

Con Edison's reputation as a good neighbor is important. Do your part to preserve it by always using the work area protection principles described in this document when you are on the job.

Plan the Work and Work the Plan

In order to work efficiently and to minimize possible disruptions for pedestrians and vehicular traffic, it's important to prepare in advance before arriving at a work location. Here are some factors to consider:

Scheduling: When scheduling street work, try to avoid hours of unusually heavy traffic.

Permits: Review the work and Department of Transportation (DOT) permit requirements before planning work. Follow DOT stipulations.

Requirements include:

- *Posting of permits to face the nearest curb line at the work area setup. Posted permits must provide the following information: name of the contractor, start and expiration dates, contact telephone number, permit number, and type of work (gas, steam, or electric system). Lettering must be 1 1/2 inches high;*
- Determining days and times to perform work;
- Securing permission for lane closings.

Efficient Deployment: Maintain street work areas only for as long as is necessary. Move in quickly and safely, do the job, and move out. Minimize obstruction and excessive exposure to traffic.

Materials: Before leaving the yard, review work orders and make sure that all equipment and supplies are available to complete the job as promptly as possible.

Evaluate the Work Area

Determine how existing conditions will affect the job, and how work area protection must be adapted to the location. The following must be considered:

Vehicular Traffic:

- Assess the volume and speed of traffic.
- Arrange in advance with the appropriate authority to shut down a traffic lane when work must be done at approaches to and exits from tunnels and bridges.
- Allow for the free passage of emergency vehicles, including fire engines and ambulances.

Pedestrian Traffic: Observe the pedestrian routes to crosswalks and bus stops.

Changes in Work Plan: Reassess protective devices and working conditions based on any changes in the traffic patterns or scope of work that may occur during the work operation.

Business Establishments and Other Public Facilities: When excavations are to be made near schools, hospitals, theaters, or large business establishments, where there is substantial pedestrian and vehicular traffic, notify customers in advance so that they will be inconvenienced as little as possible.

Work Area Considerations

Use the following parameters in your planning so that the job setup can occupy the smallest work area consistent with safe operations:

Width of Work Area: Generally should not exceed the width of one traffic lane.

Where this is not possible (e.g., excavations, manholes between two lanes), doing the job in steps should be considered. In congested areas with unusual traffic conditions, notify the local police precinct.

Length of Work Area: Should be separated from oncoming traffic by placing a tool cart, Pel bag, vehicle, or other similar barriers between the working point and oncoming traffic. For increased protection, a buffer zone (the same width as the work area) should be located in front of the work area. The area in front of the buffer zone will be used to channelize and taper traffic flow away from the work area by using traffic cones and/or stanchions.

Mobilization:

1. Day or night, before moving out into traffic lanes, operate hazard lights on the vehicle. For tool carts, mount the directional arrow signs and appropriate advance-warning flasher; and use channelizing devices (traffic cones and/or stanchions), as well as the required warning signs.
2. Warn oncoming motorists during the move into traffic lanes. When necessary, a crew member equipped with a signaling device and wearing a retroreflective vest should warn oncoming motorists.
3. If a traffic light is present, wait for the light to change before mobilizing equipment in or out of traffic lanes.
4. Some operations require work vehicles to be positioned facing oncoming traffic. Maneuvering a vehicle into such a position can present a risk to workers, the vehicle, and the public, if it is not performed using good judgment and appropriate safety equipment, i.e., a hard hat, flag, and retroreflective clothing.
5. The vehicle's hazard lights must be in operation and visible to all approaching traffic during the maneuver until the vehicle is within a protected work area.
6. Select traffic-control devices to protect the work areas.

Following Through: Setting Up the Street Work Area

In creating the work area protection setup, these elements are a part of the job-site characteristics to consider and the tools to use.

Steps to follow for setting up work area:

- Wear proper PPE (traffic vests, hard hat).
- Dome light/flashers/arrow boards.
- Position vehicle upstream from work site to begin channeling traffic.
- Flaggers to warn traffic, when necessary.
- Place advance warning sign(s); sign is first.
- Begin laying down traffic devices (e.g., cones, stanchions), working your way down to the work site.
- Continue to channel traffic using cones; determine work site termination.
- Establish work site.
- Establish work site termination with cones (downstream).
- Establish pedestrian channeling, when necessary.

Personal Protective Equipment: Employees exposed to vehicular traffic, e.g., when setting up, maintaining, removing, or working outside of work area protection, must wear hard hats and retroreflective safety apparel.

Advance-Warning Signs: Remember – oncoming drivers must be able to see the work area if they are to avoid it. Therefore, night or day, arrange your traffic-warning equipment to provide advance warning to oncoming drivers. Channelizing devices tapered to move traffic away from the work area with a series of warning signs extended in the direction of oncoming traffic must be used.

Traffic Devices: Set up the selected devices to control vehicle and pedestrian traffic and protect the work area. Provide clearly defined boundaries of street and sidewalk work areas throughout the work operation day and night.

Intersections: At intersections, place the most effective warning equipment so that it faces the heaviest oncoming traffic. Set up traffic-control devices on alternate sides of an intersection to control flow around a work area.

Lamp Reels: When taking temporary service from a lamppost, cover the open door with a lamppost apron to protect exposed wiring. (Contractors are required to use generators to obtain power.) ALWAYS lay cord along the curb. AVOID laying cord diagonally across traffic lanes. If necessary, use an extra lamp reel. Use shunt boards to cover cord and hose that protrude into pedestrian walkways or traffic lanes.

Pedestrian Passageways: Minimum must be 5-feet-wide. Where required, protect pedestrian and bus-stop passageways with barricades, planking, steel plates, or shunt boards extending well beyond the defined passageway. Use signage to indicate alternate paths and access to bus stops.

Using Wheel Chocks at Worksites: All commercially plated vehicles must be chocked within the work area.

Note: The work zone is an area with construction, maintenance, or utility activity, including on company property.

All vehicles in work area up to 26,001 Gross Vehicle Weight Rating (GVWR) require **two** chocks (including tool carts and extra machines).

Vehicles with 26,001 Gross Vehicle Weight Rating (GVWR) or greater require **four** chocks.

Using Wheel Chocks on Flat Roads: Place one chock in front and behind one rear wheel. (For vehicles with four chocks, set up front and behind both rear wheels).

Using Wheel Chocks on Inclined Roads: For vehicles set up or parked facing uphill on a job site, place chocks behind rear wheels on both sides. (Rear of front tires are to be steered on an angle toward curb shoulder where applicable).

For vehicles set up or parked downhill on a job site, place all chocks in front of rear wheels. (Steer front tires on an angle toward the curb shoulder where applicable).

Emergency brake must be in place at all times when a vehicle is stationary at a work area. Also, chocks must make contact with tires leaving no gap space.

Hazard-Vehicle Lights: If a vehicle must stand in lanes of moving traffic for work purposes and is not within a protected work area, the hazard-vehicle light(s) must be in operation day and night.

Street Openings: If it is necessary to leave street work areas unattended at night, provide traffic-control devices to include use of Type III barricades around the work area to protect motorists and pedestrians.

Plating: Provide plating or decking when required. All road plates must be pinned and ramped to avoid pedestrian foot injury or injury to motorists due to plate movement.

Floodlights: When it is dark, and when using flaggers, use flood lamps where required for additional protective illumination or work illumination. Lamp glare should not impede motorists or workers.

Subsurface Structure Openings: When opening service valve castings S1, S2, S3, 32-inch cover, or 44-inch covers for any underground structures, manhole guardrails in conjunction with telescoping rails, must be in place to prevent pedestrians from falling into the structure, and to prevent debris or other materials from entering. In addition, you must follow the appropriate entry procedures for enclosed or confined spaces. Larger sub-surface structures require type 2 barricades to be installed.

Housekeeping: Good housekeeping is an important item in street work area protection.

Demobilization of the Job:

Steps to follow for breaking down work area:

- Wear proper PPE.
- Clean up work area.
- Break down work site.
- Pick up traffic devices in reverse order.
- Work your way back toward the Advance Warning sign.

Moving Out of the Work Area

Just as with setup of the work area, proper procedures must be observed when the job is finished and the site is being cleared.

Hazard-Vehicle Lights: Traffic-warning equipment and hazard-vehicle lights must be in operation while moving from traffic lanes to the curb.

Flagger: A trained member of the crew, wearing a retroreflective vest and hard hat, should warn oncoming motorists with a signaling device where necessary.

Traffic Controls: If a traffic light is present, wait for the red light before moving out of the traffic lane.

Plates: Ensure that all road plates are left pinned and ramped to maximize public safety.

Ongoing Work: If the job is shared by another Con Edison work area setup, make sure to leave the work area protection and the setup in good condition.

Housekeeping: Before leaving the area, inspect the site to be sure that no tools, equipment, or debris are left behind. Always work the job to make the public think well of you and the company. Remember, on the job, ***you are Con Edison***.

Advance-Warning Signage and Equipment for Work Area Protection

2

The purpose of advance warning is to properly alert motorists and pedestrians to physical conditions ahead.

Note: The advance-warning area may vary from a single sign to a series of signs in advance of the temporary traffic-control zone activity area.

Signage distances may be adjusted where necessary, depending on roadway limitations or for more effective warning and guidance.

Signage must effectively warn oncoming traffic, allowing adequate time for driver response. The employee must make the judgments necessary to establish and maintain effective advance warning.

Advance-Warning Signs

Description: Warning signs must have a black legend on an orange background and be retroreflective for nighttime use. Diamond-shaped warning signs are preferred. However, where necessary, the alternate rectangular shape may be used. Minimum sizes for warning signs are 30 inches by 30 inches (diamond); 36 inches by 36 inches for conventional roads, and 48 inches by 48 inches for freeway or expressways. Rectangle sign sizes are to be 24 inches by 18 inches for conventional roads, and 36 inches by 24 inches for freeways or expressways.

Signs Displaying the Symbol of a Worker or the Words "Road Work Ahead" or "Utility Work Ahead"

Instructions for Use: These signs are required to be posted for all work done in a traffic lane, parking lane, or on a shoulder. They must be posted first and in front of channelizing devices.

The sign displaying the symbol of a worker (the "worker symbol") may be used for short-duration work areas, while the "Road Work Ahead" and "Utility Work Ahead" signs are to be used for long-duration work areas (i.e., more than three days).

The sign may be mounted on portable "crashworthy" supports and must face oncoming traffic.



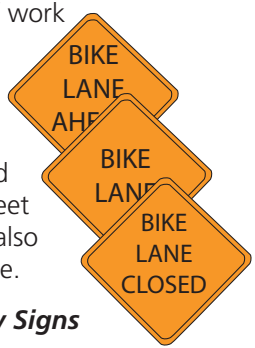
For short-duration work that occupies a location for up to three days, such as a manhole operation where workers are present or work in a parking lane, the standard distance between the warning sign and the lane closure or work area is 150 feet.

For long-duration work (more than three days), such as an excavation in a travel lane, the standard distance between the warning sign and the lane closure or work area is 300 feet.

Different distances may be used where necessary for more effective warning and guidance.

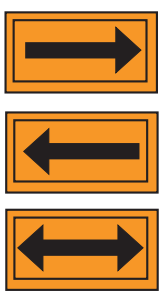
Bike Signs

"Bike Lane" signs are to be used when stipulated on the work permit issued by the city. If work is affecting a bike route/lane, a bike lane closed advance warning sign must be posted 350 feet and 200 feet prior to work, and also posted at work zone.



Directional-Arrow Signs

Description: Orange retroreflective background at least 48 inches by 24 inches for conventional roads, and 60 inches by 30 inches for expressway, with a clearly recognizable black arrow symbol. Standard or variable arrow signs (as shown) may be used.



Instructions for Use: The arrow board may be mounted on a vehicle, tool cart, barricade, or portable supports. It must be mounted at a minimum height of 1 foot to the bottom of the sign and must face in the direction of the oncoming traffic. The arrow must indicate the direction in which the traffic may pass.

Note: Arrow signs are intended to give motorists clear information and provide them with effective guidance. Therefore, care must be taken to ensure that the proper message is displayed at all times.

"Flagger Ahead" Signs

Description: The "Flagger Ahead" sign must be diamond shaped, minimum 30 inches by 30 inches, 36 inches by 36 inches conventional, 48 inches by 48 inches expressway, with a black legend and border on retroreflective orange background. It shows the silhouette of a person standing with the right arm (facing the viewer) extended horizontally and holding a flagstaff horizontally, with the flag hanging down. The free arm is shown bent with the palm above shoulder level.



Instructions for Use: The "Flagger Ahead" sign shall be placed after the worker symbol or "Road Work Ahead" or "Utility Work Ahead" sign and well before the flagging location.

Lane-Closure Signs

Description: Lane-closure warning signs must have a black legend and border on an orange retroreflective background.



Instructions for Use: Advance notice of closed lanes must be provided when work areas must interrupt the flow of traffic in through lanes. This sign should be placed after the worker symbol or "Road Work Ahead" sign and may be placed at the beginning of the taper created by the use of channelizing devices.

Road Closed Signs



Description: This is a horizontal rectangular white sign, 48 inches by 30 inches, with a black border and the words "Road Closed" in black on two lines.

Instructions for Use: The "Road Closed Ahead" sign should be used when the roadway is closed to all road users except contractors' equipment or officially authorized vehicles. This sign should be accompanied by appropriate warning and detour signage. This sign should be installed at or near the center of the roadway, on or above a Type III barricade that closes the roadway.

Note: New York City requires closed-street permits from the DOT. Both the police department and the fire department's communications center require notification 24 hours in advance of nonemergency street closings. The local community planning board requires a notification seven days in advance when closing more than 50% of moving lanes per direction. Westchester permits vary by municipality.

"Sidewalk Closed" Signs

Description: This device is used when a sidewalk must be closed in order to conduct work. This is a visual indicator to notify pedestrians that passage though this area is prohibited. Provisions must also be made to indicate redirection of pedestrian traffic.

Persons With Visual Disabilities

Adequate provisions, as determined by an engineering study or by engineering judgment, should be made for persons with visual disabilities. Because printed signs and surface delineations are not accessible to pedestrians with visual disabilities, blocked routes, alternate crossings, and sign and signal information should be communicated to pedestrians with visual disabilities by providing the following: audible information devices, accessible pedestrian signals, and barriers and channelizing devices that are detectable to pedestrians who have low vision or who are traveling with the aid of a long cane. The following three items should be considered when planning for pedestrians:

A. Pedestrians should not be led into conflicts with work site vehicles, equipment, and operations.

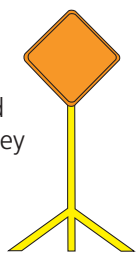
B. Pedestrians should not be led into conflicts with vehicles moving through or around the work site.

C. Pedestrians should be provided with a reasonably safe, convenient, and accessible path that replicates as nearly as practical the most desirable characteristics of the existing sidewalk(s) or foot path(s). Where pedestrians who have visual disabilities encounter work sites that require them to cross the roadway to find an accessible route, instructions

should be provided using an audible information device. Accessible pedestrian signals with accessible pedestrian detectors might be needed to enable pedestrians with visual disabilities to cross wide or heavily traveled roadways. A pedestrian route should not be severed and/or moved for nonconstruction activities, such as parking for vehicles and equipment.

High-Level Warning Devices

These devices are used in addition to signage. They can be lighted or unlighted as described below, and they provide clear, highly visible warning of the work area for both pedestrians and vehicles.



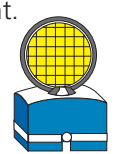
Flag Trees

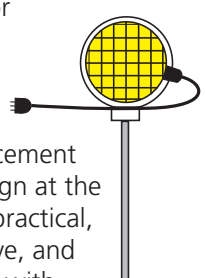
Description: The flag tree should display a minimum of two 16 inches by 16 inches flags with their lowest corners at a height of 8 feet. Other warning signs may be mounted below the flags to alert and warn traffic in advance of a work area during daylight hours.

Instructions for Use: At work areas where the placement of the advance-warning sign at the standard distances is not practical or is found to be ineffective, a flag tree may be used in conjunction with a worker symbol or road work ahead sign in advance of the work area (also in advance of any arrow boards) to effectively warn traffic. It must be placed at a sufficient distance in front of the work area to warn oncoming drivers.

Advance-Warning Flasher: Type B High-Intensity Flashing Warning Lights

Description: The high-intensity, warning light (Type B) provides a flashing yellow light in one direction only, for use both day and night. These lights can be mounted on traffic signs, or barricades to warn road users. These warning lights must be in accordance with current Institute of Transportation Engineers (ITE) "Purchase Specification for Flashing and Steady-Burn Warning Lights."





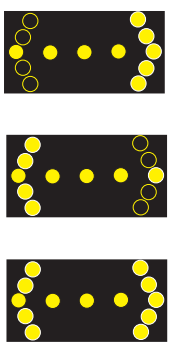
Instructions for Use: At work areas where the placement of the advance warning sign at the standard distances is not practical, or is found to be ineffective, and the advance-warning sign with flag tree is also found to be ineffective, the

advance-warning flasher may be used in conjunction with the advance-warning sign to provide additional warning to oncoming traffic. When mounted on an advance-warning sign, the distance from the roadway to the bottom of the lens of the light must not be less than 8 feet.

Note: The flag tree can be used in conjunction with the advance-warning sign during daylight hours and/or the advance-warning flasher during hours of darkness.

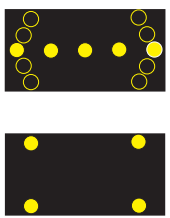
Flashing-Arrow Panel

Description: The unit must consist of a black rectangular background at least 4 feet wide and 2 feet high, with yellow flashing lights at least 4 inches in diameter, which form a clearly recognizable arrow symbol.



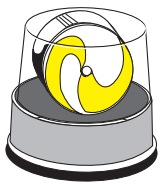
Instructions for Use: The unit may be mounted at a height of at least 7 feet from the bottom of the unit on a trailer or other suitable support. Vehicle-mounted panels should be as high as practicable. This sign can provide additional warning and directional information to assist in merging and controlling traffic around the work area.

If using an arrow panel, the arrow or chevron mode must be used for lane closures on multi-lane streets. If more than one lane is closed, a separate arrow panel must be used for each closed lane. The caution mode must be used in situations where one lane of a two-way street is closed. The caution mode may also be used for work (including surveying) done on shoulders and sidewalks near traffic situations.



Note: Arrow panels may be used in conjunction with warning signs. They may not be used to replace warning signs.

Hazard-Vehicle Light



Description: Vehicle-mounted, revolving (360 degrees) amber light.

Instructions for Use: The light must be displayed and be visible to all approaching traffic when the vehicle is operated at a work site in the roadway and the vehicle is not within a protected work area.

Work Area Protection

Work area protection involves the immediate area in which workers' activities are taking place. Consideration must be given to pedestrian and motorist protection. The work area is generally bordered by:

- Stanchions with telescoping rails and/or orange barrier tape, and/or
- Barricades Type I, Type II, or Type III.

Traffic-control devices, including channelizing devices, such as stanchions and cones, as well as sign supports and barricades, must conform to new requirements set by the National Cooperative Highway Research Program (NCHRP) Report 350, "Recommended Procedures for the Safety Performance of Highway Features," and are to be constructed of crashworthy materials.

Protection of Pedestrians

Traffic-control devices used to delineate pedestrian walkways must be crashworthy so that if struck by a vehicle, there will be a minimal threat to pedestrians, workers, and the occupants of vehicles.

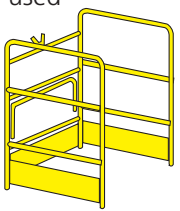
When existing pedestrian paths are disrupted or closed, alternate routes must be provided to crosswalks and bus stops. Signage may be provided to improve recognition of a temporary pedestrian route.

Stanchions with telescoping rails are to be used to channel pedestrians safely around the work area. Such barricades should be detectable to users of canes with a bottom rail no higher than 2 inches above ground, and a top rail at least 32 inches above ground.

If storing materials outside of the work area setup near pedestrian pathways (sidewalks and crossings), Type III barricades should be used to channel pedestrians safely around these storage areas.

Note: The devices must form a continuous barrier without any gaps between the devices.

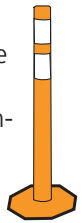
Subsurface Protection Devices



Description: Manhole guardrail and telescoping rails are used to prevent personnel, debris, tools and pedestrians from falling into subsurface structures and are not a traffic-control device. Manhole guardrails are yellow and equipped with three sides and two rails, plus a toe-board. The height of the top rail must not be less than 42 inches. Telescoping rails are mounted onto stanchions. The first rail is placed at the bottom of the stanchions and the second rail is secured at the top.

Instructions for Use: Manhole guardrails are to be used for open manholes. Manhole guardrails must be used for the following subsurface type of structure opening with type of covers: service valve castings, SI, S2, S3, 32-inch manhole cover, and 44-inch manhole cover. Larger subsurface structures require type 2 barricades.

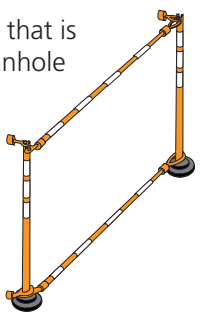
Stanchions, Telescoping Rails, and Boundary Tape





Description: Stanchions must be crashworthy*, must consist of orange uprights at least 42 inches high with bases, and may be of a tubular or cone style. Each must have a minimum of two retroreflector bands near the top of the stanchion. The boundary tape is orange.

Instructions for Use: To outline the boundaries of street work areas such as:



- An open manhole that is protected by a manhole guardrail;
- Vault cage entry;
- Overhead pole work;
- Setup around Vactor/flush trucks.

* Temporary Traffic-Control (TTC) devices used to delineate a TTC zone pedestrian walkway must be crashworthy and, when struck by vehicles, present a minimum threat to pedestrians, workers, and occupants of impacting vehicles.

Barricades

Description: Barricades must be crashworthy and are of three types:

Type I – Has one rail that must be a minimum length of 2 feet and a width of 8 inches to 12 inches. Minimum height requirement is 36 inches.

Type II – Has two rails that must each be a minimum length of 2 feet and a width of 8 inches to 12 inches.

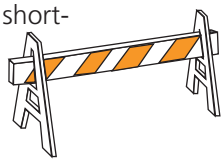
Type III – Has three rails that must each be a minimum length of 4 feet and a width of 8 inches to 12 inches. Minimum height requirement is 60 inches.

In addition, for all types:

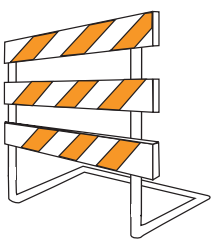
- Rails must be marked with alternate orange and white stripes at an angle of 45 degrees.
- Rails must be retroreflective for night use. And 270 square inches for freeways.

Instructions for Use: Barricades are used to mark an obstruction (work area) in the roadway and are required to outline excavations.

- The Type I barricade is used for temporary or short-duration work and for out lining excavations.



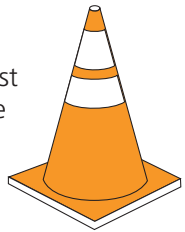
- The Type III barricade is normally used to face oncoming traffic for long-duration work where the barricade is to remain in the roadway for extended periods.



- Telescoping rails with stanchions are to be used to channel pedestrians safely around the work area. Type II or Type III barricades may be used at pedestrian crossings, as well as at sidewalks or other areas where pedestrians would normally come into contact with the work area.
- Ballasts must not be placed on the top rail and must not consist of nondeformable objects such as rocks or concrete.

Note: The addition of company identification must not detract from the striping on the face of the barricade rail(s) facing oncoming traffic.

Cones



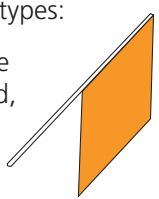
Description: Cones must be orange and must be between 28 and 36 inches in height with two reflectorized bands near the top. For nighttime use, cones must be retroreflectorized or equipped with lighting devices for maximum visibility. Retroreflectorization of cones that are 28 to 36 inches in height must be provided by a 6-inch-wide white band located 3 to 4 inches from the top of the cone and an additional 4-inch-wide white band located approximately 2 inches below the 6-inch-wide band.

Instructions for Use: The primary function of cones is to channel traffic. The cone should be used to control and direct traffic around or through the work area by gradually narrowing the roadway and indicating the path to be followed. Cones may be used in combination with:

- A flag inserted in the top of the cone to enhance its target value during daylight hours;
- Type B warning lights (high-intensity flashers), which may be used day or night (warning lights must flash when used to warn of a condition);
- Type C steady-burn warning lights when used to channelize traffic.

Signaling Devices

Description: Signaling devices must be one of the following types:



- Signal flag – must be retroreflectorized red, at least 24 inches by 24 inches, securely fastened to a staff 36 inches long.



- Signal light – a steadily burning red or red-orange flashlight wand.

- Paddle – a combination "Stop" and "Slow" sign on an octagonal panel, at least 18 inches wide with letters 6 inches high, securely fastened to a rigid handle. Both faces must be retroreflectorized for nighttime use. The "Stop" face must be red with white letters and border. The "Slow" face must be orange with black letters and border.

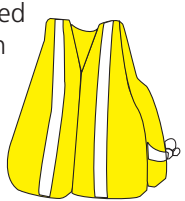


Instructions for Use: Signaling devices should be used by flaggers to issue signals to oncoming traffic.

- The signal flag is for use during daylight hours, and the signal light is for use during emergency situations by a single flagger.
- The "Stop" and "Slow" paddles are used day or night when more guidance to motorists is needed. However, they should not be used where display of the paddle face in the opposite direction would be inappropriate or misleading.
- Use of the "Stop" and "Slow" paddle is preferable in a two-way traffic condition, such as the middle of a street, as opposed to an intersection where traffic may travel in four directions.

Safety Apparel

Description: Flaggers, as well as employees outside of the work area setup, must wear approved safety apparel available in Class & Stock.



Note: Must be used in work where mobile equipment is used or machinery is moving

Instructions for Use: Vests or compliant apparel must be worn on the outside of all other clothing. Trained employees assigned as flaggers must wear safely apparel when controlling traffic. When leaving or working outside a protected work area, employees exposed to vehicle traffic, e.g., setting up, maintaining, or removing work area protection, must wear a safety vest. Surveyors and employees working in the roadway with minimum protection must wear a safety vest.

Remember: The value of your safety vest is diminished when you crouch, bend, or move into a position that reduces your visibility or the reflective value of the vest.

Flags (used in conjunction with traffic-control devices)

Description: Flags must be orange; a minimum of 16 inches by 16 inches and attached to a staff at least 30 inches long.

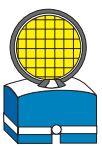


Instructions for Use: Flags may be displayed in a manner that does not obscure the legend above any channeling device, on vehicles or tool carts, on stanchions and barricades, and above warning signs.

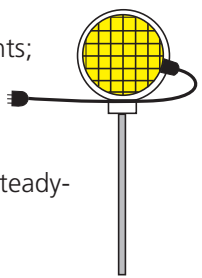
Note: Flags are a supplement to increase the target value and visibility of the work area during daylight hours. Flags may be placed at suitable intervals of not more than 20 feet during daylight hours on barricades used to outline excavations.

Low-Intensity Warning Lights

Description: Low-intensity lighting is for use during nighttime hours only. All warning lights must comply with the ITE "Purchase Specification for Flashing and Steady-Burn Warning Lights," such as:

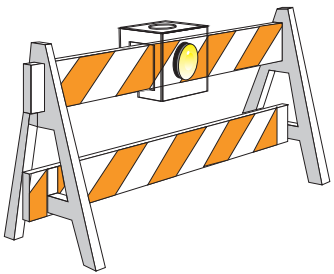


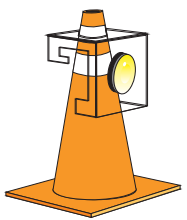
- Type A low-intensity flashing warning lights;
- Type C steady-burn warning lights;
- Type D 360-degree steady-burn warning lights.

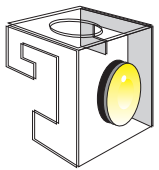


Instructions for Use: On barricades used to outline excavations, one light must be placed on the barricades at suitable intervals of not more than 20 feet. Use during hours of darkness only. (Use Type B high-intensity flashing warning lights for day and night.) Warning lights must have a minimum mounting height of 30 inches.

Safety cones/barricade LED lights







Traffic Control and Work Area Protection Arrangements

3

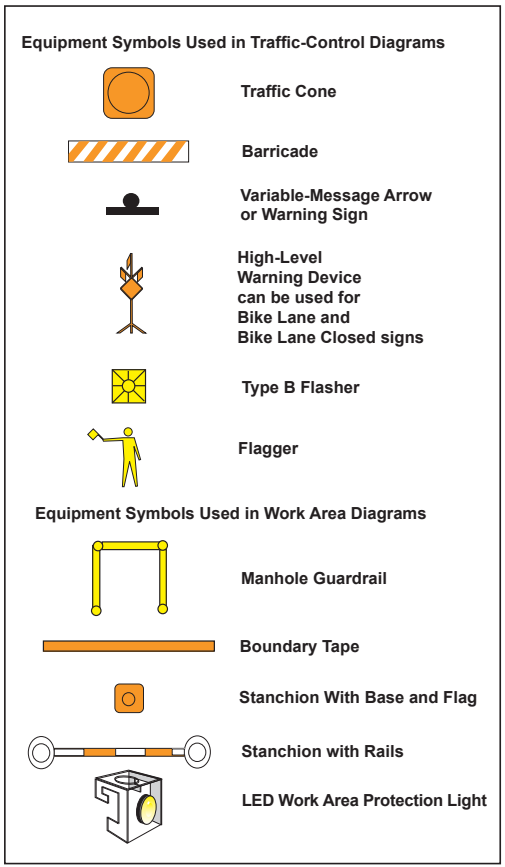
Work Area Protection Diagrams

This section provides graphic diagrams showing a variety of typical work locations. In each case, a scene is provided showing the work area protection properly deployed. In addition, a smaller "blueprint" diagram providing an overhead view of the job site helps to clarify the placement of signage, lights, barriers, and other work area protection equipment.

The arrangements shown in this section do not cover every possible work area configuration. They are intended to provide a representative sample of field conditions and to offer guidance when planning work area protection in similar settings. If you're not sure how to proceed, talk to your supervisor.

Using these diagrams as reference, you must also:

1. *Review the DOT permit for conditions of work. Verify information if needed.*
2. Select a traffic-control diagram that meets most nearly the requirements to control traffic at the work site.
3. Select a work area protection diagram for your type of operation.
4. Set up the work site in accordance with the arrangements selected. Adapt the arrangements where necessary to meet local conditions.



Work Area Protection Diagrams

These configurations are generally applicable to comparable work areas with similar road conditions.

- Setup for Pole Setting on Four-Lane Road With Two Lanes of Traffic in Each Direction
- Setup for Curved Two-Lane Road With Two-Way Traffic
- Setup in Middle Lane of Three Lanes of Traffic Moving in the Same Direction
- Setup in One Lane of a Four-Lane Road With Two Lanes of Traffic in Each Direction
- Setup at an Intersection With Pedestrian Crosswalks
- Setup at an Intersection With Pedestrian Crosswalks
- Setup Around Subsurface structure in Sidewalk Area
- Setup in Middle of Roadway Diverting Traffic
- Setup in Street Blocking Bike Lane

Setup for Pole Setting on Four-Lane Road With Two Lanes of Traffic in Each Direction

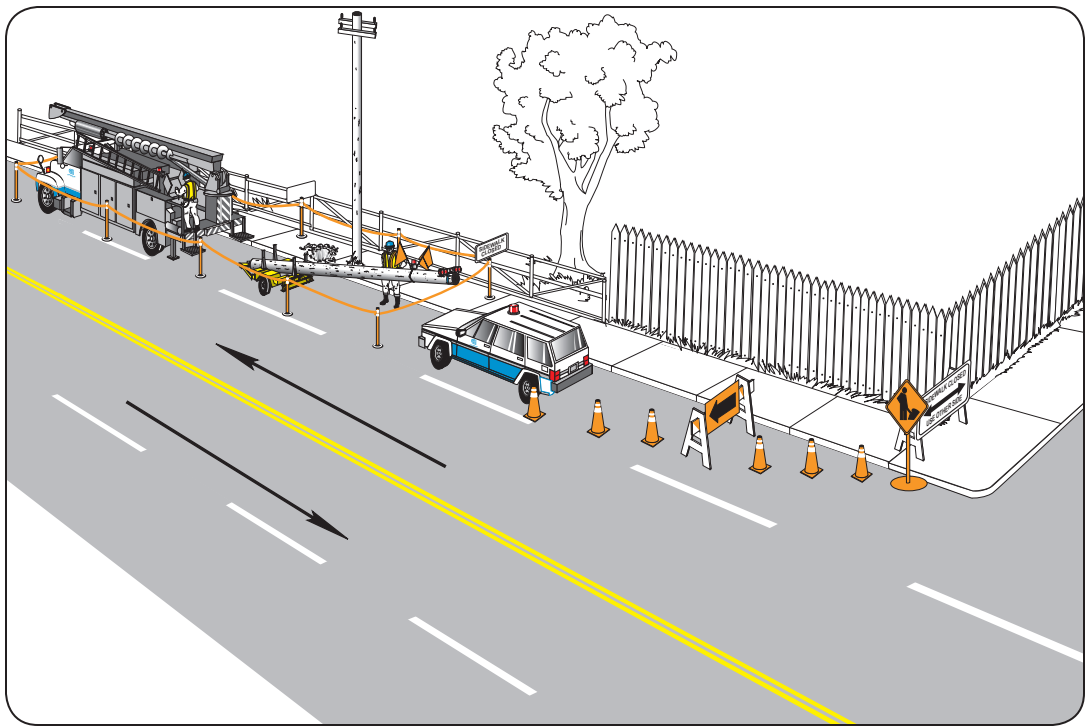
This configuration is generally applicable to comparable work areas with similar road conditions.

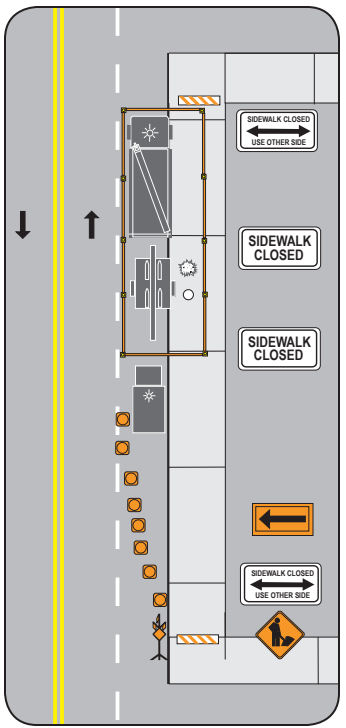
Setup

- Where necessary, assign a flagger while the work area is being prepared.
- Place the advance-warning sign at the beginning of the tapered work zone.
- Place the "Lane Closed" sign to appear in plain view after the advance-warning sign for traffic traveling toward the one closed lane.
- Place traffic cones so that the traffic is tapered away from the work area.
- Set up stanchions and boundary tape. (Tape may be used when pedestrians have restricted access to the work area.)
- Post "Sidewalk Closed" sign near setup (optional).
- Post "Sidewalk Closed — Use Other Side" sign on both sides of the work area, at the nearest corners to restrict pedestrian traffic on the work side of the street.

Equipment

- Advance-warning sign ("Worker Symbol," "Work Area Ahead," or "Utility Work Ahead")
- 28" or 36" traffic cones
- Lane-closure sign (arrow board or flashing-arrow panel)
- Stanchions and boundary tape
- Sidewalk-closed signage





Blueprint of work area

Setup for Bucket Truck on Curved Two-Lane Road With Two-Way Traffic

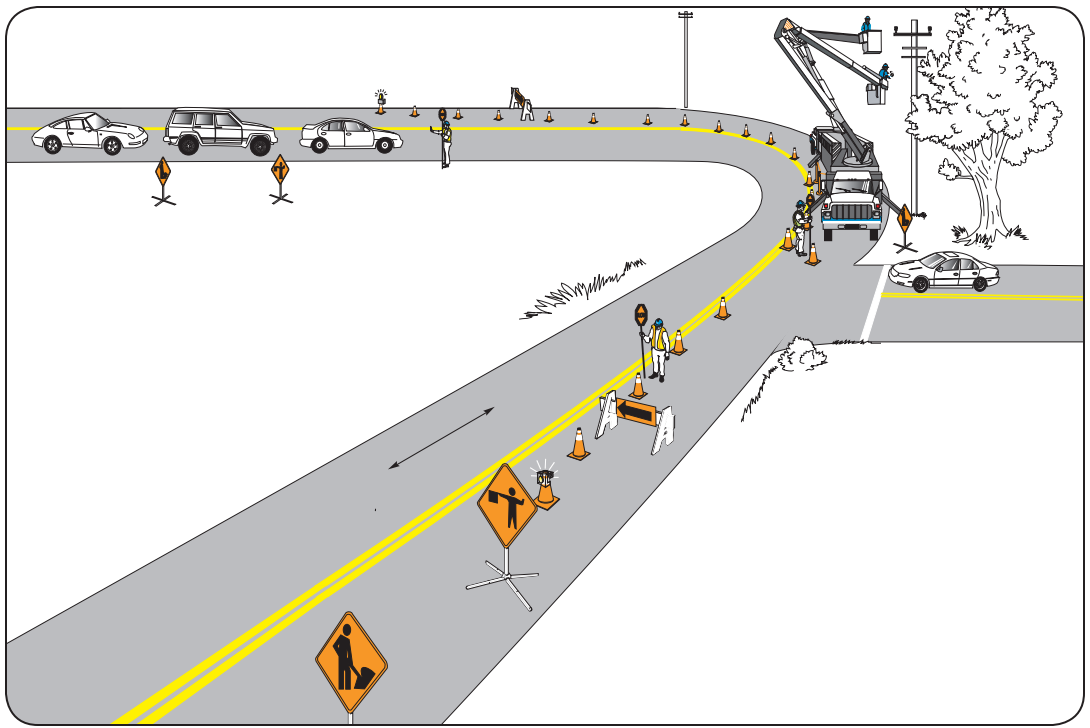
This configuration is generally applicable to comparable work areas with similar road conditions.

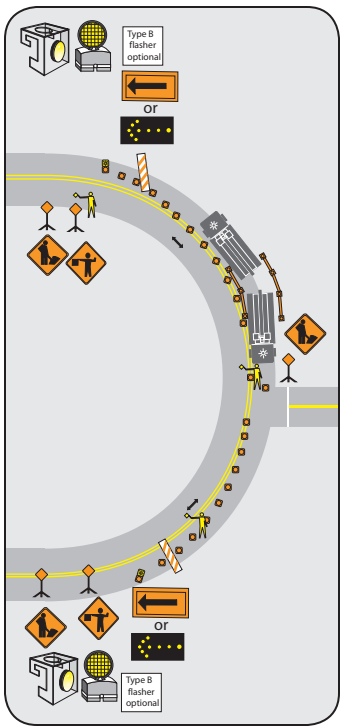
Setup

- Assign three flaggers, one at each end of the work area, and one at a nearby intersection, to control the flow of two-way traffic in one lane. The flagger position should be within a protected area, such as the tapered area.
- Ensure communications among flaggers (walkie-talkies).
- Place the advance-warning sign at the beginning of the tapered work zone for both sides of oncoming traffic.
- Place "Flagger Ahead" signs after the advance-warning sign and well before the flagger position.
- Place the "Lane Closed" sign to appear in plain view after the advanced warning sign for traffic traveling toward the one closed lane.
- Place the "Lane Closed" sign for traffic approaching on the opposite side of the double yellow line (optional).
- Place traffic cones so that upstream and downstream traffic are both tapered away from the work area.
- Set up stanchions and boundary tape to extend around work areas (tape may be used when pedestrians have restricted access to the work area).

Equipment

- 3 advance-warning signs ("Worker Symbol," "Work Area Ahead," or "Utility Work Ahead")
- Flags (optional)
- 2 lane-closure signs (arrow board or flashing-arrow panel)
- 2 "Flagger Ahead" signs
- 28" or 36" traffic cones
- Stanchions and boundary tape, safety cone, barricade LED lights
- Type B flashers (optional)
- 3 sets of flagger-communication equipment
- 3 flagger paddles





Blueprint of work area

Setup for Excavation in Middle Lane of Three Lanes of Traffic Moving in the Same Direction

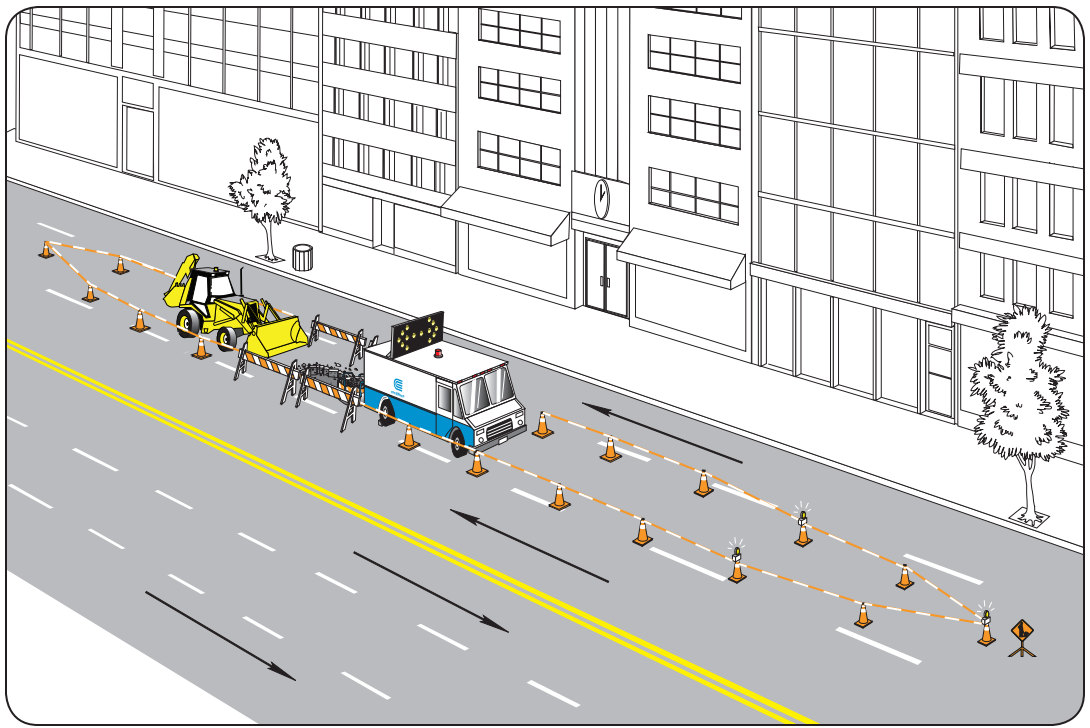
This configuration is generally applicable to comparable work areas with similar road conditions.

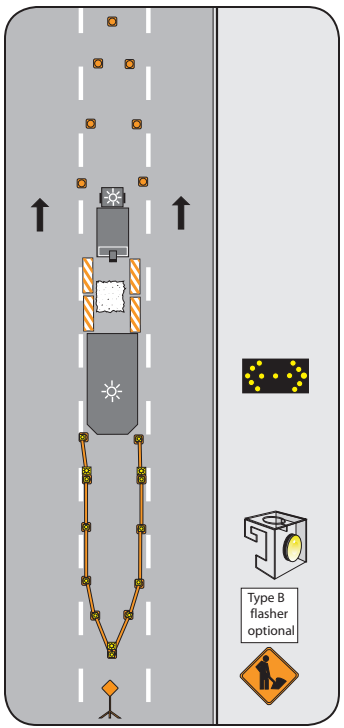
Setup

- Where necessary, assign a flagger while the work area is being prepared.
- Place the advance-warning sign at the beginning of the tapered work zone.
- Place the "Lane Closed" sign in plain view after the advance-warning sign.
- Place traffic cones so that the traffic is tapered away from the work area.
- Place sturdy barricades around the excavation work area.
- Filled Pel bags should be placed inside the work area nearest barricades that are most at risk of impact from oncoming traffic.

Equipment

- Advance-warning sign ("Worker Symbol," "Work Area Ahead," or "Utility Work Ahead")
- Flags (optional)
- 28" or 36" traffic cones
- Lane-closure sign (arrow board or flashing-arrow panel)
- Type B flashers/LED lights (optional)
- Stanchion and telescoping rails
- Barricades





Blueprint of work area

Setup for Flush Truck in One Lane of a Four-Lane Road With Two Lanes of Traffic in Each Direction

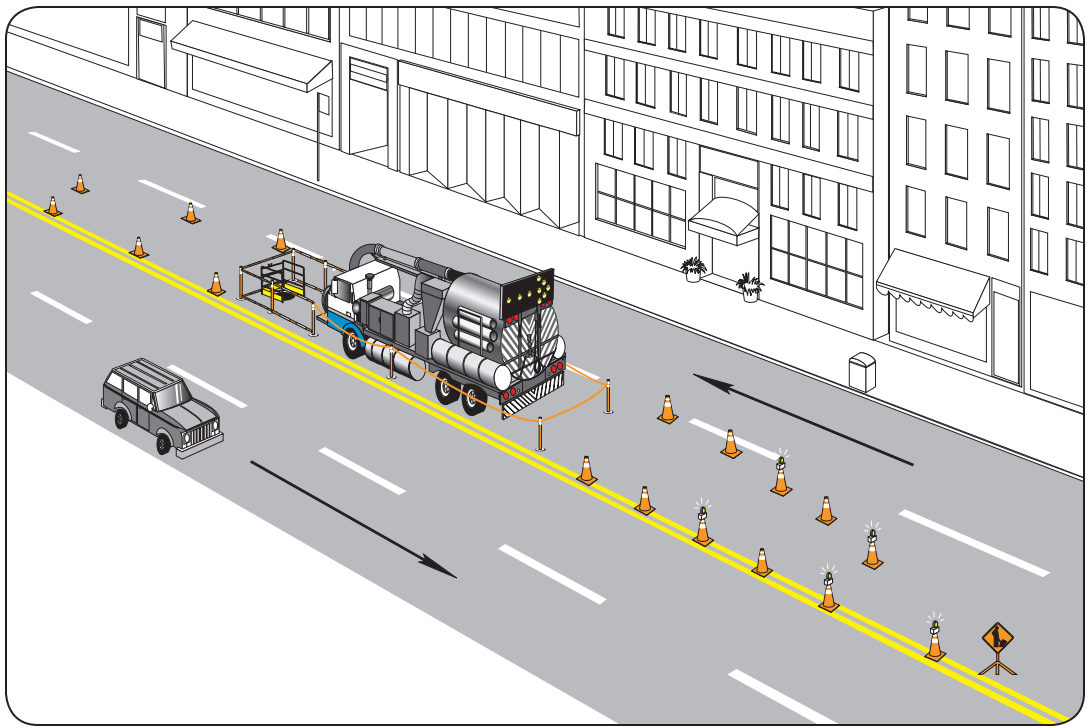
This configuration is generally applicable to comparable work areas with similar road conditions.

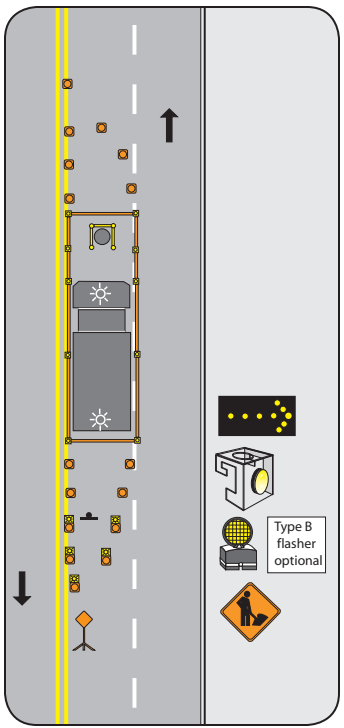
Setup

- Where necessary, assign a flagger while the work area is being prepared.
- Place the advance-warning sign at the beginning of the tapered work zone for both sides of oncoming traffic.
- Place the "Lane Closed" sign to appear in plain view after the advance-warning sign for traffic traveling toward the one closed lane.
- Place the flashing-arrow panel, in the caution mode (no arrow) for traffic approaching on the opposite side of the double yellow line (optional).
- Place traffic cones so that the oncoming traffic is tapered away from the work area.
- Place traffic cones to ease the downstream traffic flow and maintain separation of traffic flowing in the opposite direction.
- Set up stanchions and boundary tape to extend completely around the flush operation. (Tape may be used when pedestrians have restricted access to the work area.)

Equipment

- Advance-warning sign ("Worker Symbol," "Work Area Ahead," or "Utility Work Ahead")
- Flags (optional)
- 28" or 36" traffic cones
- Lane-closure sign (arrow board or flashing-arrow panel)
- Flashing-arrow panel, in the caution mode (optional)
- Stanchions, telescoping rails, and boundary tape
- Type B flashers (optional)
- Manhole guardrail





Blueprint of work area

Setup for Tool Cart at an Intersection With Pedestrian Crosswalks

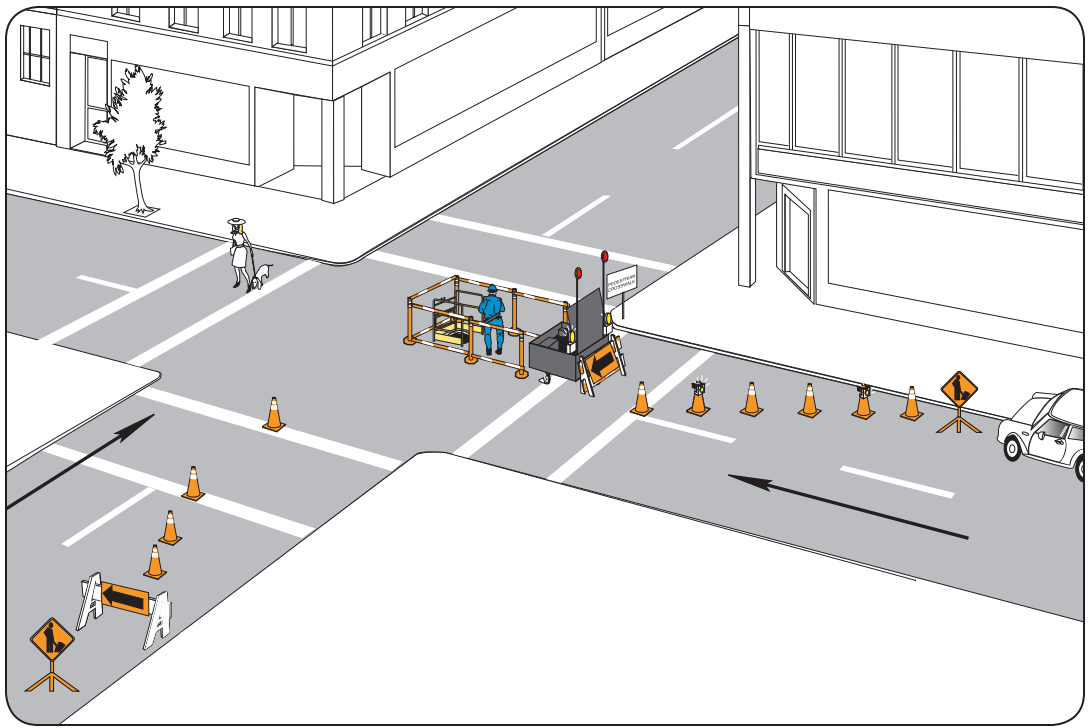
This configuration is generally applicable to comparable work areas with similar road conditions.

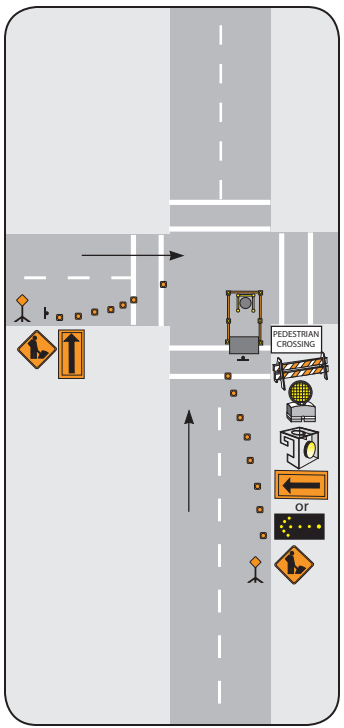
Setup

- Where necessary, assign a flagger while the work area is being prepared.
- This work area is immediately preceded by a parking lane. Place one advance-warning sign in the parking lane and another advance-warning sign for traffic that is restricted to the left of the work area.
- Place the "Lane Closed" sign so that it appears in plain view after the advance-warning sign for traffic that is restricted to the left of the work area. ("Lane Closed" signs are not required for parking lanes.)
- Place traffic cones so that the traffic is tapered away from the work area for oncoming traffic. Maintain pedestrian access to crossings not affected by the work area.
- Maintain pedestrian safety from upstream traffic at all relocated crossings with placement of Type III barricades or with barricades equipped with a bottom rail at most 6 inches above street level and a top rail at least 36 inches high (see Protection of Pedestrians, page 17).
- Place Type B flashers on barricades at pedestrian crossings.
- Post the "Pedestrian Crossing" sign to redirect pedestrian traffic.
- Set up stanchions and boundary tape to extend around work areas. (Tape may be used when pedestrians have restricted access to the work area.)

Equipment

- 2 advance-warning signs ("Worker Symbol," "Work Area Ahead," or "Utility Work Ahead")
- 28" or 36" traffic cones
- 1 lane-closure sign (arrow board or flashing-arrow panel)
- Type III barricades or barricades equipped with two rails
- Stanchions, telescoping rails
- 2 to 4 Type B flashers (required)
- "Pedestrian Crossing" sign (optional)
- LED work area protection lights (optional)
- Manhole guardrail





Blueprint of work area

Setup for Cable Trucks at an Intersection With Pedestrian Crosswalks

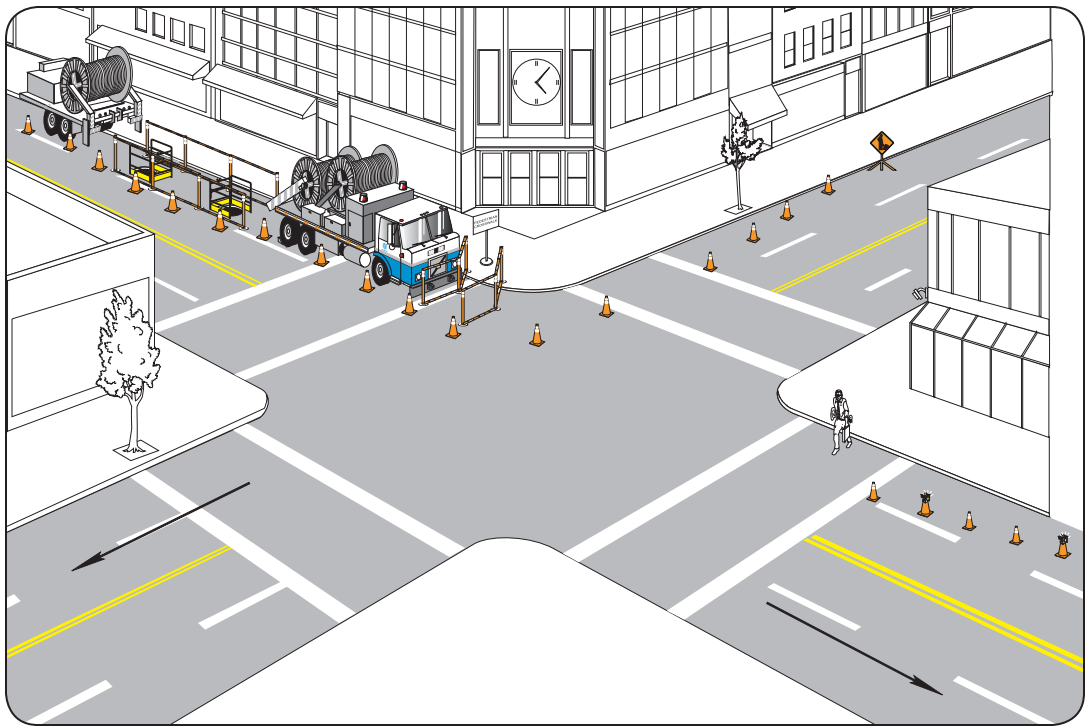
This configuration is generally applicable to comparable work areas with similar road conditions.

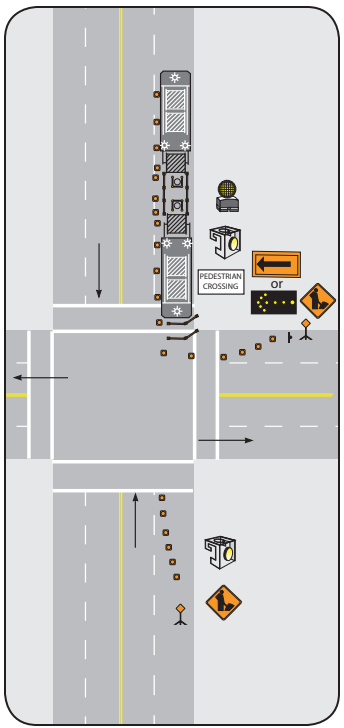
Setup

- Where necessary, assign a flagger while the work area is being prepared.
- Place the advance-warning signs on the far side of the intersection for traffic traveling upstream and for traffic that is restricted from turning into that lane.
- Place the "Lane Closed" sign to appear in plain view after the advance-warning sign for traffic traveling toward the one closed lane.
- Place traffic cones so that the traffic is tapered away from the work area for oncoming traffic.
- Maintain pedestrian access to crossings not affected by the work area.
- Maintain pedestrian safety from upstream traffic at all relocated crossings with placement of Type III barricades or with barricades equipped with a bottom rail at most 6 inches above street level and a top rail at least 36 inches high (see Protection of Pedestrians, page 17).
- Place Type B flashers on barricades at pedestrian crossings.
- Post the "Pedestrian Crossing" sign to redirect pedestrian traffic.
- Set up stanchions and boundary tape to extend around work areas. (Tape may be used when pedestrians have restricted access to the work area.)

Equipment

- 2 advance warning signs ("Worker Symbol," "Work Area Ahead," or "Utility Work Ahead")
- Flags (optional)
- 28" or 36" traffic cones
- 2 lane-closure signs (arrow board or flashing-arrow panel)
- Type III barricades or barricades equipped with two rails
- Stanchions and telescoping rails
- 2 to 4 Type B flashers (required)
- "Pedestrian Crossing" sign (optional)
- Manhole guardrails





Blueprint of work area

Job setup on sidewalk

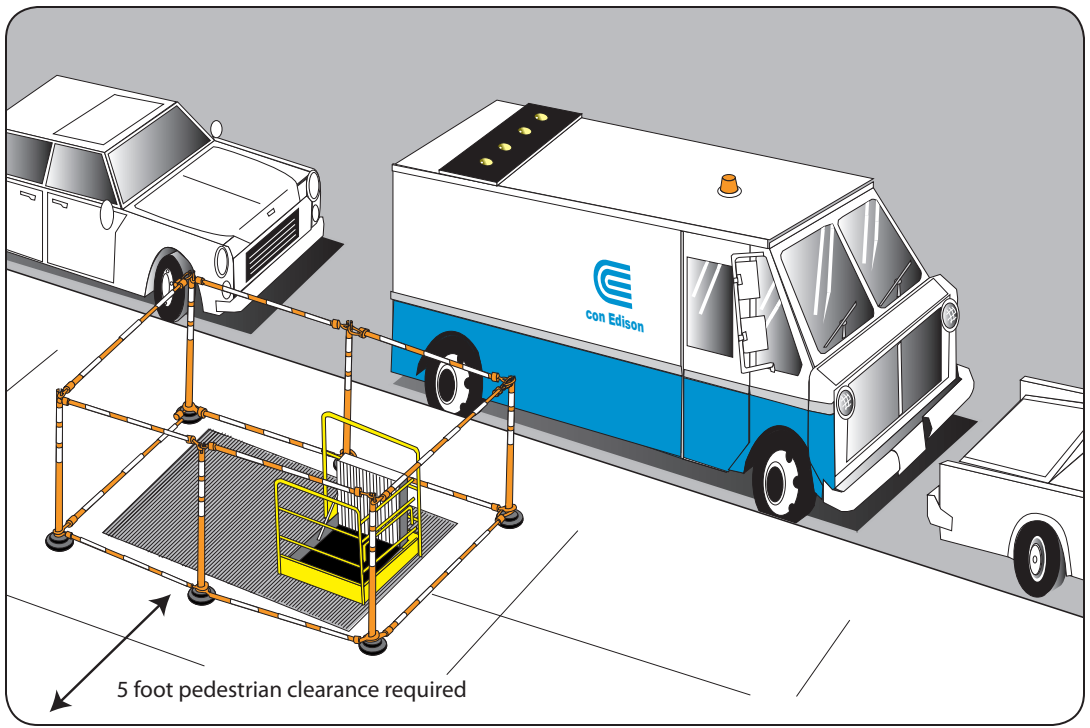
This configuration is generally applicable to comparable work areas with similar sidewalk conditions.

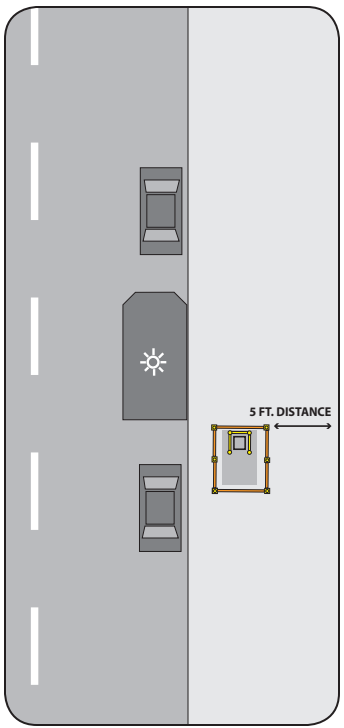
Setup

- Secure area with telescoping rail/stanchion combination.
- Two telescoping rails must be used per section, one on the bottom and the other hung on the top of the stanchions.
- Place cones around setup to give advance warning to pedestrians.
- Open underground structure covers.
- Utilize manhole guardrails, when feasible.

Equipment

- Stanchions and telescoping rails
- Manhole guardrail





Blueprint of work area

Closure/redirection of bike lane

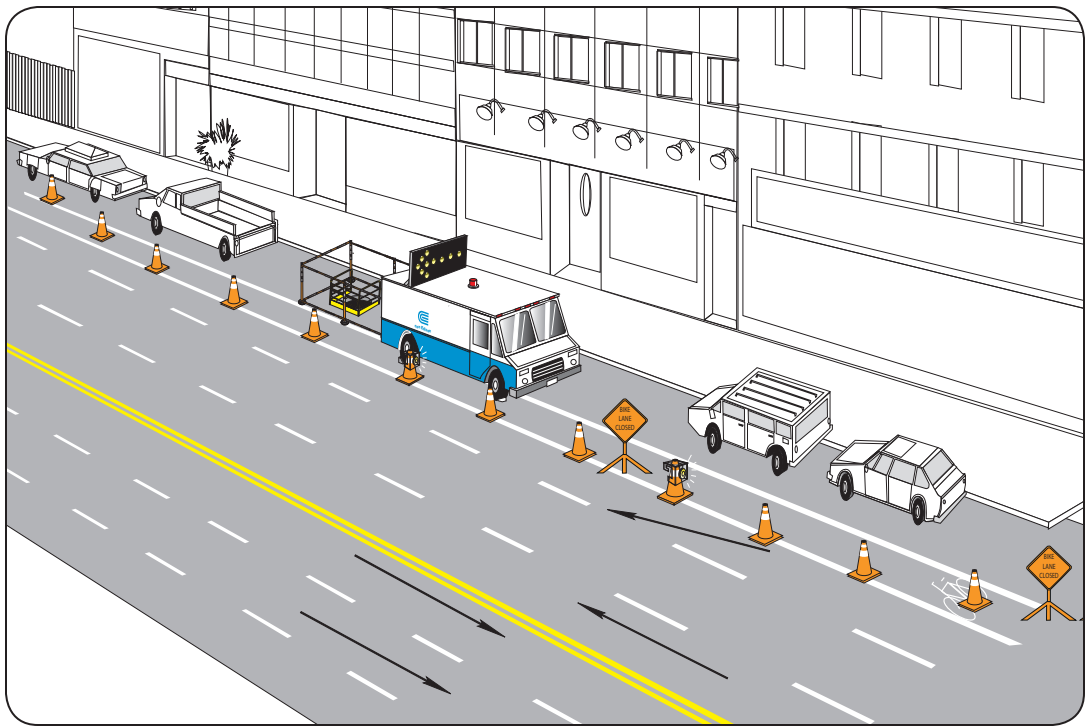
This configuration is generally applicable to comparable work areas with similar road conditions.

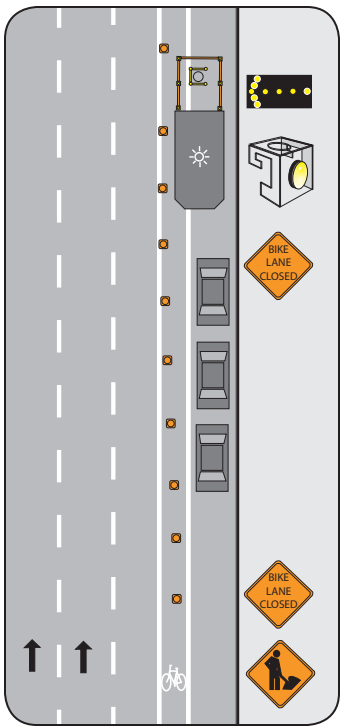
Setup

- Assign two flaggers while the work area is being prepared.
- Place the advance-warning signs on the far side of the intersection for traffic traveling upstream and for traffic that is restricted from turning into that lane.
- Place the "Bike Lane Closed" advance warning sign 350 feet and 200 feet prior to work zone, and also post at work zone.
- Place traffic cones so that the traffic is tapered away from the work area for oncoming traffic, while maintaining the bike lane.
- Maintain pedestrian access to crossings not affected by the work area.
- Set up stanchions with telescoping rails to extend around work areas. (Tape may be used when pedestrians have restricted access to the work area.)

Equipment

- Advance-warning signs ("Worker Symbol," "Work Area Ahead," or "Utility Work Ahead")
- Bike lane closed sign
- Flags (optional)
- 28" or 36" traffic cones
- 2 lane-closure signs (arrow board or flashing-arrow panel)
- Stanchions and telescoping rails
- Manhole guardrail and telescoping rails





Blueprint of work area

Diverting traffic into an oncoming lane

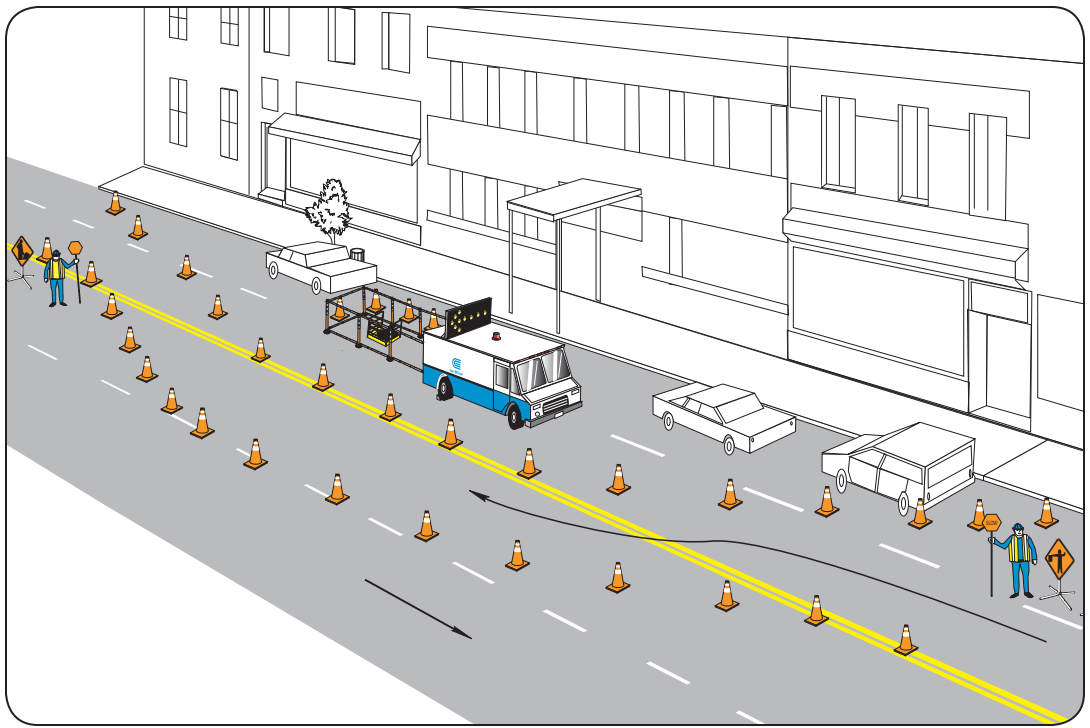
This configuration is generally applicable to comparable work areas with similar road conditions.

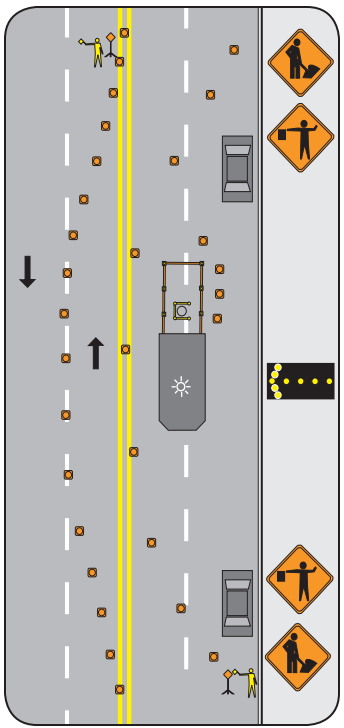
Setup

- Assign two flaggers while the work area is being prepared.
- Place the advance-warning sign at the beginning of both ends of the tapered work zone for both sides of oncoming traffic.
- Place the "Lane Closed" sign to appear in plain view after the advance-warning signs for traffic traveling toward the one closed lane.
- Place the flashing-arrow panel for traffic approaching on both sides of the double yellow line, directing the the traffic away from the work area.
- Place traffic cones so that the oncoming traffic is tapered away from the work area.
- Place traffic cones to ease the downstream traffic flow and maintain separation of traffic flowing in the opposite direction.
- Set up stanchions with telescoping rails around work set up behind the vehicle.

Equipment

- 2 advance-warning signs ("Worker Symbol," "Work Area Ahead," or "Utility Work Ahead")
- Flags (optional)
- 28" or 36" traffic cones
- 2 lane-closure signs (arrow board or flashing-arrow panel), whichmust direct traffic coming from both directions
- Stanchions and telescoping rails around work area
- Manhole guardrail





Blueprint of work area

Setup for Excavations in Sidewalk Area Re-directing Pedestrian Traffic

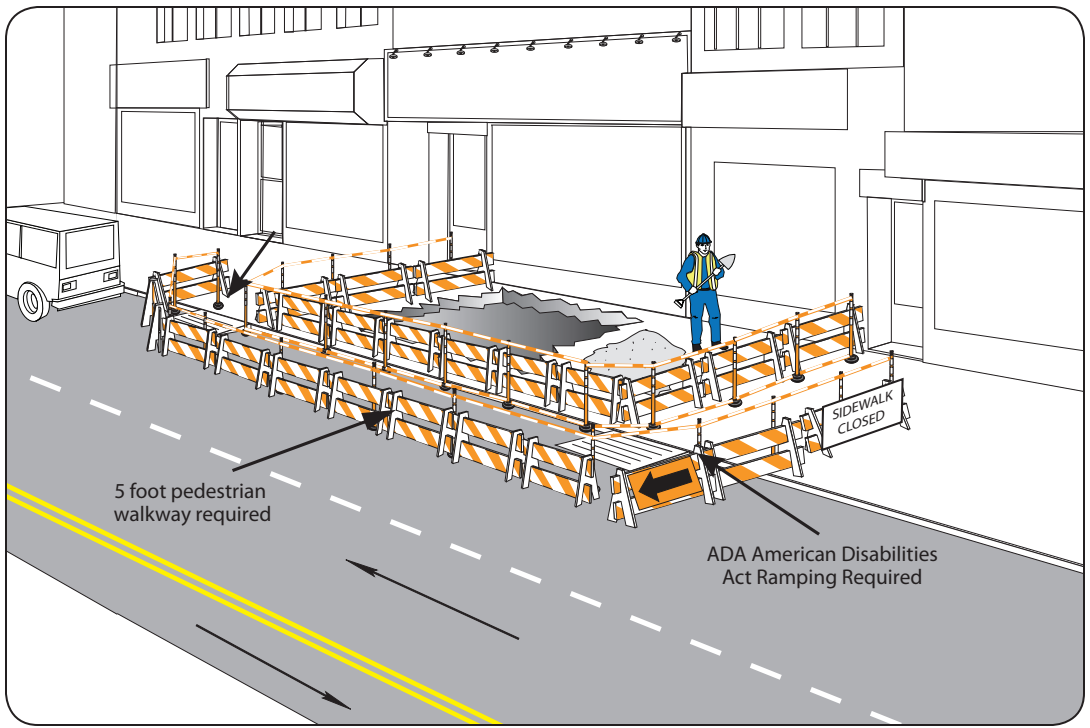
This configuration is generally applicable to comparable work areas with similar road conditions.

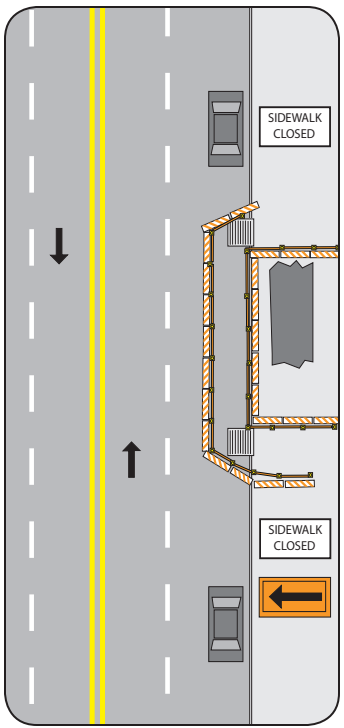
Setup

- Where necessary, assign a flagger while the work area is being prepared.
- Place sturdy barricades around the excavation work area.
- Place stanchions with telescoping rails to channel pedestrians around work area.
- Install ramps at curb entrance and exit of pedestrain passageway.
- Filled Pel bags should be placed in work area.
- Post "Sidewalk Closed" sign near setup.
- Post "Sidewalk Closed Use Other Side" sign on both sides of work area, at the nearest corners, to restrict pedestrian traffic on the work side of the street.

Equipment

- Type III barricades or barricades equipped with 2 rails
- Stanchions with telescoping rails
- Directional-arrow signs
- Sidewalk closed signs
- Ramps





Blueprint of work area

Setup for Excavation Near Curbside in Vehicle Parking Lanes

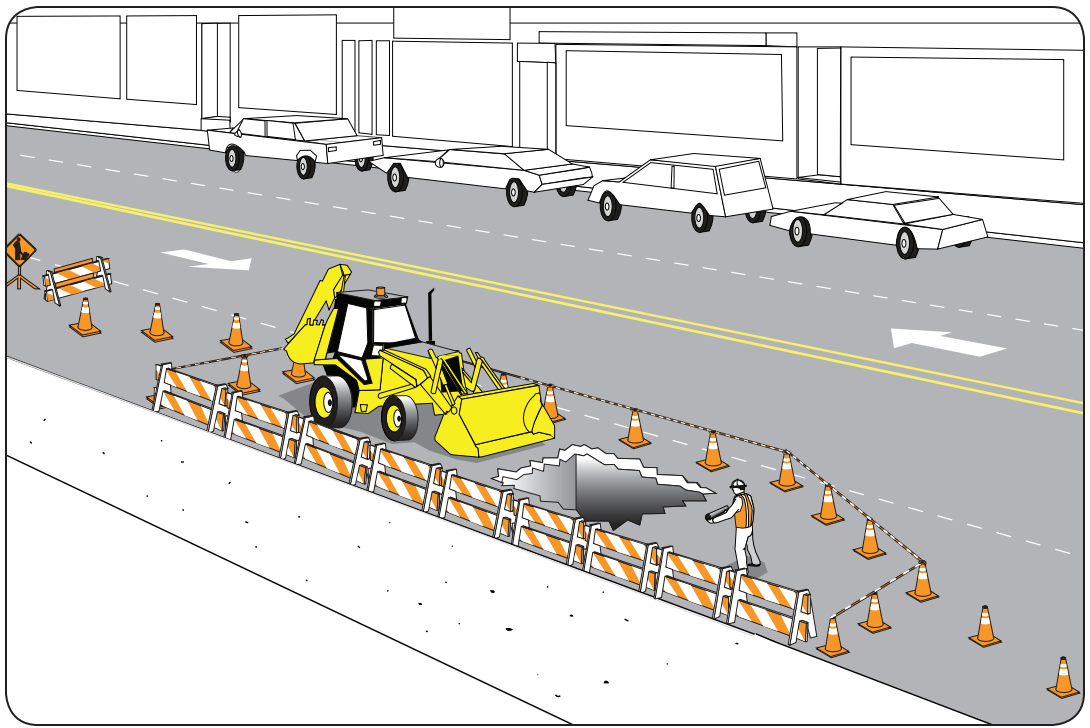
This configuration is generally applicable to comparable work areas with similar road conditions.

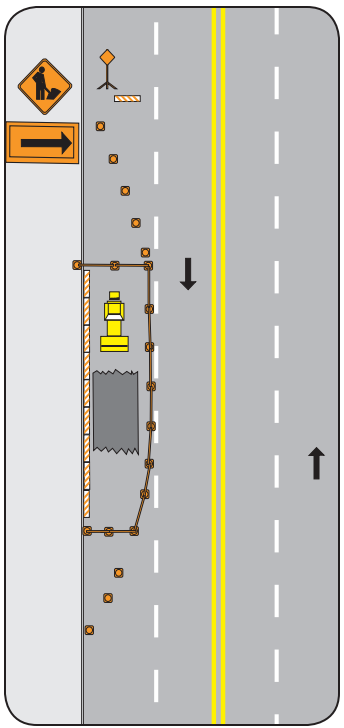
Setup

- Place sturdy barricades around the excavation work area.
- Cones with telescoping rails may be used around work area closed to vehicle traffic (optional).
- Lane-closure sign (arrow board or flashing-arrow panel).
- Type B flashers (optional).
- Advance–warning sign at the beginning of the tapered work zone.
- Filled Pel bags should be placed inside the work area nearest barricades that are most at risk of impact from oncoming traffic.

Equipment

- Type III barricades or barricades equipped with 2 rails
- Directional-arrow signs
- 28"-36" traffic cones
- Advance–warning sign
- Telescoping rails





Blueprint of work area

Setup for Excavations Near Intersections and Crosswalks While Redirecting Pedestrians

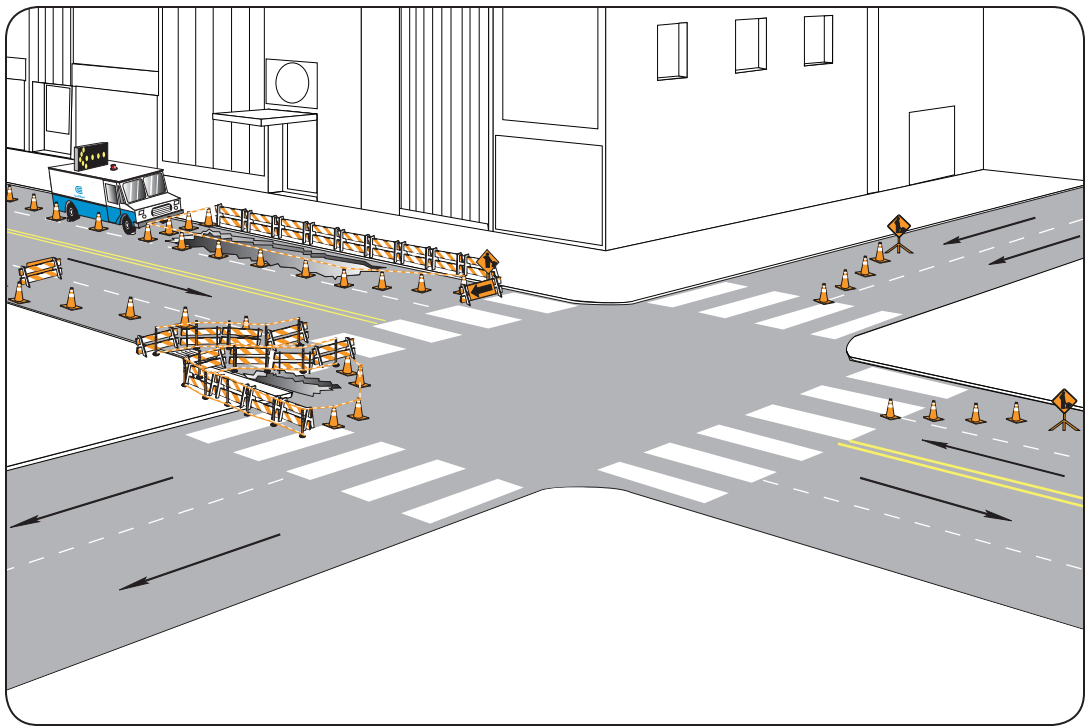
This configuration is generally applicable to comparable work areas with similar road conditions.

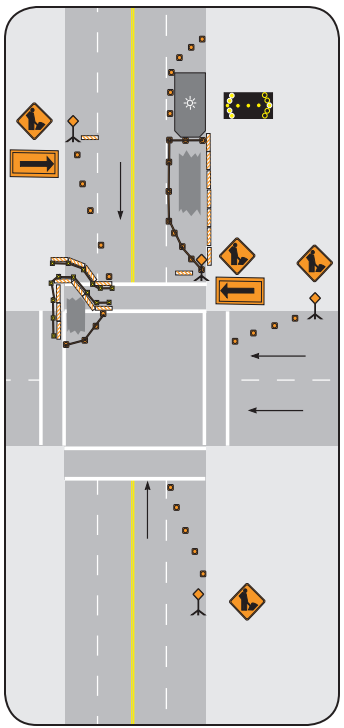
Setup

- Place sturdy type barricades around the excavation work area.
- Post the "Pedestrian Crossing" sign to redirect pedestrian traffic.
- Place Type B flashers on barricades at pedestrian crossing.
- Filled Pel bags should be placed inside the work area nearest barricades that are most at risk of impact from oncoming traffic.
- Maintain pedestrian safety from upstream traffic at all relocated crossings with placement of Type III barricades or barricades equipped with a bottom rail, no more than 6 inches above street level, and a top rail at least 36 inches high (see Protection of Pedestrians, page 17).

Equipment

- 4 advance-warning signs ("Worker Symbol," "Work Area Ahead," or "Utility Work Ahead")
- Flags (optional)
- 28" or 36" traffic cones
- 1 lane-closure sign (arrow board or flashing-arrow panel)
- Type III barricades or barricades equipped with two rails
- Stanchions, telescoping rails
- "Pedestrian Crossing" sign (optional)





Blueprint of work area

Setup for Boom Truck for Transformer Installment

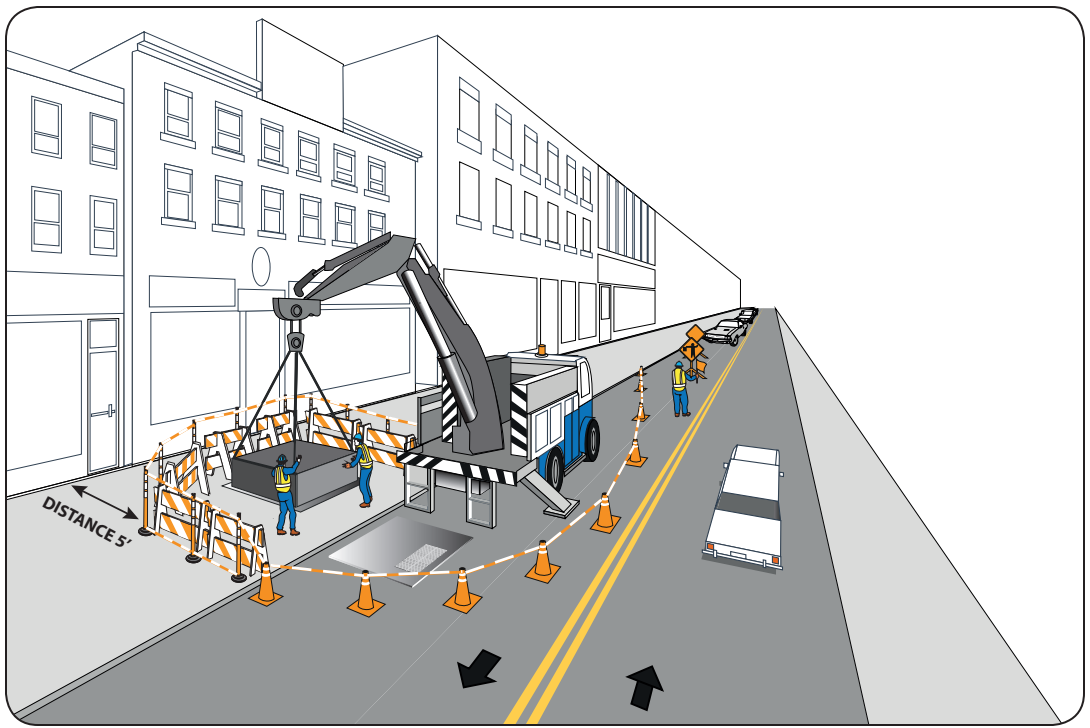
This configuration is generally applicable to comparable work areas with similar sidewalk conditions.

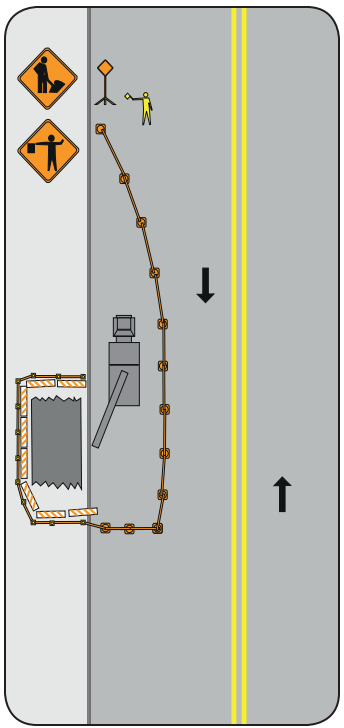
Setup

- Type 2 barricades (upper and lower rails) must be used in sidewalk area placed around the subsurface structure.
- Secure work area with cones/ telescoping rails combination in roadway.
- Install advance warning to pedestrians.
- Open underground structure covers.
- Use manhole guardrails when feasible.

Equipment

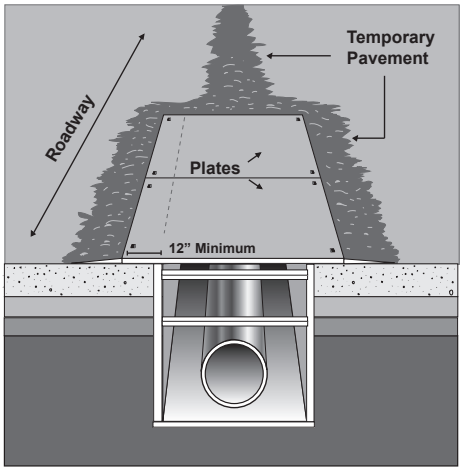
- Advance–warning sign (“Worker Symbol,” “Work Area Ahead,” or “Utility Work Ahead”)
- Flagger ahead sign
- Type 2 barricades
- 28” or 36” traffic cones
- Stanchions and telescoping rails





Blueprint of work area

Excavation Operations



Where operations require open trenches, plates should be used to maintain passageways for pedestrians and traffic lanes for vehicles.

- Plates must be large enough to span the opening, have a minimum bearing area one (1) foot wide on each side of the trench, and must be adequate to carry the load.
- Trench walls and adjacent soil must be sufficiently stable to use plates.
- Areas at the edge of plates must be tapered to provide smooth riding and safe walking conditions. ***It is important to avoid pedestrian tripping hazards or plate movement.***
- Plates must be fastened with spikes in pre-drilled holes, or spiked securely from the side to prevent movement off the openings.
- For wide trenches or unstable soil conditions, consider constructing temporary bridges.

Sign Placement During Winter Months and the Winter Moratorium

- Signs must be posted five feet prior to the steel plate(s) throughout the winter months, *regardless of weather conditions*.
- On two-way streets, signs must be posted on both sides of the street (i.e., on sidewalks) five feet prior to the steel plates.

The Winter Moratorium requires special handling of steel plates in travel lanes.

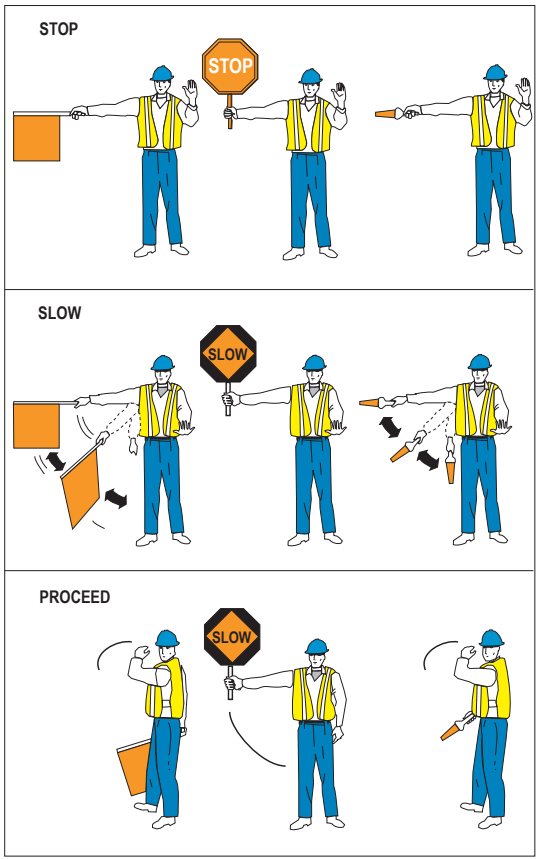
- Between December 1 and March 1, all steel plates in a travel lane must be recessed (countersunk), except if work can be completed within five working days from the permit work start date. In that case, steel plates can be pinned and ramped.
- Signs indicating Steel Plates Ahead or Raise Plow are required between December 1 and March 1, *even if steel plates are countersunk*.

Flagger at Work Sites

A flagger will be required for certain work operations where the traffic must be stopped or controlled. Flagging is a form of communication with the motorist. The language of flagging consists of only three signals: STOP, SLOW, and PROCEED.

When traffic in both directions must use a single lane for a limited distance, movements from each end must be coordinated. Provisions should be made for alternate one-way movement through the constricted section via methods such as flagger control, a flag transfer, a pilot car, traffic-control signals, or stop, or yield control. Control points at each end should be chosen to permit easy passing of opposing lanes of vehicles. If traffic on the affected one-lane roadway is not visible from one end to the other, then flagging procedures, a pilot car with a flagger, or a traffic-control signal should be used to control opposing traffic flows.

- Flaggers must wear approved safety apparel available in Class & Stock that is compliant with American National Standard for High-Visibility Apparel, ANSI 107-2010, ASTM 1506 HRC 1, Class 2 or 3 risk exposure.
- The flagger must be clearly visible at all times to approaching traffic for a distance sufficient to permit proper response by the motorist to the flagger's instructions and to permit traffic to reduce speed before entering the work zone.



- The "Flagger Ahead" sign must go before the flagger station, and the flagging station should be well ahead of the work area.
- The flagger station should be located at the start of the taper.
- The flagger should always face the oncoming traffic and make eye contact with the lead motorist.
- The flagger should stand alone, never permitting a group of workers to congregate around the flagger station.
- Flaggers will focus on the task at hand, directing traffic, and shall not be distracted by other factors, including, but not limited to, personal cell phones, electronic devices, and the like.
- When the situation requires the use of flags, only approved flags shall be used.
- When two flaggers are used, one flagger will be designated as the lead flagger.
- When two flagging stations are not visible to one another, radio communication is required or a third flagger may be stationed at a point visible in between each flagging station.
- If the flagging stations are too far apart for verbal communications, the flag transfer method of one-lane, two-way traffic control may be used. In this method, the driver of the last vehicle proceeding into the one-lane section is given a red flag and instructed to deliver it to the flagger at the other end. The opposite flagger, upon receipt of the flag, then knows that it is reasonably safe to allow traffic to move in the other direction.
- Flaggers must be illuminated at night.
- Floodlights must not produce a disabling glare condition for approaching road users, flaggers, or workers.

Stock Numbers and Descriptions

This list of stock numbers and device descriptions will help you identify the exact equipment needed to safely complete field operations.

Numbers	Description
059-6007	Chock galvanized steel
587-0894	Sign; Symbol of men working with case provided
024-7601	Sign; Bike lane ahead legend, 36" diamond shape, reflective
024-7619	Sign; Bike lane closed for work area protection
024-7429	Sign; Flagger ahead symbol, 36" diamond shape, reflective
024-7742	Sign; Lane closed ahead, 36"x36" diamond shaped
024-7510	Sign; Road closed
024-7486	Sign; Sidewalk closed
587-1298	Stand; Work area protection-advance warning
587-0491	Light; Portable compact rotary 360 degree beacon

Numbers	Description
059-4812	Guard; Manhole-sub surface protection devices
686-0274	Stanchion base
686-0282	Stanchion pole
059-1487	Tape; Safety barrier
059-5520	Retractable cone — bar extends from 6' to 10' orange white
NS0108630	Barricade; Rail
NS0108629	Barricade; A-frame
NS0108632	28" cone
NS0108631	36" cone
024-1984	Flag; Red danger
680-0107	Safety vest; S/M
680-0102	Safety vest; L/XL
680-0101	Safety vest; 2XL/3XL
587-1579	LED work area protection lights



May 2014

Hazard Communication (HAZCOM) Program

Policy and Purpose

GEI's policy is to furnish employees with a working environment safe from recognized hazards. This program is designed to provide GEI's compliance with OSHA's Federal Hazard Communication Standard (29 CFR 1910.1200 and 1926.59).

The GEI Hazard Communication (HAZCOM) Program has been compiled to provide guidelines meeting the requirements of OSHA's Hazard Communication Standard. This program addresses the evaluation of potential GEI workplace hazards and communication of these hazards to GEI employees.

Scope

In accordance with 29 CFR 1910.1200 and 1926.59, this program applies to any potentially hazardous chemical which is known to be present in the workplace in such a manner that employees may potentially be exposed under normal conditions of use. GEI employees speak and understand English; hazard communication is conveyed in English.

Location of Written Program

The written HAZCOM is located on the GEI Health and Safety intranet page.

Responsibilities

Overall coordination and implementation of GEI's HAZCOM Program is the responsibility of the CHSO. Any questions, comments, or suggestions relating to GEI's HAZCOM Program should be directed to the CHSO or the RHSOs. The following subsections delineate the responsibilities of personnel as required for successful implementation of this program.

Corporate Health and Safety Officer

The CHSO will:

- Develop and oversee implementation of the written HAZCOM Program.
- Track that field personnel engaged in hazardous waste operations receive OSHA 40-hour Health and Safety Training, 24-hour supervised on-the-job training, 8-hour Supervisory Training, and annual 8-hour Retraining as required by OSHA (29 CFR 1910.120 and 29 CFR 1926.65).
- Track that other personnel receive the general Health and Safety training and annual 4-hour refresher training as required by GEI.

Regional Health and Safety Officer

The RHSO will:

- Determine that all new employees in their region receive training in accordance with the GEI HAZCOM Program within 30 days of hire or prior to performing field work (whichever is sooner). This will be conducted in conjunction with the new employee health and safety orientation.
- Maintain at his/her office/branch an inventory of Safety Data Sheets (SDSs) as available for all hazardous materials with which employees have the potential of coming into contact with while on the job.
- Determine that SDSs are made readily available for employee review upon request by the employee.
- Determine that GEI's label and warning protocol for hazardous materials is complied with.
- Determine that field personnel are familiar with GEI's HAZCOM Program regarding chemical use and potential chemical exposures in the field.

Supervisors (Project Managers and/or Project Staff)

Project Managers and/or Field Team Leaders will:

- Develop and oversee completeness of site-specific HASPs for their projects.
- Implement the hazard communication programs and HASPs for their projects.
- Determine that field personnel are familiar with GEI's HAZCOM Program regarding site-specific chemical use and potential chemical exposures at the site.
- Determine that employees working on their project sites are familiar with site-specific HASPs and comply with the HASPs.
- Determine that copies of Safety Data sheets (SDS) for chemicals used in the field are attached to the final copy of the HASP and are reviewed by GEI field personnel.

Staff

It is the Staff's responsibility to:

- Read GEI's HAZCOM procedure within 30 days of employment by GEI or prior to performing field work for GEI (whichever is sooner).
- Gain familiarization with SDSs of those hazardous materials that they use or may be exposed to.
- Use information and measures learned from the GEI HAZCOM Program, including associated training and professional experiences, to protect themselves from adverse exposure to hazardous materials.

Program Requirements

Safety Data Sheets (MSDSs) and Chemical List

Safety Data Sheets (SDSs) will be obtained for each required chemical from the chemical manufacturer, supplier or vendor. Complete sets of SDSs for chemicals specific to each office/branch are maintained in each office and made readily available for review upon request by any employee. The content and location of the SDS binders varies by office location. SDS for the Denver Ecology laboratory are maintained in the lab under the direction of the Laboratory Manager.

The binders typically contain SDSs for:

- Chemicals that are typically used for decontamination. Supplies of these chemicals are generally kept in GEI field equipment storerooms.
- Chemicals that are typically used for sample preservation. Sample bottles typically come pre-preserved from the laboratories.
- Chemicals that may be encountered on typical GEI job sites such as decontamination chemicals and laboratory reagents. SDSs included in site-specific HASPs should be reviewed prior to performing field work on those sites.
- Chemicals used to calibrate instruments. These chemicals are generally kept in small quantities to be used only by instrument technical personnel.

If an employee needs an SDS for a specific chemical, they should contact the manufacturer (including searching the manufacturer's website) or distributor. If the chemical is a sample preservative, then the employee should contact the laboratory from which they ordered the glassware. SDSs must be retained for 30 years.

SDS for chemical products brought onto jobsites, such as laboratory reagents, decontamination supplies, and gasoline, diesel fuel or calibration gases, will be included in the site-specific HASP. GEI employees working on project sites with multiple employers will be given the opportunity to be informed of the chemicals at the project site through the Project Safety briefing conducted at the beginning on the project and through the safety briefings conducted during the project.

Before beginning a field assignment, an Activity Hazard Analysis (AHA) will be performed for each activity, routine and non-routine, which will be conducted by GEI personnel to determine what chemicals will be used. SDS will be included in the appendix of the Health and Safety Plan. Employees involved in non-routine tasks will discuss these tasks with the Project Manager, the CHSO or RHSO.

Label and Warnings

GEI's labeling system for containers of hazardous materials is as follows:

- Containers are labeled, tagged, or marked in a legible fashion, with the identity of the hazardous materials contained therein.
- Containers are labeled, tagged, or marked in a legible fashion with the appropriate hazard warnings. This warning may be of any type of message, words, pictures or symbols that convey the hazards of the chemical.
- All required container labels, tags and/or markings are legible.
- Labels are affixed to the container itself (vs. lid). Lids may also be labeled, but not in lieu of container labeling.
- GEI employees will not deface or remove labels from containers.

The GEI field equipment room maintenance technician is responsible that the GEI labeling system is complied with at his/her office location. Project Managers and project staff are responsible for determining that the GEI labeling system is complied with for the field portion of their projects.

Training

The GEI Office/Branch Manager is responsible for determining that the GEI personnel employed at his/her office/branch complies with the HAZCOM Program. Training records will be maintained for a minimum of three years.

GEI's HAZCOM Program training requirements are listed below:

- Newly hired employees who may use or be exposed to hazardous materials will be required to familiarize themselves with the GEI HAZCOM Program and with the SDSs associated with their job function.
  Employees will be required to attend a HAZCOM Program classroom training session as part of the annual HAZWOPER refresher training program or the general Health and Safety training program. Training will provide information on:

  - The physical and health hazards of the chemicals in the work area.
  - Methods and observations that may be used to detect the presence or release of a hazardous material.
  - Chemicals in the work area.
  - Measures employees can take to protect themselves from these hazards.
  - The details of the GEI HAZCOM Program, including an explanation of MSDSs and GEI's container labeling system.

Biennial Review

This program will be formally reviewed by the GEI CHSO and company management on a biennial basis or more frequently if the CHSO deems it necessary to promote personnel safety. The program will be revised as necessary for continuing compliance with the OSHA Federal Hazard Communication Standard.

Job Hazard Analysis

Task	Air Monitoring and Odor Control		
Revision Date	October 2023	**Client Name**	Consolidated Edison
Project Name	Former Woodworth Ave MGP Site	**Project Number**	2101005 and 2201010
Tools/Equipment Used	Hand tools, PID, Dustrack, Tripod with Enclosure, Biosolve® Pinkwater®, Sprayer		
Task Specific Training	Annual Safety Training (Hazwoper), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☒ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile ☐Respirator ☐Other		

JHA Prepared By: Jessie Papageorge	Date: 10/26/23	Approved by: Melissa Felter	Date:10/30/23

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carrying Equipment/Site Setup	Heavy lifting, strains/sprains, slip/trips/falls, pinch points	Non-Powered Hand Tools HS-008a, Manual Lifting HS-025, GEI Ergonomic Program	• Use proper lifting techniques • Check route for clearance of trip hazards • Wear appropriate footwear and gloves to protect hands against sharp edges and soft tissue injuries • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items • Use the buddy system when necessary
2. Site Walk	Slip/trips/falls, repetition	Hazard Identification HS-026, GEI Ergonomic Program	• Wear steel-toed boots and high visibility reflective vest when traversing work areas • Maintain good housekeeping in the work area to prevent slips, trips, and falls. • Maintain situational awareness and a high level of communication with others on site. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

3. Biosolve® Pinkwater® Mixing and Application	Chemical Contact	Hazard Identification HS-026	• Wear proper PPE during mixing and application including nitrile gloves and a face shield or chemical googles. • Dispose of gloves after use and wash hands.
4. Demobilize from Site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	Driving – Site Mobilization		
Revision Date	October 2023	**Client Name**	Consolidated Edison
Project Name	Former Woodworth Ave MGP Site	**Project Number**	2101005 and 2201010
Tools/Equipment Used	Rental/Fleet/Personal Vehicle		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☐Safety Glasses ☐Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☐ Gloves Nitrile ☐Respirator ☐Other		
JHA Prepared By: Jessie Papageorge	**Date: 10/25/23**	**Approved by: Melissa Felter**	**Date:10/30/23**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Inspect Vehicle	Slips/trips/falls	Hazard Identification HS-026, Driver Safety HS-004	• Walk around vehicle to inspect for any vehicle safety issues or hazards that could be within the travel path. • Adjust mirrors and seats prior to driving. • Becoming familiar with dashboard, center console, and steering controls. • Locate the turn signals, windshield wipers, lights, emergency flashers, and the heating, air conditioning, and defrost controls. • Use a spotter if needed when backing up.
2. Driving	Struck by/crushing hazards	Driver Safety SOP HS-004	• Employees must wear their safety belt while in a moving vehicle. • Employees will follow safe driving behaviors, which include limiting distractions such as manipulating radios or other equipment that may cause a distraction. Employees will not exceed the posted speed limit and will maintain a safe distance between other vehicles. • Use defensive driving techniques. • Avoid driving during hazardous weather conditions. • Driving distance and time after a 12-hour shift will not exceed 30 miles/48 km or 30 minutes (whichever is greater). • Vehicle accidents will be reported in accordance with GEI's

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

			accident reporting procedures.
3. Parking Vehicle	Struck by, crushing hazards, security	Driver Safety SOP HS-004	• Be aware of surrounding conditions. Park in designated areas or a safe area away from heavy equipment. • Position the vehicle in a manner which reduces or eliminates the need to operate the vehicle in reverse. Choose an easy-exit parking space, like pull-through or where no one else is parked. • Don't crowd neighboring vehicles; be sure to park your vehicle in the middle of your space. • Secure equipment and supplies in the trunk or where they cannot be seen. Or take items with you if they cannot be hidden. • If at night, park in well lit areas.
4. Site Entry	Slips/trips/falls, struck by, crushing	Working Around Heavy Equipment HS-018, Hazard Identification HS-026	• Don appropriate PPE prior to walking on site. • Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Avoid distractions like using cell phones while traversing the site.
5. Backing Up Vehicle	Struck by, crushing	Driver Safety HS-004	• Before entering your vehicle do a walk-around. Check for fences, poles, drop-offs, buildings, etc. • Know your clearances. While performing your walk-around also check for obstructions, low hanging eaves and tree limbs, wires, and any other potential clearance-related obstacles. • Use a spotter. Do not allow the spotter to be positioned directly behind your vehicle or walk backwards behind you while giving instructions. They should be off to the driver's side where you can see them in your side mirror.

Job Hazard Analysis

Task	Drum Handling/Staging		
Revision Date	October 2023	**Client Name**	Consolidated Edison
Project Name	Former Woodworth Ave MGP Site	**Project Number**	2101005 and 2201010
Tools/Equipment Used	Drum handling/drum dolly		
Task Specific Training	GEI Annual Safety Training (HAZWOPER), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile, Cut resistant ☒Respirator if action levels are exceeded ☐Other		
JHA Prepared By: Jessie Papageorge	**Date: 10/25/23**	**Approved by: Melissa Felter**	**Date: 10/30/23**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Mobilize On Site/Equipment Setup	Slips/trips/falls, stuck by, crushing hazards	Hazard Identification HS-026	• Wear PPE that properly fits, is in good condition, and is appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed to reach work areas.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective e: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Job Hazard Analysis
Task: Drum Handling/Staging
Project: Former Woodworth Ave MGP Site
Date: October 2023

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2. Moving/Staging Drums	Contaminant Contact, Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	Container Management HS–003 Manual Lifting HS–025 Ergonomic Program	• Wear proper PPE during sampling including nitrile gloves and safety glasses and face shield as appropriate. • Before moving, check the drum for damage and confirm the bung/lid is securely fastened. Use proper tools to secure. • Confirm the pathway you plan to take is clear and free from debris. • Confirm the drum trolley being used is in a good condition and is designed to handle the specific drum-type being handled; some drum trolleys cannot handle plastic open-top drums. • Do not attempt to move drums up and down steep slopes with manual equipment not intended for the application. • Operate drum hand trucks with a straight back using two hands and your leg if required by the design of the trolley; confirm no one is standing close to the load during manipulation. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help.
3. Demobilize from site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	**Excavation/Construction Observation**		
Revision Date	October 2023	**Client Name**	Consolidated Edison
Project Name	Former Woodworth Ave MGP Site	**Project Number**	2101005 and 2201010
Tools/Equipment Used	Field book, phone camera		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☒ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Refective Vest ☒Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☐ Gloves ☐Respirator ☐Other		

JHA Prepared By: Jessie Papageorge	**Date: 10/25/23**	**Approved by: Melissa Felter**	**Date: 10/30/23**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Mobilize on site	Heavy lifting, strains/sprains, slip/trips/falls, pinch points, struck by, crushing hazards	Working Around Heavy Equipment HS-018, Manual Lifting HS-025, Hazard Identification HS-026 GEI Ergonomic Program, GEI Personal Protective Equipment Program	• Don appropriate PPE that properly fits, is in good condition, and is suitable for the activities and hazards. • Check in with appropriate heavy equipment operator personnel as applicable. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed to reach work areas. • Use the buddy system when necessary

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Job Hazard Analysis
Task Name: Excavation/Construction Observation
Project: Former Woodworth Ave MGP Site
Date: October 2023

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2.Conducting project activities around/near heavy equipment operations	Slip/trips/falls, pinch points, struck by, crushing hazards, unstable or non-secured load, noise exposure	Noise Exposure HS-012, Traffic Hazards HS-016, Working Around Heavy Equipment HS-018, Hazard Identification HS-026 GEI Ergonomic Program, GEI Personal Protective Equipment Program,	• Wear hardhat, high visibility safety vest, steel-toed, steel-shank boots or EH-rated safety boots with coposie toe and shank, safety glasses, nitrile/neoprene gloves, and earplugs. • Identify yourself and your work location to heavy equipment operators so they may incorporate you into their operations. • Coordinate hand signals with operators and field staff. • Approach heavy equipment from the front so operator can see you • Stay alert! Pay attention to equipment backup alarms and swing radii. • Wear high visibility safety reflective vest when working near equipment and/or motor vehicle traffic. • Position yourself in a safe location when filling out logs or talking with contractor or other field staff. • Notify the contractor immediately if any problems arise. • Do not stand or sit under suspeneded loads or near any pressurized equipment lines. • Do not sit and stand near heavy equipment that is when materials are being unloaded, loaded, etc. • If a task requires inspection of materials, this should be done after they are securely stored. • Do not operate cellular telephones in the vicinity of heavy equipment operation.
3. Demobilize from site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	Groundwater Sampling – (Low Flow)		
Revision Date	October 2023	**Client Name**	Consolidated Edison
Project Name	Former Woodworth Ave MGP Site	**Project Number**	2101005 and 2201010
Tools/Equipment Used	Hand tools, pump, water level meter, battery		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile/Cut resistant ☐Respirator ☐Other		

JHA Prepared By: Jessie Papageorge	Date: 10/25/23	Approved by: Melissa Felter	Date: 10/30/23

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carry Equipment and Set-up	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary
2. Open Monitoring Well	Cuts/Scrapes, Insect Bites	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Use proper tools to open monitoring wells • Open casings slowly in case insects inhabit the area. • If insect nest is inside casing, open protective casing and see if insects will leave the area. Once the insects physically leave the area, contact project manager if problem persists. • If severely allergic to insects, have appropriate epinephrine on hand.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

			• Remain calm and still if a single stinging insect is flying around. (Swatting at an insect may cause it to sting.) • If you are attacked by several stinging insects at once, run to get away from them. (Bees release a chemical when they sting, which may attract other bees.) • Follow incident reporting procedures if first aid is needed.
3. Cut Tubing	Cuts/Scrapes, pinch points	Non-Powered Hand Tools HS-008a	• Keep free hand out of the way. • Secure work if cutting through thick material. • Use only sharp blades; dull blades require more force that results in less knife control. • Pull the knife through the object and away from your body; pulling motions are easier to manage. • Do not put the knife in your pocket. • Wear leather or Kevlar gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.
4. Deploy Water Level Meter	Awkward position, contaminant exposure	Hazard Identification HS– 026 Ergonomic Program	• Wear Nitrile/neoprene gloves and dispose of gloves after use and wash hands. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep control of the reel when deploying the probe. Avoid letting the probe drop quickly into the well. • Reel the probe up slowly to avoid splashes from contaminated groundwater or sediment. • Keep trafficked areas free from slip/trip/fall hazards.
5. Collect GW Reading/Samples	Awkward position, contaminant exposure	Hazard Identification HS– 026 Benzene Awareness Program Ergonomic Program	• Wear Nitrile/neoprene gloves and dispose of gloves after use and wash hands. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
6. Pack Groundwater Samples	Heavy lifting, cuts, or abrasions	Manual Lifting HS–025 Ergonomic Program	• Confirm that the lids on all bottles are tight (will not leak). • Place cushioning/absorbent material in the bottom of the cooler and then place the containers in the cooler with sufficient space to allow for the addition of cushioning between the containers. • Use proper dollies or other lifting tools. • Use proper lifting techniques. • Take regular breaks and do not work in unusual positions for long periods of time. • If glassware breaks, dispose of in puncture-resistant containers. Use cut resistant gloves to handle any broken glass.

7. Drum Purge Water	Contaminant Contact, Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	Container Management HS–003 Manual Lifting HS–025 Ergonomic Program	• Wear proper PPE during sampling including nitrile gloves and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards.
8. Equipment Decontamination	Contaminant Contact, Cuts or Abrasions, Slips/Trips/Falls	Hazard Identification HS–026 Benzene Awareness Program Ergonomic Program	• Wear nitrile gloves and glasses to provide eye protection from splashing. • Wash hands immediately after use. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
9. Equipment De-Mob	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary

Job Hazard Analysis

Task	**NAPL Gauging and Recovery**		
Revision Date	10/24/23	**Client Name**	Consolidated Edison
Project Name	Former Woodworth Ave MGP Site	**Project Number**	2101005 and 2201010
Tools/Equipment Used	Pump, generator, compressor, interface probe, tubing cutter, string		
Task Specific Training	GEI Annual Safety Training (HAZWOPER), First Aid/CPR		
Minimum PPE Required	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☒Hearing Protection ☐ Personal Flotation Device (PFD) ☒ Face Shield ☐ Chaps ☒ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile/Cut resistant ☐Respirator ☐Other		

JHA Prepared By: Melissa Felter	**Date: 10/24/2023**	**Approved by: Jessie Papageorge**	**Date: 10/25/23**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carry Equipment and Set-up	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary
2. Cut Tubing/String	Cuts/Scrapes, pinch points	Non-Powered Hand Tools HS-008a	• Keep free hand out of the way. • Secure work if cutting through thick material. • Use only sharp blades; dull blades require more force that results in less knife control. • Pull the knife through the object and away from your body; pulling motions are easier to manage. • Do not put the knife in your pocket. • Wear leather or Kevlar gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

3. Set up pump, generator and compressor, if needed.	Heavy Lifting, Slips/Trips/Falls	Manual Lifting HS–025 Ergonomic Program	• Check air compressor hoses before use. • Position the generator downwind of the work area. • Keep trafficked areas free from slip/trip/fall hazards.
4. Fuel generator	Heavy Lifting, Slips/Trips/Falls	Manual Lifting HS–025 Ergonomic Program	• Turn off the generator and allow to cool at least 15-minutes before refueling. • Gasoline used to refill the generator will be stored in an OSHA-approved portable fuel container (safety can).
5. Drum Purged NAPL	Contaminant Contact, Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	Container Management HS–003 Manual Lifting HS–025 Ergonomic Program Benzene Awareness Program	• Wear proper PPE during sampling including nitrile gloves, Tyvek or Tyvek apron with sleeves , and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards.
6. Equipment Decontamination	Contaminant Contact, Cuts or Abrasions, Slips/Trips/Falls	Hazard Identification HS–026 Benzene Awareness Program Ergonomic Program	• Wear nitrile gloves and glasses to provide eye protection from splashing. • Wash hands immediately after use. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
7. Equipment De-Mob	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary

Job Hazard Analysis

Task	Sediment Sampling – Hand Auger		
Revision Date	October 2023	**Client Name**	Consolidated Edison
Project Name	Former Woodworth Ave MGP Site	**Project Number**	2101005 and 2201010
Tools/Equipment Used	Hand Auger, Work Gloves, Sample Jars		
Task Specific Training	Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☒ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☒Hearing Protection ☒ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile/leather or cut resistant gloves ☐Respirator ☐Other		

JHA Prepared By: Jessie Papageorge	Date: 10/25/23	Approved by: Melissa Felter	Date: 10/30/23

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carry Equipment and Set-up	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries • Wear appropriate footwear • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items. • Use the buddy system when necessary
2. Hand Auger Use	Cuts and lacerations/pinch points	Non-Powered Hand Tools HS-008a	• Use proper lifting techniques. • Do not remove equipment guards on equipment. • Take regular breaks and do not work in unusual positions for long periods of time. • Inspect equipment or tools prior to use. Tag and remove from service if tool is damaged.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

3. Soil Sampling	Contaminant Exposure, Cuts/Scrapes, Repetition, Slips/Trips/Falls	Hazard Identification HS-026/Container Management HS-003	• Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Excavation entry will be allowed only with proper sloping or shoring. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
4. Drum Soil/Sediment Cutting	Contaminant Contact, Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	Container Management HS–003 Manual Lifting HS–025 Ergonomic Program	• Wear proper PPE during sampling including nitrile gloves and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards.
5. Pack Samples	Heavy lifting, cuts, or abrasions	Manual Lifting HS–025 Ergonomic Program	• Confirm that the lids on all bottles are tight (will not leak). • Place cushioning/absorbent material in the bottom of the cooler and then place the containers in the cooler with sufficient space to allow for the addition of cushioning between the containers. • Use proper dollies or other lifting tools. • Use proper lifting techniques. • Take regular breaks and do not work in unusual positions for long periods of time. • If glassware breaks, dispose of in puncture-resistant containers. Use cut resistant gloves to handle any broken glass.
6. Equipment Decontamination	Contaminant Contact, Cuts or Abrasions, Slips/Trips/Falls	Hazard Identification HS–026 Ergonomic Program	• Wear nitrile gloves and glasses to provide eye protection from splashing. • Wash hands immediately after use. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
7. Demobilize from site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	**Soil Sampling – Drill Rig**		
Revision Date	October 2023	**Client Name**	Consolidated Edison
Project Name	Former Woodworth Ave MGP Site	**Project Number**	2101005 and 2201010
Tools/Equipment Used	Geoprobe or Sonic Drill Rig (operated by subcontractor), PID, measuring tape, metal spoon/spatula		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Minimum PPE Required	☒ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☒Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile, Cut resistant ☒Respirator if action levels are exceeded ☐Other		
JHA Prepared By: Jessie Papageorge	**Date: October 2023**	**Approved by: Melissa Felter**	**Date: 10/30/23**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Mobilize On Site/Equipment Setup	Slips/trips/falls, stuck by, crushing hazards	Hazard Identification HS-026	• Wear PPE that properly fits, is in good condition, and is appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed to reach work areas.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2. Utility survey	Shock, Explosion, Fire	Utility Markout HS-014	• Ensure that all utilities have been properly marked prior to beginning work. • If a utility strike occurs, call the appropriate authorities immediately. Clear the area and do not delay.
3. Observe contractor activities	Struck by/crushing hazards	Working Around Heavy Equipment HS-018	• Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Coordinate hand signals with operators. • Confirm equipment inspection has been completed. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Position yourself in a safe location. • Confirm adequate clearance from overhead utilities. • Notify the contractor immediately if any problems arise. • Do not stand or sit under suspended loads or near any pressurized equipment lines. • Do not operate cellular telephones in the vicinity of heavy equipment operation.
4. Sample Soil	Contaminant Exposure, Cuts/Scrapes, Repetition, Slips/Trips/Falls	Hazard Identification HS-026/Container Management HS-003	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or composite toe and shank; safety glasses; Nitrile/neoprene gloves; and earplugs as necessary. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Excavation entry will be allowed only with proper sloping or shoring. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
5. Drum Soil Cuttings	Contaminant Contact, Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	Container Management HS–003 Manual Lifting HS–025 Ergonomic Program	• Wear proper PPE during sampling including nitrile gloves and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards.

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
6. Pack Soil Samples	Heavy lifting, cuts, or abrasions	Manual Lifting HS–025 Ergonomic Program	• Confirm that the lids on all bottles are tight (will not leak). • Place cushioning/absorbent material in the bottom of the cooler and then place the containers in the cooler with sufficient space to allow for the addition of cushioning between the containers. • Use proper dollies or other lifting tools. • Use proper lifting techniques. • Take regular breaks and do not work in unusual positions for long periods of time. • If glassware breaks, dispose of in puncture-resistant containers. Use cut resistant gloves to handle any broken glass.
7. Equipment Decontamination	Contaminant Contact, Cuts or Abrasions, Slips/Trips/Falls	Hazard Identification HS–026 Benzene Awareness Program Ergonomic Program	• Wear nitrile gloves and glasses to provide eye protection from splashing. • Wash hands immediately after use. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
8. Demobilize from site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

GEI Consultants

June 2020

Former Woodworth Avenue Works
HASP Addendum

Addendum 1

GEI added additional text to the utility clearance section to reflect the Human Performance Improvement (HPI) Tools.

The following Corporate Environmental, Health and Safety Procedures (CEHSP) document have been updated in the attached HASP to reflect the most current version.

Utility Clearance Process for Intrusive Activities – Corporate EH&S Remediation Program, Revision 3, – May 22, 2020.

GEI added corporate guidelines for performing field work activities throughout the COVID-19 coronavirus outbreak. Additional Con Edison guidelines to vendors for performing work in response to the COVID-19 outbreak have been added to the attached HASP.

GEI added additional text to the project description and hazard analyses to reflect the additional project work scope of surficial sediment sample collection and oversight of sewer video inspections.

Final

2.1 General

Engineer GEI Consultants, Inc., P.C. (GEI)
5586 Post Road, Suite 1
East Greenwich, RI 02818

Project Name Former Woodworth Avenue Works
Woodworth Avenue and Ashburton Avenue
Yonkers, New York

This Health and Safety Plan (HASP) establishes policies and procedures to protect GEI personnel from the potential hazards posed by the activities at the Former Woodworth Avenue Works located between Woodworth Avenue and Ashburton Avenue in Yonkers, New York. Reading of the HASP is required of on-site GEI personnel and will be reviewed by GEI subcontractors. Subcontractors for this project will be required to develop their own HASP for protection of their employees, but at a minimum must adhere to applicable requirements set forth in this HASP. GEI will verify that its subcontractor's HASP includes Con Edison's site-specific requirements, as outlined in this HASP. Additionally, federal, state and local representatives, as well as Con Edison employees may be required to sign and adhere to this HASP, depending on the nature of their presence onsite during activities conducted by GEI. The plan identifies measures to minimize accidents and injuries, which may result from project activities or during adverse weather conditions. Activities performed under this HASP will comply with applicable parts of OSHA Regulations, primarily 29 Code of Federal Regulations (CFR) Parts 1910 and 1926, and Con Edison policies and procedures. A copy of this HASP will be maintained on site for the duration of the work.

Included in Section 1 and Appendix A is a route to the nearest medical facility from the Site with directions and contact information. Safety data sheets (formerly known as Material Safety Data Sheets [MSDS]), specific to chemicals that may be used while working at the Site, are in Appendix B. Appendix C details the signs, symptoms, care and procedures to both heat and cold stress. Appendix D includes the Tailgate Safety Briefing form, the Project Safety Briefing form, the Accident/Incident Report Form and the Near Miss Reporting Form. Appendix E contains the GEI Health and Safety (H&S) Standard Operating Procedures (SOPs) that apply to this project, updated in June 2020. Appendix F contains the Con Edison Corporate Environmental, Health, and Safety Procedures that apply to this project. Appendix G contains the GEI's Hazard Communication (HAZCOM) Program. Appendix H contains Con Edison Coronavirus COVID-19 Guidelines. Appendix I contains the GEI Coronavirus COVID-19 Field Work Guidelines, dated April 2020.

2.2 Project Description

The project will include the installation of soil borings, test pits, subsurface soil sampling, installation and sampling of groundwater monitoring wells, installation of temporary soil vapor sampling probes, monitoring and recovery of dense nonaqueous phase liquids (DNAPL), video inspections of the sewer system, and collection of surficial sediment samples at low tide on the bank of the Hudson River. This RI is intended to determine the nature and extent of MGP-related by-products on the Former Woodworth Avenue Works Site. All investigation activities will be conducted in accordance with this Health and Safety Plan (HASP) and Field Sampling Plan (FSP).

Final

2.4 Con Edison Corporate Environmental, Health and Safety Procedures

GEI and GEI's Subcontractors agree to abide by the conditions of the Con Edison Corporate Environmental, Health, and Safety Procedures (CEHSPs) included in Appendix F of this HASP while conducting work at the Site. Specifically, the applicable CEHSPs included are:

- CEHSP E08.02 – Noise Construction and Utility Activities
- CEHSP S05.03 – Personal Protective Equipment – Protective Clothing
- CEHSP S12.00 – Lockout Tagout Procedures
- CEHSP S17.01 – Electrical Enclosed Spaces
- CEHSP A28.00 – Calling a Time Out
- CEHSP A32.00.01 – Rules We Live By, with 2016 (January 31, 2016) 'Rules' Table*
- Utility Clearance Manual for Intrusive Activities – Corporate EH&S Remediation Program, Revision 3, May 22, 2020
- Work Area Protection Field Manual
- Coronavirus (COVID-19) Guidelines

*Work at this Site will comply with the Central Operations Column of the Rules We Live By table.

4.1.1 Coronavirus (COVID-19)

GEI field employees will follow the COVID-19 Field Guidance in Appendix E.

Distancing
COVID-19 spreads from person-to-person primarily through droplets that are emitted from the initial person to a distance of 6 feet.

- Maintain a distance of at least 6 feet (2 meters) from others. This includes during site meetings and breaks and while performing work tasks. Meetings should be held outside or by phone/video.
- Minimize the number of employees in one location to the extent possible. Follow local restrictions for maximum number of people congregated in one location at a time.
- If tasks need to be performed close to others (within 6 feet) and that cannot be avoided, wear appropriate PPE including a face mask (surgical or cloth), gloves, and eye protection.
- NOTE: Face masks are not a substitute for distancing. Masks are meant to protect others in case you are infected. Contact the Safety Team (safetyteam@geiconsultants.com) to discuss any special circumstances and the PPE warranted.
- Wear nitrile gloves as much as practicable and change them frequently. As practicable, wash your hands or use sanitizer between glove changes. Wash your hands after wearing gloves.
- Minimize and stagger time in office spaces to performing essential duties such as picking up and dropping off equipment and samples. If you need to spend more time in a project

Final

office (e.g., a construction trailer), it's important that the workspace allows for proper social distancing.

- When traveling to project sites, travel in separate vehicles. Do not travel in the same vehicle.

Hygiene Practices

The hygiene practices we have been instructed to perform more routinely apply to performing field work as well, such as:

- Frequent hand washing with soap and warm water for 20 seconds. If soap and water are not readily available, use hand sanitizer (containing 60% alcohol) until soap and water can be used. If sanitizer is not available, bringing gallon containers of water and soap may be a good substitute.
- If you are filling water bottles (for drinking or hand washing) keep the bottle away from the spigot to avoid transfer of germs or contaminants.
- Wipe down surfaces with disinfectant on a routine basis (at least once per day). This includes field equipment and other items that may have previously been used by others. This is especially important while working in construction trailers. When using company and personal vehicles, wipe surfaces including the steering wheel, gear shifter, controls, and door handles before and after use.
- Wear nitrile gloves as frequently as possible. Hand washing is necessary after removing gloves.
- When greeting others avoid handshaking, hugging, or other personal contact. A greeting from a distance such as a wave is suggested.
- Avoid sharing field equipment and other materials with others. Before using field equipment or putting it away, wipe it down with disinfectant or wash it with soap and water. Note, use extra caution using disinfectants while collecting environmental samples to ensure that the samples are not compromised.

Table 2. Activity Hazard Analysis

General Hazards These Hazards Apply to All Site Activities	Control Measure
Coronavirus – COVID-19	• Maintain a distance of 6 feet from others. • If tasks needed to be performed close to others, limit time spent in close proximity. • When travelling to project site, travel in separate vehicles. • Frequent washing of hands with soap and warm water for 20 seconds. If soap is not available, use hand sanitizer with 60% alcohol. • Wipe down surfaces such as equipment surfaces, vehicle steering wheel, gear shifter, controls and door handles with disinfectant routinely before and after use. • Wear Nitrile gloves as frequently as possible. • Wash hands after gloves removal. • Avoid shaking hands, hugging, or other personal contact.

Final

Activity	Potential Hazard	Control Measures
Working near Water	Drowning, hypothermia	• While working near water stay inside guard rails and or barriers. • While working out of out of safety zones a personal flotation device (PFD) must be worn at all times and an approved 30-inch ring buoys will be readily available for emergency rescue operations. • Use appropriate fall protection. • Buddy system shall be in use. • See SOP HS-017

4.2.2.1 Underground Utilities

No excavating, drilling, boring, or other intrusive activities will be performed until an underground utility survey, conducted by knowledgeable persons or agencies, has been made. This survey will identify underground and in-workplace utilities such as the following:

- Electrical lines and appliances;
- Telephone lines;
- Cable television lines;
- Gas lines;
- Pipelines;
- Steam lines;
- Water lines;
- Sewer lines; and/or
- Pressurized air lines.

Please refer to GEI's SOP HS-014 Utility Mark Out (Appendix E) and Con Edison's – Utility Clearance Process for Intrusive Activities – Corporate EH&S Remediation Program (Appendix F). Dig Safely New York (Call 811) will be contacted to mark out utilities at the Site address prior to start of any intrusive activities. Be sure to have receipt of a utility mark out across the entire work area. Look for visible evidence of utility markings on the ground in the form of painted identifications for sewer, water, gas, communications, storm water, oil or petroleum, etc. It is required that prior to drilling, hand excavation occur, to minimally, 5 feet below ground surface, to pre-clear locations from utilities. Ensure that as part of the utility clearance process, the HPI Risk Assessment worksheet included in the Con Edison – Utility Clearance Process for Intrusive Activities is completed prior to the start of intrusive work.

The location of utilities will be discussed with GEI employees and subcontractors during a Site Safety Briefing. Identified utilities should be marked or access otherwise restricted to avoid chance of accidental contact.

Even when a utility search has been completed, drilling, boring, and excavation should commence with caution until advanced beyond the depth at which such utilities are usually located. Utilities will be considered "live" or active until reliable sources demonstrate otherwise.

Final

4.2.10 Working Near Water

The buddy system will be used when working near water, in which two persons operate as a single unit in order to monitor and assist each other in performing tasks. Personnel must be attired in a United States Coast Guard (USCG)-approved Type III or Type V work vest. The vest must be properly sized for the individual and must be secured. A throwable rescue device (Type IV personal flotation device [PFD] flotation aid) along with whatever equipment (i.e., ladders, lifting gear, or rescue boat) necessary will be immediately available to recover an individual from the water.

Waders may not be worn when working along, over, or in moving waters; or in waters influenced by tides or acted upon by waves when water depths exceed knee height unless specifically approved by the Safety Director. Waders may be worn in still waters and in water depths up to the waist, if bottom conditions are firm and well understood. Waders should never be worn aboard a watercraft.

Take special care on slippery rocks along shorelines, lakeshores, riverbanks, and creeks. Always look ahead at the ground when walking around the water's edge and avoid stepping on stones that have algal growth, especially those in intertidal areas, as these are extremely slippery. Employees should limit access to areas where these slip/fall hazards exist, especially in locations containing tidal water flow.

Table 4. Site-Specific PPE

Task	PPE Level	Site-Specific Requirements	Respirator
Mobilization/Demobilization			
Reconnaissance	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D - None
Mobilization/Demobilization of Equipment and Supplies	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D – None
Establishment of Site Security, Work Zones, and Staging Area	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D - None
Investigation/Construction			
Drilling,Groundwater Well Installation, Excavation, Backfilling, Sampling, Monitoring Well Repair, sediment sampling	D	Hard hat, safety glasses, steel toe/shank safety boot with overboot as needed, reflective vest, leather work gloves as needed, nitrile gloves, hearing protection as needed, Tyvek as needed, face coverings as required	Level D initially, Level C-If action levels exceeded (see Section 9 of HASP)
Remediation Observation			
Observe Contractor Activities	D	Hard hat, safety glasses, steel toe/shank safety boot with overboot as needed, reflective vest, leather work gloves as needed, nitrile gloves, hearing protection as needed, Tyvek as needed, face coverings as required	Level D initially, Level C-If action levels exceeded (see Section 9 of HASP)

Use of Level A or Level B PPE is not anticipated. If conditions indicating the need for Level A or Level B PPE are encountered, personnel will leave the Site and this HASP will be revised with oversight of the CHSO or GEI personnel will not re-enter the Site until conditions allow.

Final

Final

GEI Consultants

June 2020

Former Woodworth Avenue Works
HASP Addendum

Addendum 2

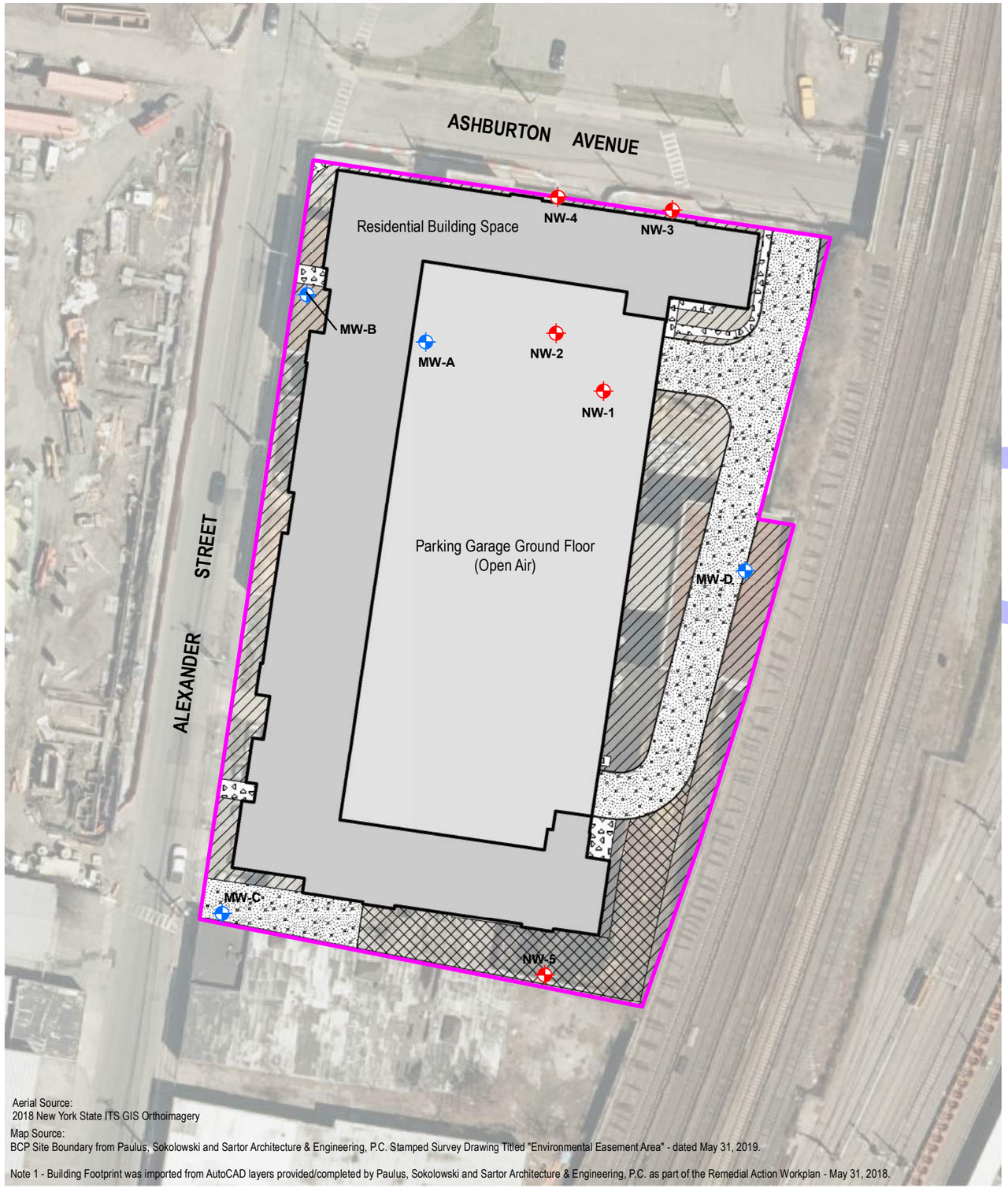
GEI added additional text describing dense nonaqueous phase liquids (DNAPL) monitoring and recovery at two adjacent properties. The attached figures show the additional locations.

APPROVED

2.2 Project Description

The project will include the installation of soil borings, test pits, subsurface soil sampling, installation and sampling of groundwater monitoring wells, installation of temporary soil vapor sampling probes, monitoring and recovery of dense nonaqueous phase liquids (DNAPL) onsite and at two adjacent properties, video inspections of the sewer system, and collection of surficial sediment samples at low tide on the bank of the Hudson River. This RI is intended to determine the nature and extent of MGP-related by-products on the Former Woodworth Avenue Works Site. All investigation activities will be conducted in accordance with this Health and Safety Plan (HASP) and Field Sampling Plan (FSP).

APPROVED



Aerial Source:
2018 New York State ITS GIS Orthoimagery

Map Source:
BCP Site Boundary from Paulus, Sokolowski and Sartor Architecture & Engineering, P.C. Stamped Survey Drawing Titled "Environmental Easement Area" - dated May 31, 2019.

Note 1 - Building Footprint was imported from AutoCAD layers provided/completed by Paulus, Sokolowski and Sartor Architecture & Engineering, P.C. as part of the Remedial Action Workplan - May 31, 2018.

APPROVED

LEGEND

- BCP SITE BOUNDARY
- RESIDENTIAL BUILDING SPACE
- PARKING GARAGE (OPEN AIR)
- SIDEWALK
- GRASS PAVER
- ASPHALT
- LANDSCAPED
- NAPL RECOVERY WELL LOCATION
- GROUNDWATER MONITORING WELL LOCATION

0 30 60 120

SCALE IN FEET

AKRF
34 S. Broadway #401, White Plains, NY 10601

Polychrome East
NYSDEC Site (BCP #C360098)
Yonkers, New York

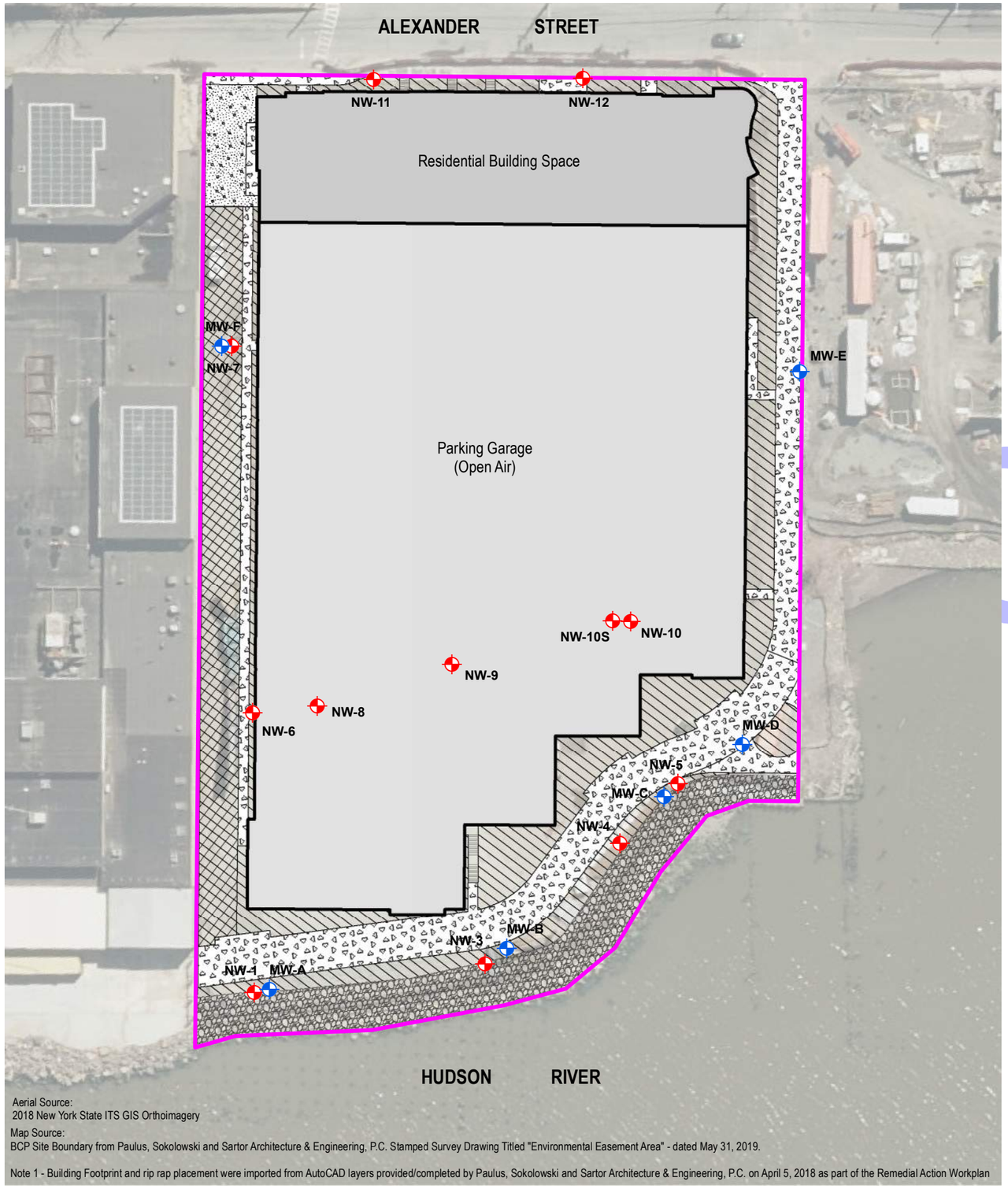
NAPL RECOVERY AND GROUNDWATER MONITORING WELLS

DATE
12/20/2019

PROJECT NO.
180132

FIGURE
7

©2019AKRF Q:\Projects\180132 - AVALONBAY YONKERS - BLD 3 - PCE\Technical\GIS and Graphics\Hazmat\FER\180132 Fig 7 NAPL Recovery and GW Wells.mxd12/20/2019 8:37:10 AM mvelleux



Aerial Source:
2018 New York State ITS GIS Orthoimagery

Map Source:
BCP Site Boundary from Paulus, Sokolowski and Sartor Architecture & Engineering, P.C. Stamped Survey Drawing Titled "Environmental Easement Area" - dated May 31, 2019.

Note 1 - Building Footprint and rip rap placement were imported from AutoCAD layers provided/completed by Paulus, Sokolowski and Sartor Architecture & Engineering, P.C. on April 5, 2018 as part of the Remedial Action Workplan

LEGEND

- BCP SITE
- RESIDENTIAL BUILDING
- PARKING GARAGE (OPEN
- ESPLANADE
- GRASS PAVER
- ASPHALT
- LANDSCAPED
- RIP RAP
- NAPL RECOVERY WELL
- GROUNDWATER MONITORING WELL LOCATION (SHALLOW NAPL RECOVERY)

0 30 60 120

SCALE IN FEET

APPROVED

AKRF
440 Park Avenue South, New York, NY 10016

Polychrome West
NYSDEC Site (BCP #C360099)
Yonkers, New York

NAPL RECOVERY & GROUNDWATER MONITORING WELL LOCATION PLAN

DATE
12/19/2019

PROJECT NO.
180017

FIGURE
7

©2019 AKRF Q:\Projects\180017 - AVALONBAY YONKERS - BLD 2 - PCW\Technical\GIS and Graphics\Hazmat\FER\180017 Fig 7 NAPL Recovery and GW Wells.mxd 12/19/2019 2:26:59 PM mvelleux

GEI Consultants

August 2022

Former Woodworth Avenue Works
HASP Addendum

Addendum 3

GEI added additional SDSs to Appendix B for additional decontamination fluids to be used at the Site.

SAFETY DATA SHEET

Version 6.6
Revision Date 05/24/2022
Print Date 06/18/2022

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Acetone

Product Number : 179124
Brand : SIGALD
Index-No. : 606-001-00-8
CAS-No. : 67-64-1

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 2), H225
Eye irritation (Category 2A), H319
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal Word Danger

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Hazard statement(s)

H225	Highly flammable liquid and vapor.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.

Precautionary statement(s)

P210	Keep away from heat/ sparks/ open flames/ hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing mist or vapors.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/ doctor if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Repeated exposure may cause skin dryness or cracking.

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula	:	C_3H_6O
Molecular weight	:	58.08 g/mol
CAS-No.	:	67-64-1
EC-No.	:	200-662-2
Index-No.	:	606-001-00-8

Component	Classification	Concentration
acetone		
	Flam. Liq. 2; Eye Irrit. 2A; STOT SE 3; H225, H319, H336 Concentration limits: >= 20 %: STOT SE 3, H336;	<= 100 %

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
Show this material safety data sheet to the doctor in attendance.

If inhaled
After inhalation: fresh air. Call in physician.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower.

In case of eye contact
After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed
After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Carbon dioxide (CO2) Foam Dry powder

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture
Carbon oxides
Combustible.
Pay attention to flashback.
Vapors are heavier than air and may spread along floors.
Development of hazardous combustion gases or vapours possible in the event of fire.
Forms explosive mixtures with air at ambient temperatures.

5.3 Advice for firefighters
In the event of fire, wear self-contained breathing apparatus.

5.4 Further information
Remove container from danger zone and cool with water. Prevent fire extinguishing water from contaminating surface water or the ground water system.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel: Do not breathe vapors, aerosols. Avoid substance contact. Ensure adequate ventilation. Keep away from heat and sources of ignition.
Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains. Risk of explosion.

6.3 Methods and materials for containment and cleaning up

Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up with liquid-absorbent material (e.g. Chemizorb®).
Dispose of properly. Clean up affected area.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling
Work under hood. Do not inhale substance/mixture. Avoid generation of vapours/aerosols.

Advice on protection against fire and explosion
Keep away from open flames, hot surfaces and sources of ignition.Take precautionary measures against static discharge.

Hygiene measures
Change contaminated clothing. Preventive skin protection recommended. Wash hands after working with substance.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Keep container tightly closed in a dry and well-ventilated place. Keep away from heat and sources of ignition.

Storage class
Storage class (TRGS 510): 3: Flammable liquids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Component	CAS-No.	Value	Control parameters	Basis
acetone	67-64-1	TWA	250 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Not classifiable as a human carcinogen		
		STEL	500 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Not classifiable as a human carcinogen		
		TWA	250 ppm 590 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1,000 ppm 2,400 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		C	3,000 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		PEL	500 ppm 1,200 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	750 ppm 1,780 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
acetone	67-64-1	Acetone	25 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

Predicted No Effect Concentration (PNEC)

Compartment	Value
Soil	33.3 mg/kg
Sea water	1.06 mg/l
Fresh water	10.6 mg/l
Sea sediment	3.04 mg/kg
Fresh water sediment	30.4 mg/kg
Onsite sewage treatment plant	100 mg/l

8.2 Exposure controls

Appropriate engineering controls

Change contaminated clothing. Preventive skin protection recommended. Wash hands after working with substance.

Personal protective equipment

Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Safety glasses

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Skin protection
This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Full contact
Material: butyl-rubber
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Butoject® (KCL 898)

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Splash contact
Material: Latex gloves
Minimum layer thickness: 0.6 mm
Break through time: 10 min
Material tested:Lapren® (KCL 706 / Aldrich Z677558, Size M)

Body Protection
Flame retardant antistatic protective clothing.

Respiratory protection
required when vapours/aerosols are generated.
Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Control of environmental exposure
Do not let product enter drains. Risk of explosion.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: clear, liquid Color: colorless
b)	Odor	pungent, weakly aromatic
c)	Odor Threshold	0.1 ppm
d)	pH	5 - 6 at 395 g/l at 20 °C (68 °F)
e)	Melting point/freezing point	Melting point/range: -94 °C (-137 °F) - lit.
f)	Initial boiling point and boiling range	56 °C 133 °F at 1,013 hPa - lit.
g)	Flash point	-17.0 °C (1.4 °F) - closed cup
h)	Evaporation rate	No data available
i)	Flammability (solid,	No data available

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

	gas)	
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 13 %(V) Lower explosion limit: 2 %(V)
k)	Vapor pressure	245.3 hPa at 20.0 °C (68.0 °F)
l)	Vapor density	No data available
m)	Density	0.791 g/cm3 at 25 °C (77 °F) - lit.
	Relative density	No data available
n)	Water solubility	soluble, in all proportions
o)	Partition coefficient: n-octanol/water	No data available
p)	Autoignition temperature	465.0 °C (869.0 °F)
q)	Decomposition temperature	Distillable in an undecomposed state at normal pressure.
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	none

9.2 Other safety information

Conductivity	0.01 µS/cm at 20 °C (68 °F)
Surface tension	23.2 mN/m at 20.0 °C (68.0 °F)

SECTION 10: Stability and reactivity

10.1 Reactivity

Vapors may form explosive mixture with air.

10.2 Chemical stability

The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions

Risk of ignition or formation of inflammable gases or vapours with:
chromosulfuric acid
chromyl chloride
ethanolamine
Fluorine
Strong oxidizing agents
strong reducing agents
Nitric acid
chromium(VI) oxide
Risk of explosion with:
nonmetallic oxyhalides
halogen-halogen compounds
Chloroform
nitrating acid
nitrosyl compounds

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

hydrogen peroxide
halogen oxides
organic nitro compounds
peroxi compounds
Exothermic reaction with:
Bromine
Alkali metals
alkali hydroxides
Halogenated hydrocarbon
Sulfur dichloride
phosphorous oxichloride

10.4 Conditions to avoid
Warming.

10.5 Incompatible materials
rubber, various plastics

10.6 Hazardous decomposition products
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - female - 5,800 mg/kg
Remarks: (ECHA)
LC50 Inhalation - Rat - 4 h - 76 mg/l - vapor

Remarks: Unconsciousness
Drowsiness
Dizziness
(External MSDS)
LD50 Dermal - Rabbit - 20,000 mg/kg
Remarks: (IUCLID)
No data available

Skin corrosion/irritation
Skin - Rabbit
Result: Mild skin irritation - 24 h
(Draize Test)
Remarks: (RTECS)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Eye irritation - 24 h
(Draize Test)
Remarks: (RTECS)

Respiratory or skin sensitization
Maximization Test - Guinea pig
Result: Not a skin sensitizer.
Remarks: (ECHA)
Chronic exposure may cause dermatitis.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Germ cell mutagenicity
Test Type: Mutagenicity (mammal cell test): chromosome aberration.
Test system: Chinese hamster ovary cells
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 473
Result: negative
Test Type: Ames test
Test system: Salmonella typhimurium
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 471
Result: negative
Test Type: In vitro mammalian cell gene mutation test
Test system: Mouse lymphoma test
Metabolic activation: without metabolic activation
Method: OECD Test Guideline 476
Result: negative

Carcinogenicity

IARC: No ingredient of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No ingredient of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
Inhalation - May cause drowsiness or dizziness. - Narcotic effects

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

11.2 Additional Information

RTECS: AL3150000
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

After absorption:

Headache
Salivation
Nausea
Vomiting
Dizziness
narcosis
Coma

Other dangerous properties can not be excluded.

Handle in accordance with good industrial hygiene and safety practice.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Kidney - Irregularities - Based on Human Evidence

Skin - Dermatitis - Based on Human Evidence

Kidney - Irregularities - Based on Human Evidence

Skin - Dermatitis - Based on Human Evidence

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	flow-through test LC50 - Pimephales promelas (fathead minnow) - 6,210 mg/l - 96 h (OECD Test Guideline 203)
Toxicity to daphnia and other aquatic invertebrates	static test LC50 - Daphnia pulex (Water flea) - 8,800 mg/l - 48 h Remarks: (ECHA)
Toxicity to algae	static test NOEC - M.aeruginosa - 530 mg/l - 8 d (DIN 38412) Remarks: (maximum permissible toxic concentration) (IUCLID)
Toxicity to bacteria	static test EC50 - activated sludge - 61.15 mg/l - 30 min (OECD Test Guideline 209)

12.2 Persistence and degradability

Biodegradability	aerobic - Exposure time 28 d Result: 91 % - Readily biodegradable. (OECD Test Guideline 301B)
Biochemical Oxygen Demand (BOD)	1,850 mg/g Remarks: (IUCLID)
Chemical Oxygen Demand (COD)	2,070 mg/g Remarks: (IUCLID)
Theoretical oxygen demand	2,200 mg/g Remarks: (Lit.)

12.3 Bioaccumulative potential

Does not bioaccumulate.

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Endocrine disrupting properties

No data available

12.7 Other adverse effects

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself. See www.retrologistik.com for processes regarding the return of chemicals and containers, or contact us there if you have further questions.

SECTION 14: Transport information

DOT (US)
UN number: 1090 Class: 3 Packing group: II
Proper shipping name: Acetone
Reportable Quantity (RQ): 5000 lbs
Poison Inhalation Hazard: No

IMDG
UN number: 1090 Class: 3 Packing group: II EMS-No: F-E, S-D
Proper shipping name: ACETONE

IATA
UN number: 1090 Class: 3 Packing group: II
Proper shipping name: Acetone

SECTION 15: Regulatory information

SARA 302 Components
This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Fire Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

SECTION 16: Other information

Further information
The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Copyright 2020 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.
The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

Version: 6.6 Revision Date: 05/24/2022 Print Date: 06/18/2022

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

COLGATE-PALMOLIVE Company
SAFETY DATA SHEET

AJAX CLEANER POWDER-OXYGEN BLEACH

This industrial Safety Data Sheet is not intended for consumers and does not address consumer use of the product. For information regarding consumer applications of this product, refer to the product label.

Version 1.1 SDS Number: 660000000222 Revision Date: 05/14/2015

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name : AJAX CLEANER POWDER-OXYGEN BLEACH

Product code : 200000017621

: B01809190000

Manufacturer or supplier's details

Company : Colgate-Palmolive Co
Commerical Consumer Group
191 East Hanover Avenue
Morristown, NJ 07960-3151

Telephone : US: Consumer Affairs - 1-800-468-6502

Emergency telephone number : For emergencies involving spill, leak, fire, exposure or accident call CHEMTREC (24hr) at (800) 424-9300 or (703) 527-3887.

Medical Emergency (24HR): For MEDICAL EMERGENCIES involving this product call: (888) 489-3861

Recommended use of the chemical and restrictions on use

Recommended use : A formulated multi-purpose cleaner

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Appearance	powder
Colour	off-white

GHS Classification

Acute toxicity (Inhalation) : Category 4

GHS Label element

Hazard pictograms :



Signal word : Warning

Hazard statements : H332 Harmful if inhaled.

Precautionary statements : **Prevention:**
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P271 Use only outdoors or in a well-ventilated area.
Response:
P304 + P340 + P312 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.

Potential Health Effects

Inhalation : May be harmful if inhaled.

Skin : May cause skin irritation upon prolonged contact.

Eyes : Causes eye irritation on direct contact.

Ingestion : May be harmful if swallowed in large quantities.

Aggravated Medical Condition : None known.

Carcinogenicity:

IARC No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

OSHA No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

NTP No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous components

Chemical Name	CAS-No.	Concentration (%)
LIMESTONE	1317-65-3	>= 90 - <= 100
SODIUM CARBONATE	497-19-8	>= 5 - < 10

SECTION 4. FIRST AID MEASURES

If inhaled : Remove victim to fresh air. Get medical attention, if symptoms persist.

In case of skin contact	:	Flush skin with large amounts of water. If irritation develops and persists, get medical attention.
In case of eye contact	:	Flush eyes with water at least 15 minutes. Get medical attention if eye irritation develops or persists.
If swallowed	:	Drink 8 ounces of clear water. Get medical attention.
Most important symptoms and effects, both acute and delayed	:	Harmful if inhaled.

SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Hazardous combustion products	:	No hazardous combustion products are known
Special protective equipment for firefighters	:	Self-contained breathing apparatus and full protective clothing should be worn when fighting chemical fires.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Use personal protection recommended in Section 8 of the SDS.
Methods and materials for containment and cleaning up	:	Cover with inert, absorbent material and remove to disposal container. Spill area may be slippery. Flush with plenty of water.

SECTION 7. HANDLING AND STORAGE

Conditions for safe storage	:	Store at controlled room temperature at 20-25°C (68-77°F).

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value type (Form of exposure)	Control parameters / Permissible concentration	Basis
LIMESTONE	1317-65-3	TWA (Respirable)	5 mg/m3	NIOSH REL
		TWA (total)	10 mg/m3	NIOSH REL
		TWA (Respirable)	5 mg/m3	NIOSH REL

		TWA (total)	10 mg/m3	NIOSH REL
		TWA (total dust)	15 mg/m3	OSHA Z-1
		TWA (respirable fraction)	5 mg/m3	OSHA Z-1
		TWA (Total dust)	15 mg/m3	OSHA P0
		TWA (respirable dust fraction)	5 mg/m3	OSHA P0

Engineering measures : In an industrial work environment, no special precautions or control measures are required.

Personal protective equipment

Respiratory protection : General and local exhaust ventilation is recommended to maintain vapor exposures below recommended limits. Where concentrations are above recommended limits or are unknown, appropriate respiratory protection should be worn. Follow OSHA respirator regulations (29 CFR 1910.134) and use NIOSH/MSHA approved respirators. Protection provided by air purifying respirators against exposure to any hazardous chemical is limited. Use a positive pressure air supplied respirator if there is any potential for uncontrolled release, exposure levels are unknown, or any other circumstance where air purifying respirators may not provide adequate protection.

Protective measures : In an industrial work environment, if a splash is likely, chemical goggles may be needed. Prolonged skin contact may require protective gloves. For consumer use, no unusual precautions are necessary.

Hygiene measures : In an industrial work environment, avoid eye and prolonged skin contact.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance : powder

Colour : off-white

pH : 10.4

Flash point : No data available

Density : 1.04 g/cm3

SECTION 10. STABILITY AND REACTIVITY

Possibility of hazardous reactions	:	Hazardous polymerisation does not occur.
Incompatible materials	:	Strong oxidizing agents
Hazardous decomposition products	:	None known.

SECTION 11. TOXICOLOGICAL INFORMATION

Acute toxicity

Harmful if inhaled.

Product:

Acute oral toxicity	:	Acute toxicity estimate : > 5,000 mg/kg Method: Calculation method
Acute inhalation toxicity	:	Acute toxicity estimate : 1.63 mg/l Exposure time: 4 h Test atmosphere: dust/mist Method: Calculation method

Components:

LIMESTONE:

Acute oral toxicity	:	LD50 (Rat): > 2,000 mg/kg Method: OECD Test Guideline 420
Acute inhalation toxicity	:	LC50 (Rabbit): > 3 mg/l Exposure time: 4 h Test atmosphere: dust/mist Method: OECD Test Guideline 403
Acute dermal toxicity	:	LD50 (Rat): > 2,000 mg/kg Method: OECD Test Guideline 402

SODIUM CARBONATE:

Acute oral toxicity	:	LD50 (Rat): 2,800 mg/kg
Acute inhalation toxicity	:	LC50 (Rabbit): 2.3 mg/l Exposure time: 2 h Test atmosphere: No information available. Method: No information available.
Acute dermal toxicity	:	LD50 (Rabbit): > 2,000 mg/kg Method: No information available.

Skin corrosion/irritation

Not classified based on available information.

Components:

LIMESTONE:

Result: No skin irritation

SODIUM CARBONATE:
Remarks: No data available

Serious eye damage/eye irritation

Not classified based on available information.

Components:

LIMESTONE:
Result: No eye irritation

SODIUM CARBONATE:
Result: Irritation to eyes, reversing within 21 days

Respiratory or skin sensitisation

Skin sensitisation: Not classified based on available information.
Respiratory sensitisation: Not classified based on available information.

Components:

LIMESTONE:
Exposure routes: Inhalation
Result: Does not cause respiratory sensitisation.

Exposure routes: Dermal
Result: Does not cause skin sensitisation.

SODIUM CARBONATE:
Exposure routes: Inhalation
Remarks: No data available

Exposure routes: Dermal
Remarks: No data available

Germ cell mutagenicity

Not classified based on available information.

Carcinogenicity

Not classified based on available information.

Reproductive toxicity

Not classified based on available information.

STOT - single exposure

Not classified based on available information.

STOT - repeated exposure

Not classified based on available information.

Aspiration toxicity

Not classified based on available information.

Further information

Product:

Remarks: This product has not been tested as a whole. However, this formula was reviewed by expert toxicologists in the Product Safety Assurance Department of Colgate-Palmolive and is determined to be safe for its intended use. This review has taken into consideration available safety-related information including information on individual ingredients, similar formulas and potential ingredient interactions. This review is a component of the hazard determination used to prepare the statements in Section 3 of the SDS.

SECTION 12. ECOLOGICAL INFORMATION

The product has not been tested as a whole for environmental toxicity. However, environmental information on the ingredients in this product have been reviewed by the Environmental, Health and Safety group of Colgate-Palmolive and determined to have an acceptable environmental profile. This evaluation is based on available information on individual ingredients, interactions of ingredients, and similar ingredients. Biodegradability claims are supported by data on ingredients (i.e., surfactants are biodegradable) or testing conducted on the final product (i.e., This product is biodegradable).

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal methods

Waste from residues : Any disposal practice must be in compliance with local, state and federal laws and regulations (contact local or state environment agency for specific rules). Do not dump in sewers, any body of water or on the ground.

SECTION 14. TRANSPORT INFORMATION

DOT : Not regulated.

TDG : Not regulated.

IATA : Not regulated.

IMDG : Not regulated.

International Regulation

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

National Regulations

SECTION 15. REGULATORY INFORMATION

OSHA Hazards : Combustible dust, Moderate skin irritant, Severe eye irritant

EPCRA - Emergency Planning and Community Right-to-Know Act

CERCLA Reportable Quantity

Components	CAS-No.	Component RQ (lbs)	Calculated product RQ (lbs)
SODIUM DODECYL BENZENE SULFONATE	25155-30-0	1000	*

*: Calculated RQ exceeds reasonably attainable upper limit.

SARA 304 Extremely Hazardous Substances Reportable Quantity

Components	CAS-No.	Component RQ (lbs)	Calculated product RQ (lbs)
SULFUR DIOXIDE	7446-09-5	500	*

*: Calculated RQ exceeds reasonably attainable upper limit.

SARA 311/312 Hazards : Acute Health Hazard

SARA 302 : No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 : This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Clean Air Act

This product does not contain any hazardous air pollutants (HAP), as defined by the U.S. Clean Air Act Section 12 (40 CFR 61).
This product does not contain any chemicals listed under the U.S. Clean Air Act Section 112(r) for Accidental Release Prevention (40 CFR 68.130, Subpart F).
This product does not contain any chemicals listed under the U.S. Clean Air Act Section 111 SOCMI Intermediate or Final VOC's (40 CFR 60.489).

Clean Water Act

The following Hazardous Substances are listed under the U.S. CleanWater Act, Section 311, Table 116.4A:

SODIUM DODECYL BENZENE SULFONATE	25155-30-0
Sulfuric Acid	SULFURIC ACID

The following Hazardous Chemicals are listed under the U.S. CleanWater Act, Section 311, Table 117.3:

SODIUM DODECYL BENZENE SULFONATE	25155-30-0
Sulfuric Acid	SULFURIC ACID

This product does not contain any toxic pollutants listed under the U.S. Clean Water Act Section 307

Massachusetts Right To Know

LIMESTONE	1317-65-3
SODIUM DODECYL BENZENE SULFONATE	25155-30-0
Sulfuric Acid	SULFURIC ACID
SULFUR DIOXIDE	7446-09-5

Pennsylvania Right To Know

LIMESTONE	1317-65-3
SODIUM CARBONATE	497-19-8
SODIUM DODECYL BENZENE SULFONATE	25155-30-0
Sulfuric Acid	SULFURIC ACID
SULFUR DIOXIDE	7446-09-5
SODIUM SULFATE	7757-82-6

New Jersey Right To Know

LIMESTONE	1317-65-3
SODIUM CARBONATE	497-19-8
SODIUM DODECYL BENZENE SULFONATE	25155-30-0

California Prop 65 : This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

The components of this product are reported in the following inventories:

TSCA : All ingredients in this product are listed on the TSCA Inventory or are not required to be listed on the TSCA Inventory.

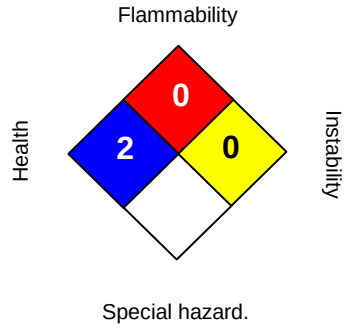
Inventories

AICS (Australia), DSL (Canada), IECSC (China), REACH (European Union), ENCS (Japan), ISHL (Japan), KECI (Korea), NZIoC (New Zealand), PICCS (Philippines), TSCA (USA)

SECTION 16. OTHER INFORMATION

Further information

NFPA:



HMIS III:

HEALTH	2
FLAMMABILITY	0
PHYSICAL HAZARD	0

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Disclaimer: The information on this sheet is limited to the material identified and is believed by the Colgate-Palmolive Company to be correct based on its knowledge and information as of the date noted. Colgate makes no representation, guarantee or warranty, expressed or implied, as to the accuracy, reliability or completeness of the information and assumes no responsibility for injury, damage or loss resulting from the use of the material.

GEI Consultants

February 2023

Former Woodworth Avenue Works
HASP Addendum

Addendum 4

GEI revised Section 2.2, Project Description, of the HASP to reflect the additional scope of work not previously covered under the HASP, as described in the proposed Interim Remedial Measure Work Plan

2.2 Project Description

The project is focused on remediation of MGP-impacted soil identified on Site in previous investigations. Remedial activities include the removal of MGP source material within the foundation of former Holder No. 2, immobilization of remaining MGP impacts within the former holder beneath the groundwater table with Controlled Low Strength Material (Flowable Fill), backfill with clean import fill material, and restoration of the disturbed area with asphalt pavement. Additional activities including the installation of soil borings, test pits, subsurface soil sampling, installation and sampling of groundwater monitoring wells, installation of temporary soil vapor sampling probes, monitoring and recovery of dense nonaqueous phase liquids (DNAPL), video inspections of the sewer system, and collection of sediment samples at low tide on the bank of the Hudson River may be performed through the ongoing work at the Site.

GEI Consultants

March 2023

Former Woodworth Avenue Works
HASP Addendum

Addendum 5

GEI revised Section 2.2, Project Description, of the HASP to reflect the additional scope of work not previously covered under the HASP, as described in the Well Decommissioning Work Plan. Activities include removing the existing well covers using a concrete saw or jack hammer, tremie-grouting the recovery wells, and restoring the ground surface. These activities are included in the existing HASP in Section 4 – Hazard/Risk Analysis, Table 2 - Activity Hazard Analysis under handling/mixing cement and drilling activities (pages 13 and 14).

2.2 Project Description

The project is focused on remediation of MGP-impacted soil identified on Site in previous investigations. Remedial activities include the removal of MGP source material within the foundation of former Holder No. 2, immobilization of remaining MGP impacts within the former holder beneath the groundwater table with Controlled Low Strength Material (Flowable Fill), backfill with clean import fill material, and restoration of the disturbed area with asphalt pavement. Additional activities including the installation of soil borings, test pits, subsurface soil sampling, installation and sampling of groundwater monitoring wells, installation of temporary soil vapor sampling probes, monitoring and recovery of dense nonaqueous phase liquids (DNAPL), well decommissioning, video inspections of the sewer system, and collection of sediment samples at low tide on the bank of the Hudson River may be performed through the ongoing work at the Site.

GEI Consultants

August 2023

Former Woodworth Avenue Works
HASP Addendum

Addendum 6

GEI revised the existing HASP Table 2 - Activity Hazard Analysis (Page 14), Table 4 – Site-Specific PPE (Page 36), and Appendix B – Safety Data Sheets, of the HASP to reflect the use of Biosolve® Pinkwater® for odor control during intrusive activities.

FINAL

Table 2. Activity Hazard Analysis

Activity	Potential Hazard	Control Measures
Biosolve® Pinkwater® Mixing and Application	Chemical Contact Wear proper PPE during mixing and application including nitrile gloves and a face shield or chemical googles.	• Wear proper PPE during mixing and application including nitrile gloves and a face shield or chemical googles. • Dispose of gloves after use and wash hands.

Table 4. Site-Specific PPE

Task	PPE Level	Site-Specific Requirements	Respirator
Odor Control			
Biosolve® Pinkwater® Mixing and Application	D	Face shield or chemical googles and nitrile gloves	D - None

FINAL

Safety Data Sheet

Section 1 – Chemical Products and Company Identification

Product Names: BioSolve® Pinkwater®

Product Uses: Remediation of hydrocarbon (oil, fuel, petrochemical) contamination, including: impacted soils, suppression of VOCs, decontamination of equipment and protective clothing, and surface washing

Manufacturer:
The BioSolve Company
24 Victory Lane
Dracut, MA 01826 USA

Contact Information:

+1 (800) 225-3909	US, Canada, Mexico and Puerto Rico
+1 (781) 482-7900	All other locations

Section 2 – Hazards Identification

Health Hazards:

Eye Contact:	Causes transient eye irritation
Skin Contact:	May cause mild, transient irritation
Ingestion:	May be harmful if swallowed; can cause gastrointestinal irritation, nausea, vomiting and/or diarrhea

Hazard Mitigation: Wear protective gloves and eye/face protection
Avoid prolonged breathing of spray

Environmental Hazards: Moderately toxic to aquatic life. Avoid discharge to storm drains and waterways

GHS Classification: Toxic to aquatic life, Acute Category 2

Section 3 – Composition/Information on Ingredients

Proprietary formulation with nonionic surfactants (32% active ingredients in water)

BioSolve products contain no caustic, d-limonene or hydrocarbon solvents.

BioSolve products do not contain any hazardous ingredients as defined by CERCLA, Massachusetts Right to Know Law and California Prop 65. All ingredients are TSCA compliant.

FINAL

Section 4 – First Aid Measures

Eyes: Immediately flush eyes with water for at least 15 minutes. Hold eyelids apart while flushing to rinse entire surface of eye and lids with water. Seek medical attention for lasting irritation.

Skin: Rinse exposed area and wash with mild soap and water for several minutes. Seek medical attention if irritation develops.

Ingestion: Seek medical attention in the event of serious or persistent abdominal discomfort, nausea or diarrhea.

Inhalation: Inhalation of concentrated vapors resulting from spraying or heating in confined or poorly ventilated areas may cause irritation of nose and throat. Remove person to fresh air and seek medical attention if irritation persists.

Section 5 – Fire Fighting Measures

Suitable Extinguishing Media: None required; BioSolve products are non-flammable

Special Protective Equipment for Firefighters: None necessary

Unusual Fire or Explosive Hazards: None

Section 6 – Accidental Release Measures

In case of accidental release, breakage or leakage: Eliminate or contain source with inert material, such as sand, earth, absorbent pads, etc. Transfer liquid to suitable containers for recovery, re-use or disposal. Wipe up or mop up using water. Hard surfaces (e.g., floors, driveways) may be slippery; use care to avoid falling.

Rinse area with water. Avoid flow of run-off to surface waters. Always check with local regulations before discharging effluent to storm drains or sewers.

Section 7 – Handling and Storage

Handling: Minimize periods of exposure to extreme temperatures. Keep from freezing. If frozen, separation may occur; thaw and stir thoroughly prior to use. Freezing will not affect product performance.

Precautions: Chemical resistant gloves and eye protection are recommended while mixing and using.

Incompatibilities: Avoid contact with strong acids or strong oxidants.

Storage: Recommended storage temperature: 35º – 120º F (1º – 48º C).

Shelf Life: If unopened, more than 10 years.

FINAL

Section 8 – Exposure Controls / Personal Protection

Eyes Protection: Safety glasses; chemical goggles or face shield recommended when spraying to protect against backsplash and drift.

Skin Protection: Rubber or latex gloves recommended.

Respiratory Protection: None required, except if application results in significant misting of product. If so, use of an approved air purifying respirator is recommended.

Engineering Controls: For indoor use or for use in a confined space, normal ventilation is generally satisfactory.

Section 9 – Physical and Chemical Properties

Appearance: Deep red

Odor: Mild, pleasant sassafras fragrance

Concentration: ~32% active ingredients as sold

Boiling Point	265°F/129°C	**Vapor Pressure mm/Hg**	Not available
Melting/Freezing Point	28°F/-2°C	**Vapor Density (Air=1)**	Not available
Flash Point	Non-flammable	**Surface Tension***	29 Dyne/cm @25°C
Flammability Limits	Not applicable	**Viscosity (concentrate)**	490 centipoise
Reactivity with Water	None	**Viscosity (6% solution)**	1.5 centipoise
Evaporation Rate	Not determined	**Solubility in Water**	100%
Specific Gravity	1.01 gms/cc	**VOC Content**	Not determined
	8.43 lbs/U.S. gal	**pH**	9

*6% solution

Section 10 – Stability and Reactivity

Chemical Stability: Stable; will not decompose if used according to manufacturer's directions.

Conditions to Avoid: Prolonged exposure to heat may cause product degradation. Freezing should also be avoided as discussed in Section 7.

Incompatible Materials: Normally unreactive. Avoid strong alkalis, strong acids, strong oxidizing agents and materials with reactive hydroxyl compounds. These materials could damage the product and reduce its effectiveness during application.

Hazardous Decomposition Products: None are known.

Hazardous Polymerization: Will not occur.

FINAL

Section 11 – Toxicological Information

Overview: No adverse acute or chronic health effects expected if product used in accordance with manufacturer's directions.

Carcinogenicity: No ingredient has been shown to cause cancer in laboratory animals.

Specific Organ Toxicity: None are known.

Section 12 – Ecological Considerations

Persistence and Degradability: The total of the organic components contained in this product is not classified as readily biodegradable (OECD-301 A-F). However, this product is inherently biodegradable with 60% degradation in 28 days (OECD-301B) and estimated >95% degradation in 120 days.

Bioaccumulation Potential: The bioaccumulation factor in fish has been estimated to be low, ranging from 87 to 344.

Mobility: No data available

Aquatic Toxicity:

LC_{50} of Concentrate (As shipped)		
Mysidopsis bahia	48-hours	3.6 mg/L
Menidia beryllina	96-hours	6.4 mg/L
LC50 of 3% Dilute Solution (As Used)		
Mysidopsis bahia	48-hours	185 mg/L
Menidia beryllina	96-hours	247 mg/L
LC50 of 6% Dilute Solution (As Used)		
Daphnia magna	48-hours	287 mg/L
Pimephales promelas	96-hours	124 mg/L
Onchorhynchus mykiss	96-hours	177 mg/L

Section 13 - Disposal

DO NOT DUMP INTO STORM DRAINS OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. As manufactured, BioSolve products do not meet the definition of a hazardous waste. Small quantities of unused and uncontaminated product may be discharged to a qualified wastewater treatment facility. Always obtain approval from local and Federal regulatory agencies prior to discarding this product into public sewers.

As your supplier, we have no control over your handling and use of this product. However, the intended use of this product as a remediation and/or surface washing agent may produce wastewater containing emulsified or dispersed hydrocarbons that may be classified as a hazardous waste and should be treated and disposed of accordingly.

FINAL

Section 14 – Transportation Information

USDOT Freight Class 55 (Liquid Cleaning Compound, Non-Hazardous)
This product is not regulated by USDOT or Canadian TDG when shipped domestically by land.

North American Industry Classification System (NAICS) # 325613

U.S. ITC, Harmonized Tariff Schedule B Classification: 3402.90.30.00

Section 15 – Regulatory Information

This product is considered non-hazardous as defined by CERCLA, according to OSHA, Massachusetts Right to Know Law and California Prop 65.

Toxic Substances Control Act:	All components of this product are on the TSCA inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30.
CEPA – Domestic Substances List:	All substances contained in this product are listed on the Canadian Domestic Substances List (DSL) or not required to be listed.
Canadian CPR Compliance:	This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the SDS contains all the information required by the CPR
WHMIS Classification:	D2B Eye or skin irritant

Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with Federal, state or provincial and local laws.

FINAL

Section 16 – Other Information

HMIS Rating	Health Hazard:	1 (Eye/Skin Irritant)
	Fire Hazard:	0
	Reactivity:	0
	Personal Protective Equipment:	Rubber gloves, safety glasses or face shield
NFPA Rating	Health:	1 (Eye/Skin Irritant)
	Flammability:	0
	Reactivity:	0
	Other Hazard:	None

BioSolve Pinkwater is on the US Environmental Protection Agency's NCP Product Schedule. This listing does NOT mean that EPA approves, recommends, licenses, certifies or authorizes the use of BioSolve Pinkwater on an oil discharge. This listing means only that data have been submitted to EPA as required by Subpart J of the National Contingency Plan, 40 CFR Section 300.915.

SDS Effective Date: January 1, 2021

The information contained herein is accurate to the best of our knowledge. The BioSolve Company makes no warranty of any kind, express or implied, concerning the safe use of this material in your process or application or in combination with other substances.

For more information, visit: www.biosolve.com

FINAL

GEI Consultants

June 2020

Former Woodworth Avenue Works
HASP Addendum

Addendum 7

GEI revised the HASP for the following:

- Updated GEI staff and contact information.
- Added an appendix for current Job Hazard Analyses (JHAs) and provided JHAs for the following:
    - Driving – Site Mobilization
    - Drum Handling or Staging
    - Excavation or Construction Observation
    - Groundwater Sampling (Low Flow)
    - NAPL Gauging and Recovery
    - Sediment Sampling – Hand Auger
    - Soil Sampling – Drill Rig
- Updated the Project description to separate current and future tasks.

Table 1. Emergency Information

Important Phone Numbers	
Local Police:	911
Fire Department:	911
Ambulance:	911
State Police or County Sheriff:	911
Hospital and Occupational Clinic Information *(See Attached Maps and Directions in Appendix A)*	
St. John Riverside Hospital: 2 Park Avenue Yonkers, NY 10703 **Sancia Health Care:** 10 Pallisade Avenue Yonkers, NY 10701	(914) 964-7300 (914) 423-4466
Contacts	
Project Manager: Melissa Felter	(860) 368-5328 office (860) 608-9717 cell
Corporate Health and Safety Officer: Steve Hawkins	(860) 368-5348 office (860) 916-4167 cell
Regional Health and Safety Officer: Jessie Papageorge	(973) 873-7117 office (862) 432-2283 cell
GEI People Team:	(781) 721-4117 Boston (916) 631-4596 Sacramento
Medcor Triage	1-800-775-5866
Client Contact: Melissa Reindl	(718) 204-4331 office (646) 860-5143 cell
Other Information	
Contractor Requesting/Performing Utility Clearance: Utility Clearance Ticket Number:	TBD
Nearest Telephone Location (or alternate means of communication)	On-site Cellular

2.2 Project Description

The project will include tasks associated with the investigation of the presence and extent of manufactured gas plant (MGP)-related by-products on the Former Woodworth Avenue Works Site. These activities will be conducted in accordance with this Health and Safety Plan (HASP) and Field Sampling Plan (FSP).

Current investigation activities include:

- Non-aqueous phase liquid (NAPL) recovery
- Soil sampling, Community Air Monitoring Program (CAMP), and odor control for excavations in right of ways (ROWs) (using Biosolve)

Future investigation activities include:

- Soil sampling via drill rig
- Groundwater sampling
- Sediment sampling (using a hand auger to two feet at low tide when sediment is exposed)

The site-specific tasks, potential hazards, and control measures established to reduce the risk of injury or illness are identified in step-by-step JHAs included in Appendix H. Prior to the start of work, project team members will determine what tasks are covered in the scope of work (described above) and then develop a JHA for each of these tasks and have them reviewed by the Project Manager (PM) or their designee and approved by a member of the Safety Team. Indicated in each JHA are the specific personal protective equipment (PPE), training, equipment, health and safety SOPs and programs that apply to each task.

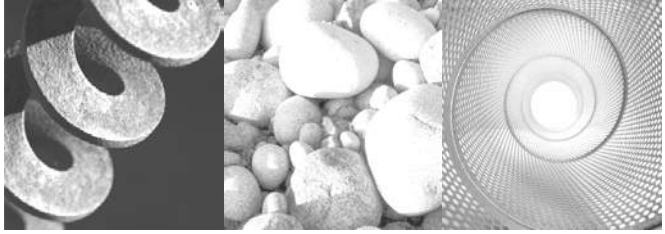
Addendums associated with prior changes in scope of work and other updates to the HASP are included as Appendix I.

6.1 GEI Personnel

• Melissa Felter, P.G	Project Manager
• Matthew O'Neil, P.E	Project Engineer
• Ricky Perryman	Site Safety Officer
• Steven Hawkins	Safety Director
• Jessie Papageorge	Regional Safety Manager

The implementation of health and safety at this project location will be the shared responsibility of the PM, the CHSO, the SSO, other GEI personnel implementing the proposed scope of work.

APPENDIX B – FIELD SAMPLING PLAN



GEI Consultants

Consulting
Engineers and
Scientists

Field Sampling Plan
Woodworth Avenue Works
Former MGP Site

Yonkers, New York
AOC Index No. CO0-20180516-519
Site #: 360164

Submitted to:
Consolidated Edison Co. of New York, Inc.
31-01 20th Avenue
Long Island City, NY 11105

Submitted by:
GEI Consultants, Inc., P.C.
455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
860-368-5300

September 2020
Project 1900674-4.1



Table of Contents

Section 1- Introduction

Section 2 - Pre-Mobilization Activities (PM)
PM-001 Public Utility Markout and Clearance (Rev. 2, June 2011)

Section 3 – Field Documentation (FD)
FD-001 Field Notebook (Rev. 2, June 2011)
FD-002 Field Observation Report (Rev. 2, June 2011)
FD-003 Sample Management and Chain of Custody (Rev. 3, June 2011)
FD-004 Photo Documentation (Rev. 2, June 2011)
FD-005 Field Observation of Bedrock Outcroppings (Rev. 2, June 2011)
FD-006 Handheld Global Positioning Receiver Operation (Rev. 2, June 2011)

Section 4 – Drilling Methods (DM)
DM-001 General Guidance on Determination of Appropriate Drilling Methods (Rev. 2, June 2011)
DM-002 Hollow-Stem Auger (Rev. 2, June 2011)
DM-004 Sonic Drilling (Rev. 2, June 2011)
DM-006 GeoProbe® Direct Push Boring (Rev. 2, June 2011)
DM-007 Monitoring Well Construction and Installation (Rev. 2, June 2011)
DM-009 Monitoring Well Development (Rev. 2, June 2011)
DM-0010 General Guidance on Monitoring Well Abandonment (Rev. 2, June 2011)

Section 5 – Sample Collection and Field Screening (SC)
SC-001 General Guidance on Sample Collection (Rev. 2, June 2011)
SC-002 Sample Handling (Rev. 3, June 2011)
SC-003 Investigation Derived Waste (Rev. 2, June 2011)
SC-004 Headspace VOC Screening (Rev. 2, June 2011)

Section 6 – Solid Matrix Sampling (SM)
SM-001 Soil Sampling Including Split-Spoon (Rev. 2, June 2011)
SM-002 VOC Soil Collection and Preservation Method (Rev. 2, June 2011)
SM-003 Soil Classification (Rev. 2, June 2011)
SM-004 Test Pit Excavation (Rev. 2, June 2011)

Section 7 – Groundwater (GW)
GW-001 Water Level and Non-Aqueous Phase Liquid (NAPL) Measurement (Rev. 3, September 2012)
GW-002 Non-Aqueous Phase Liquid (NAPL) Recovery (Rev. 3, September 2012)

GW-003 Low Flow (Low Stress) Groundwater Sampling (Rev. 2, June 2011)
GW-004 pH and Temperature Measurement (Rev. 2, June 2011)
GW-005 Turbidity Measurement (Rev. 2, June 2011)
GW-006 Specific Conductance Measurement (Rev. 2, June 2011)
GW-007 Dissolved Oxygen Measurement (Rev. 2, June 2011)
GW-008 Temporary Groundwater Sampling Points (Rev. 2, June 2011)
GW-010 Slug Test (Rev. 2, June 2011)
GW-011 Constant Head Permeability Test (Rev. 1, June 2011)
GW-014 Dense Non-Aqueous Phase Liquid (DNAPL) Measurement and Recovery (Rev. 1, June 2011)

Section 8 – Air Sampling and Monitoring (AR)

AR-001 General Guidance on Work Zone Monitoring Methods (Rev. 3, June 2013)
AR-002 Air Sampling for Dust (Particulate Matter) using the MIE DataRAM™ Real-Time Aerosol Monitor DataRam™ Real-time Aerosol Monitor (Portable) (Rev. 2, June 2011)
AR-003 Ambient Air Monitoring Method PM10 (Rev. 2, June 2011)
AR-004 PAHs in Ambient Air TO-13A (Rev. 2, June 2011)
AR-006 VOCs in Ambient Air In Summa Canisters (Rev. 1, June 2013)

Section 9 – Soil Gas Sampling (SG)

SG-001 General Guidance on Soil Vapor Intrusion Evaluations (Rev. 2, June 2011)
SG-002 Soil Vapor Sample Collection (Rev. 2, June 2011)
SG-003 Sub-Slab Soil Vapor Collection (Rev. 2, June 2011)
SG-004 Ambient Air Sample Collection (Rev. 2, June 2011)

Section 10 – Quality Control – Quality Assurance (QA)

QA-001 Equipment Decontamination (Rev. 2, June 2011)
QA-002 Field Quality Control Procedures (Rev. 4, Oct 2013)

MJF/ah
B:\Working\CON ED\1900674 Woodworth Ave MGP\Reports\RIWP\Final to NYSDEC Sept 2020\Appendices\AppA-Field Sampling Plan\FSP Cover and TOC.docx

Section 1

Introduction

STANDARD OPERATING PROCEDURE

1. Introduction

This document presents the Standard Operating Procedures (SOPs) for the Atlantic and New England Regions of GEI Consultants, Inc. (GEI). The primary intent of the document is to promote consistency in application of Standard Operating Procedures (SOPs) for environmental field and some office operations. Application and use of SOPs will be considered and may be discussed in annual staff reviews.

This SOP document encompasses a broad range of activities to improve the planning, implementation, and documentation of most environmental field and some office operations. The methodologies presented in this manual may not be applicable to site-specific situations. If you are uncertain about a procedure, confirm its adequacy with the project manager, client, and/or regulatory bodies to confirm that procedures are consistent with their expectations.

The document is organized according to the chronological sequence of typical work flow proceeding from project setup to field activities, data collection, and report preparation tasks.

Two types of documents are contained herein:

- General Guidance Procedures – Documents intended to be informative and not prescriptive. These documents are designed to provide necessary background information to adequately understand the process.
- Standard Operating Procedures – Documents intended to describe standard procedures and limitations.

2. SOP Layout Design

2.1. Header Information

- Each SOP contains within its name a two letter abbreviation of the general category in which it belongs (i.e. RE-001 means it is in Site Reconnaissance). The table of contents provides the definition for each abbreviation. The SOP name and number is provided in the header and footer of the document. The revision number is provided in the header of each SOP.
- The effective date is provided in the header of each SOP. The effective date provides the date when the revisions to the SOP are in effect and provides information as to the last time the SOP was updated. Each SOP should contain the most up-to-date version and effective date.

2.2. Footer Information

- Each footer contains the page number and total page numbers as well as a second reference to the SOP name. This should help organize and collate pages.

2.3. Body of Text

- Limitations are provided to describe precautions or common issues associated with the performance of the procedure.
- References provide sources consulted for development of the SOP.
- Attachments provide reference to external documentation that should be reviewed in conjunction with the SOP.
- At least one contact person is provided at the bottom of each SOP. These people should be contacted with any questions or comments on the particular SOP. The contact can clarify the SOP or edit as necessary.

2.4. Process for editing/updating SOPs

Should you need to make a global change to an existing SOP, the current .pdf version can be found on the Intranet.

In order to make your changes, you will need to request a WORD copy of the SOP from Andrea Hippler, Jerry Zak or Ryan Hoffman. Once you have made your changes, the SOP should be e-mailed to Jerry Zak, Andrea Hippler and Ryan Hoffman with a note as to what changed.

This document has been provided to all staff performing environmental field tasks for GEI's Atlantic and New England Regions.

3. Attachment

Attachment A – Acronym List

STANDARD OPERATING PROCEDURE

Abbreviations and Acronyms

AOC	Area of Concern
ASTM	American Society for Testing and Materials
BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethyl Benzene, Xylenes
CAMP	Community Air Monitoring Plan
CERCLA	Comprehensive Environmental Response, Cleanup, and Liability Act
CFR	Code of Federal Regulations
COC	Chain of Custody
DL	Detection Limit
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DQO	Data Quality Objectives
EC	Engineering Controls
EIS	Environmental Impact Study
EPA	Environmental Protection Agency
FID	Flame Ionization Detector
FS	Feasiblity Study
FWRIA	Fish and Wildlife Resources Impact Analysis
GAC	Granular Activated Carbon
GC/MS	Gas Chromatograph/Mass Spectrometer
GFAA	Graphite Furnace Atomic Absorption Spectrometry
GIS	Geographic Information Systems
GPR	Ground-penetrating Radar
HASP	Health and Safety Plan
HOC	Halogenated Organic Compound
HDPE	High Density Polyethylene
HPLC	High Pressure Liquid Chromatography
HSO	Health and Safety Officer
IC	Institutional Controls
ICP	Inductively Coupled Plasma Atomic Emission Spectrometry
IDW	Investigation Derived Waste
LEL	Lower Explosive Limit
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level (for EPA Drinking Water Standards)
MDL	Method Detection Limit
MGP	Manufactured Gas Plant
MSDS	Material Safety Data Sheet
NAPL	Non-aqueous Phase Liquids

NCP	National Contingency Plan
NPL	National Priority List
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
QHHEA	Qualitative Health and Human Exposure Assessment
RAO	Remedial Action Objectives
RAP	Remedial Action Plan
RCRA	Resource Conservation Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RFP	Request For Proposal
RP	Responsible Party
SARA	Superfund Amendments and Reauthorization Act
SCGs	Standards, Criteria, and Guidance
SMP	Site Management Plan
SOP	Standard Operating Procedure
SOW	Scope of Work or Statement of Work
SPLP	Synthetic Precipitate Leaching Procedure
STEL	Short-Term Exposure Limit
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compounds
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Indentified Compound from Mass Spectrometry
TOC	Total Organic Carbon
TOSCA	Toxic Substance Control Act
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
USGS	United States Geologic Survey
VOC	Volatile Organic Compounds
WP	Work Plan
XRF	X-Ray Fluorescence

MEASUREMENTS

ppm	Parts per million
ppb	Parts per billion

ppbv	Parts per billion by volume
ppmv	Parts per million by volume
bgs	Below Ground Surface
msl	Mean Sea Level
ppbv	Parts per billion by volume
µg/L	Microgram per liter
µg/Kg	Microgram per kilogram
µg/m3	Microgram per cubic meter
mg/L	Milligram per liter
mg/kg	Milligram per kilogram
Mf/L	Million fibers per liter

Section 2

Pre-Mobilization Activities (PM)

STANDARD OPERATING PROCEDURE

PM-001 Utility Markout and Clearance

1. Objective

Describe typical utility markout/clearance procedures prior to and during excavation. All markout procedures should be performed in accordance with local and state regulations.

Many states, by law, require that utility companies are notified before excavation begins. Actual procedures and requirements differ by state. City/state government may have additional requirements for utility markout procedures. Check the requirements in the locality before beginning. Also check with the GEI project manager to determine whether it is most appropriate for GEI or the drilling/excavation subcontractor to handle mark out and clearance.

2. Execution

Public Utility Markouts

- The drilling/excavation locations should be marked with white paint, stakes, or flags.
- The contractor should call the appropriate one call communication network for the state the work is being conducted in. Refer to the Reference section in this SOP for contact information. Contractors shall provide all necessary information to the one call system. Sample location maps may be provided to clarify sampling locations. The contractor shall provide GEI with the utility clearance ticket number.
- If necessary, contact the municipalities or other utility owners to mark their water, sewer, or other lines if they do not belong to the one call system. The contractor should keep a record of these calls.
- Utility plans, if available, should be obtained from the property owner or municipal offices.
- Prior to excavation, a visual check should be made that all utilities companies and municipalities have marked their locations. This includes looking for signs that a utility exists, and verifying that the markings agree with a visual check. If they do not, contact the appropriate utility to remark their locations.
- Utilities will generally only markout and clear utilities in roadways or other public property up to the property boundary. Owners of fiber optic cables, natural gas pipelines, and other high hazard utilities will often markout on private property if requested. The contractor should request this. See section on private utility clearance below.
- Public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation should adopt the American Public Works Association (APWA) Uniform Color Code using ANSI standard Z535.1 Safety Colors for temporary marking and utility identification, as follow:

The APWA Uniform Color Code

1. **White** – Proposed Excavation
2. **Pink** – Temporary Survey Markings
3. **Red** – Electric Power Lines, Cables, Conduit and Lighting Cables
4. **Yellow** – Gas, Oil, Steam, Petroleum & Gaseous Material
5. **Orange** – Communications, Alarm or Signal Lines, Cables or Conduit
6. **Blue** – Potable Water
7. **Purple** – Reclaimed Water, Irrigation and Slurry Lines
8. **Green** – Sewers and Drain Lines

However, not all organization do use these colors. Make sure the color scheme is understood.

- The excavator/contractor and consultant begins work on the scheduled work date and time (if all the facility operators have responded) taking care to find and preserve any markings that have been made.
- If markings may be disturbed during work, establish offset marks to create reference points for the underground utilities. Take photographs of the markings before starting work.
- When digging near a buried utility, the excavator/contractor and consultant should be aware of their proximity to the utility and use caution.
- If there is uncertainty about the accuracy of the markings or there are too many utilities in a given location to excavate or drill safely, consideration should be given to hand-digging the first few feet, vacuum excavation, or use of a utility location company as detailed below in Private Utility Markouts.
- Some clients may require hand or vacuum clearance to a minimum depth. Check with the GEI project manager.
- If exposing a utility, the excavator/contractor should provide proper support and protection for the utility to prevent damage. Contact the utility operator for support, guidance, or assistance.
- When the excavation is complete, the excavator/contractor should provide proper backfill for any utilities that have been exposed.

Private Utility Markouts

- Utility markouts on private property should follow the steps outlined above in public utility markouts with the additions below.
- If work is conducted on private property where public utilities may not provide markouts and the property owner cannot provide accurate utility plans, it is

recommended to use a company to determine the utility locations using one or more of the following technologies:

i. Electro-Magnetic (EM) device: This technology uses an electro-magnetic field in the subsurface to accurately locate metallic lines or non-metallic lines incorporating a metallic trace wire along their surface. The field is created either by direct contact to the pipe or tracewire, or by an induced current via radio waves.
ii. Sewer Sonde: For non-metallic lines where internal access is possible (such as clean-out ports in a sewer), a beacon or 'sonde' that emits a signal to the surface receiver as it is snaked through the pipe provides the same accuracy as the EM detector. If the internal condition of the pipe is desired, a camera can be deployed instead of a simple sonde.
iii. Ground Penetrating Radar (GPR): This technology involves radar waves reflecting to a surface receiver which provides a visual real-time map of the subsurface by which anomalies (such as pipes or tanks) may be detected. It has limitations in clay or wet soils and requires a skilled operator for interpretation. GPR should be considered for high risk utilities (e.g. PVC natural gas lines without trace wire) where line-of-sight project from site entry point to a kiosk or other building is uncertain.

- Utility markout on private property should include clearance for other types of underground structures such as underground storage tanks, septic systems, utility or access tunnels, and in-ground irrigation systems.

3. Limitations

- Markout notification time usually does not include holidays. Make sure holidays are considered and markout time is scheduled accordingly. Do not conduct excavation or drilling prior to the required wait time. Do not mark excavation locations using spray paint if it is raining or snowing enough so that the paint markings will be washed away. Consider using long stakes instead of paint if snow is predicted. Excavations within the tolerance zone should be performed with non-powered hand tools until the marked utility is exposed. The tolerance zone may be determined by the utilities, law or codes.
- When excavating close to an underground utility, it is good practice for the contractor/excavator to have a spotter assist and guide the machine operator.
- Take care not to damage the conduit or protective coating of a utility. If the excavator/contractor damages this, leave the damaged utility exposed and immediately call the utility owner.
- If contact to a gas utility occurs, notify police, fire, and emergency personnel, and evacuate employees and general public. No attempt should be made to tamper with or correct the damaged utility.

4. References

Connecticut
Name: Call-Before-You-Dig (CBYD)
Telephone: 1-800-922-4455
Website: www.cbyd.com
Wait time after notification: 2 business days (excluding holidays)
Expiration of markout: 30 days

Massachusetts, Maine, New Hampshire, Rhode Island and Vermont
Name: Dig Safe
Telephone: 1-888-DIG-SAFE or 811
Website: www.digsafe.com
Wait time after notification:
MA, ME, NH, and RI: 3 business days (excluding holidays)
VT: 2 business days (excluding holidays)
Expiration of markout: 30 days

New York State
Name: Dig Safely New York
Telephone: 1-800-962-7962
Website: www.digsafelynewyork.com
Wait time after notification: 2 business days (excluding holidays)
Expiration of markout: 30 days

New York City/Long Island
Name: New York City One Call Center
Telephone: 1-800-272-4480
Website: www.nycli1calldsi.com
Wait time after notification: 2 to 10 days (excluding holidays)
Expiration of markout: 30 days

New Jersey
Name: New Jersey One Call
Telephone: 1-800-272-1000
Website: www.nj1-call.org
Wait time after notification: 2 business days
Expiration of markout: 45 days

5. Attachment

Attachment A – Standard Utility Color Codes

6. Contact

Brian Conte
Anne Leifer

SOP PM-001

Attachment A – Standard Utility Color Codes

Color Code	Utility Description
Red	Electric
Yellow	Gas-Oil
Orange	Communications
Blue	Water
Green	Sewer
White	Proposed Excavation

Section 3

Field Documentation (FD)

STANDARD OPERATING PROCEDURE

FD-001 Field Notebook

1. Objective

Describe methods for documentation of field activities.

Documentation of site activities is a crucial part of the field investigation process. The field notebook serves as the record of field activities performed or observed during the project. It provides a factual basis for preparing field observation reports, if required, and reports to clients and regulatory agencies. Example field notes are provided in Attachment A.

2. Execution

- Use a separate all-weather bound notebook for each site/location/project number. Spiral notebooks should not be used because pages can be easily removed.
- Write neatly using black or blue pen, preferably a waterproof pen. Use of pencil is also acceptable only with approval of the project manager, such as in but not limited to, certain field conditions [e.g., cold or wet weather].
- Write the project name, project number, book number (i.e., 1 of 3), and date on the front cover. On the inside cover, identify the project name, project number, and "Return Book To:" the office address of the project manager.
- Number all of the pages of the field book starting with the first entry.
- Record activities as they occur. Record only facts and observations, regardless of whether they appear to be relevant at that time.
- Identify conditions or events that could affect/impede your ability to observe conditions (e.g. snow-covered ground surface, inability to access areas of interest).
- Neatly cross out mistakes using a single line and initial them. Erasures are not permitted.
    - If an error is made on an entry in the field notebook, the individual who made the entry should make the corrections. The corrections must be initialed and dated by the person making the correction.
- Sign or initial and date the bottom of every page with an entry if the project requires such documentation.
- Place a diagonal line through unused portions of a page.
- Record the following information upon each arrival at the site:
    - Date/time/weather.
    - GEI personnel.
    - Purpose of visit/daily objectives.
    - People (client, contractor, landowners, etc.) present upon GEI arrival.

- Record the following information during the course of the day:
  - Conversations with contractors/subcontractors, clients, visitors, GEI staff, landowners (site or abutters). If possible, record complete names, titles, and affiliations.
  - Time of arrival and departure of individuals.
  - Activities as they occur.

- Additional examples of observations to record may include and are not limited to:
  - Type and quantity of monitoring well construction materials used.
  - Use of field data sheets or electronic logging equipment (e.g. boring logs, monitoring well sampling logs, etc.).
  - Ambient air monitoring data.
  - Field equipment calibration information.
  - Locations and descriptions of sampling points.
  - Contractor/Subcontractor progress.
  - Sample media (soil, sediment, groundwater, etc.).
  - Sample collection method.
  - Number and volume of sample(s) collected and sample bottle preservatives used.
  - Sample identification number (s) and date and time of sample collection.
  - Approximate volume of groundwater removed before sampling.
  - Any field observations made such as pH, temperature, turbidity, conductivity, water level, etc.
  - References for maps and photographs of the sampling site(s).
  - Information pertaining to sample documentation: bottle lot numbers/ dates, method of sample shipments, chain-of custody record numbers, and overnight shipping numbers.
  - Surveying data (including sketches with north arrows).
  - Changes in weather.
  - Rationale for critical field decisions.
  - Recommendations made to the client representative and GEI Project Manager.
  - Site sketch of conditions at the end of the day.
  - Summary of work completed/work remaining.
  - Allow time at the end of the day to complete entries in the notebook.

3. References

New Jersey DEP Field Sampling Procedures Manual, August 2005.

ASFE Daily Field Report for Geotechnical Field Observation, 2nd Edition (2001), ASFE, Inc.

4. Attachments

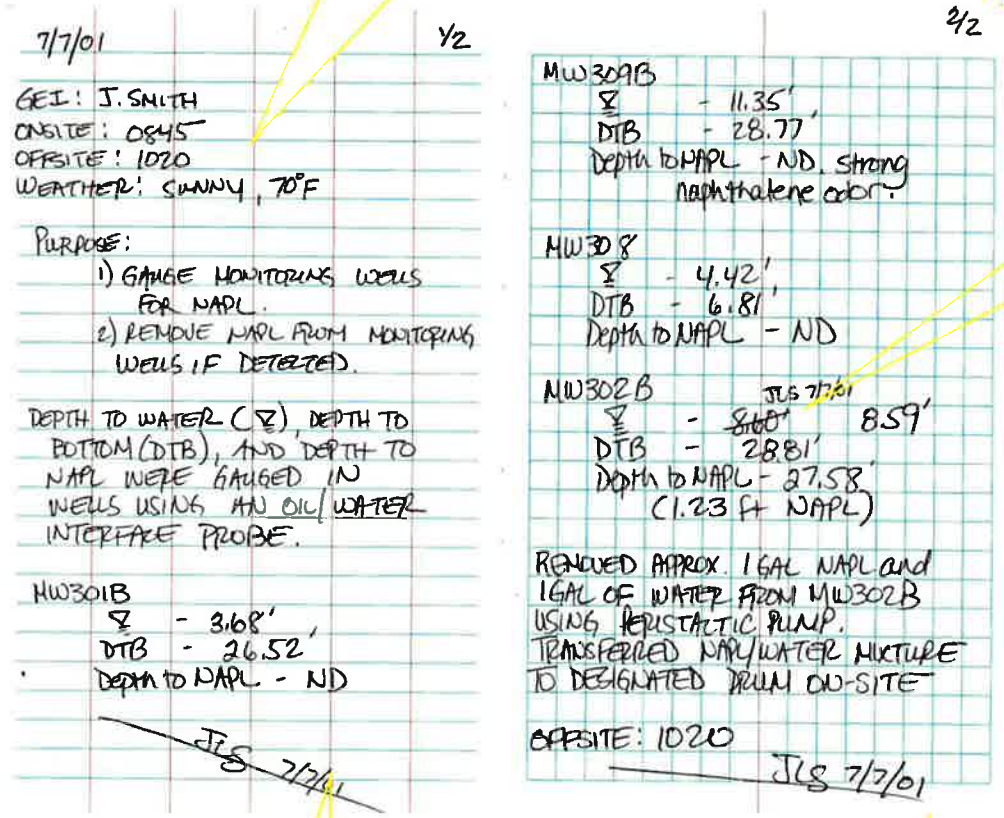
Attachment A - Example Field Notes

5. Contact

Melissa Felter
Leslie Lombardo

SOP FD-001

Attachment A – Example Field Notes



7/7/01 Y2

GEI: J. SMITH
ONSITE: 0845
OFFSITE: 1020
WEATHER: SUNNY, 70°F

PURPOSE:
1) GAUGE MONITORING WELLS FOR NAPL.
2) REMOVE NAPL FROM MONITORING WELLS IF DETECTED.

DEPTH TO WATER (▽), DEPTH TO BOTTOM (DTB), AND DEPTH TO NAPL WERE GAUGED IN WELLS USING AN OIL/WATER INTERFACE PROBE.

MW301B
▽ - 3.68'
DTB - 26.52'
DEPTH TO NAPL - ND

JLS 7/7/01

2/2

MW309B
▽ - 11.35'
DTB - 28.77'
DEPTH TO NAPL - ND. Strong naphthalene odor.

MW308
▽ - 4.42'
DTB - 6.81'
DEPTH TO NAPL - ND

MW302B JLS 7/7/01
▽ - ~~8.60'~~ 8.59'
DTB - 28.81'
DEPTH TO NAPL - 27.58'
(1.23 ft NAPL)

REMOVED APPROX. 1 GAL NAPL and 1 GAL OF WATER FROM MW302B USING PERISTALTIC PUMP. TRANSFERRED NAPL/WATER MIXTURE TO DESIGNATED DRUM ON-SITE

OFFSITE: 1020

JLS 7/7/01

Start of each day includes:
- **Date**
- **Project Number**
- **People on site**
- **Purpose of Work**
- **Weather Conditions**

Each page is numbered

Errors are single line crossed out and initialed

Blank Space crossed out and initialed

Bottom of each page signed and dated

GEI Consultants

STANDARD OPERATING PROCEDURE

FD-002 Field Observation Report

1. Objective

Describe methods to generate a Field Observation Report.

The Field Observation Report is used to record a summary of activities, observations, and decisions made during the day's field work. The daily field observation report serves as a permanent record of the day's activity for the Project Manager (PM), In-House Consultant (IHC), and/or client.

2. Execution

- If required, at the close of the day's field work, a Field Observation Report should be prepared by the individual responsible for the field notebook. This report should be completed before leaving work for the day. Contents of the report should include, at a minimum, the following information:
    - A record of person(s) present at the site, time of arrival, departure times (e.g., GEI, contractor(s), client, etc.).
    - A record of the daily objective(s) and the activities performed (e.g., drilled five borings in the overburden).
    - A summary of deviation(s) from the field plan or objectives.
    - A summary of field decisions made, who made them, and the basis for such decisions.
    - A diagram, sketch, and/or map showing the location and extent of the work or other significant observation(s) made during the day.
    - Recommendations that may result from field observations and actions that may result from implementation of those recommendations.
    - A summary listing and field sketch showing location(s) of field activity.
- Submit a draft report to the PM/IHC for review. Complete any editorial changes, sign, date, and submit the report to PM/IHC for approval/signature. Field Observation Reports should be written neatly. They are not required to be typed unless specifically requested by the PM.

3. Limitations

- The Field Observation Report is not a substitute for the field notebook.
- Not all projects require daily Field Observation Reports.
- The Field Observation Report should be based primarily on factual information. Opinions, if necessary, should be identified as such. Any speculation should be clearly noted in the report as such.

- The Field Observation Report should never be released to anyone other than the PM/IHC prior to review and sign-off unless explicitly authorized by the PM/IHC.

4. References

New Jersey DEP Field Sampling Procedures Manual, August 2005

ASFE Daily Field Report for Geotechnical Field Investigations, 2nd Edition (2001), ASFE, Inc.

5. Attachments

Attachment A - Example Field Observation Report

6. Contact

Melissa Felter
Leslie Lombardo

FIELD OBSERVATION REPORT

Project :	Guard Booth Upgrades	**Date:**	November 8, 2006
Client :	ACME Industries	**Report No.**	1
Contractor:	ABC Contracting	**Page:**	1 of 2
Subcontractor:	NA	**GEI Proj. No.**	99999-0

SOP FD-002 - Attachment A – Example Field Observation Report

Time of Arrival: 0700 **Departure: 1440** **Weather: Overcast, Raining, 55^{0}F**

Persons Contacted, Company
Jane Doe, ABC Contracting

GEI Representatives
Bill Smith

Purpose of Site Visit: To observe excavation of soils for new guard booth and sidewalk.

Observations:

1. **Excavation**
   a. Areas for guard booth and sidewalk were laid out by ABC with stakes, string, and spray paint. Locations were between the pavement and wetland area; no excavation occurred in the wetland area.
   b. Staging area for soil stockpile was located to the west of the excavation, along the fenceline; polyethylene sheeting was placed beneath the pile.
   c. HDPE membrane delivered to site; stored in garage area through the inside fence.
   d. ABC crew began hand digging area for sidewalk and guard booth. Sidewalk area measured 22 feet long by 4 feet wide by 4 inches deep. Guard booth area measured 12 feet long by 10 feet wide by 9 inches deep. Utility pole and bollard locations started today.
   e. Rain continued to get worse in the afternoon; ABC covered the entire excavation and soil stockpile with poly sheeting and secured the sheeting with grade stakes.

2. **Subgrade Preparation**
   a. Subgrade preparation for the sidewalk and guard booth areas at the site is complete.

3. **Dewatering**
   a. No dewatering occurred today.

4. **Air Monitoring**
   a. During excavation, I monitored the breathing zone of the workers with an organic vapor meter (OVM). No headspace readings were measured in soil samples S-1 through S-8.

GEI

FIELD OBSERVATION REPORT

Project :	Guard Booth Upgrades	**Date:**	November 8, 2006
Client :	ACME Industries	**Report No.**	1
Contractor:	ABC Contracting	**Page:**	2 of 2
Subcontractor:	NA	**GEI Proj. No.**	99999-0



Picture 1: Sidewalk excavation and bollard layout

By: Bill Smith	**Reviewed By:**

GEI

STANDARD OPERATING PROCEDURE

FD-003 Sample Management and Chain of Custody

1. Objective

Describe methods to label sample containers, manage the samples, and prepare Chain of Custody documentation for the samples. Sample transport is also addressed.

2. Project Setup

When setting up a sampling event, inform the recipients of the samples (laboratories) and recipients of laboratory results (data group and project managers). Discuss with the laboratory the sampling media, turnaround times, and reporting limits for appropriate regulatory criteria for the site. Include the data group on correspondence so that turnaround times, data validation, and project deliverable schedules can be tracked successfully.

- Laboratory - Number of samples, analyses needed: bottle orders and holding times, turnaround times needed, reporting limits needed for regulatory criteria.
- Data group - Number of samples, analyses requested, turnaround times and reporting limits requested, data validation needed, regulatory criteria to use for tabulating results, deliverables needed, and project name and number.
- Schedule - Inform the laboratory and Data Group of schedule delays, changes to analyses, and expediting.

3. Sampling Execution

- Review the work plan prior to sampling to determine the following:
  - Sample matrix and sampling method.
  - Required analysis and sample volumes.
  - Sample container type and preservative requirements.
  - Required analysis methods and/or report formats.
  - The turnaround time required by the project.
  - If the data will be sent directly from the laboratory to the data validator, Project Manager, or Data Group.
  - Holding time restrictions for sampling media and analytical methods.
  - Sample naming convention used for this project site.
- Sample labels should be filled out using a waterproof or permanent marker or pen. Required information includes:
  - Sample ID.
  - Date and time (military time) of sample collection.
  - Project number.
  - Sample preservatives.
  - Sampler's initials.
  - Laboratory analytical methods.

- Place the label on the jar or bottle, not on the cap. Sample custody begins at this time.
- Record the above information in the field notebook.
- Individually wrap sample jars with packing material, if needed. See SOP SC-002 for guidance on packaging samples for shipment to the laboratory by way of common carrier. Place samples in a cooler with bagged ice or freezer packs (blue ice) immediately after collection. Add sufficient ice or freezer packs to cool samples to approximately 4°C.
- Complete a chain of custody (COC) for the samples as described below. GEI or laboratory COCs may be used as long as they contain fields for all required sample information as described in Section 2.1.

3.1. Chain-of-Custody (COC) Completion

- Fill out COC neatly and in permanent ink. Alternatively, an Excel version of the GEI COC is available and can be filled out electronically.
- Certain analyses (i.e. air analysis by TO-15) require specialized, laboratory issued COCs. Make sure any specialized COCs are available before sample collection.
- Record the project name and number, the sampler's name(s) and the state where the samples were collected.
- For each sample, enter the sample identification number, date and time (military time) collected, the number of sample containers, and any additional information to fulfill project, client or regulatory requirements.
- Record the type of analysis (including laboratory method; e.g. EPA-SW846 Method XX) requested and the preservative (if appropriate) in the vertical boxes.
- Field duplicates should be anonymous to the laboratory, but must be recorded for use by the Data Group. To keep track of this information, link the field duplicate with the proper sample in the field notebook. If required by the Project Manager or Data Group, also document this information on or attach a note to the GEI copy of the COC.
- Trip blanks for large sites should be named similar to the samples they are collected with so that there are not two of the same sample name for the same site. For example, "OU1TB-122509" and "OU3TB-122509" would avoid any mistakes.
- Strike incorrect entries on the COC with a single line, followed by the initials of the person making the correction, the date, and the correct entry.
- When sample custody is ready to be relinquished, complete the bottom of the form with date and time (military time) and signatures of relinquisher and receiver of samples as indicated. The sample collector is always the first signature while the analytical laboratory is the final signature. Theoretically, all individuals handling the samples between collection and laboratory should sign the form; however, if a common carrier (i.e., Federal Express, UPS) is used for shipping, GEI must identify the carrier in the 'Received by' box on the

COC. If the sampler hand delivers the samples to the laboratory, the received box must be signed by the laboratory.

- If the samples are placed in a designated secure area (e.g. GEI sample fridge), note this location in the "Received by" box on the COC.
- GEI uses both single sheet and triplicate COCs. If using the triplicate COCs (white, yellow, and pink copies), the pink copy should be retained by the sampling personnel and provided to the Data Group for proper filing. The white and yellow copies should accompany the samples to the laboratory.
- If you are using the single sheet COC, make a copy of the COC after it has been signed by the lab courier and forward it to the Data Group.
- Prior to sample shipment by common carrier, the COC must be placed inside the cooler in a Ziplock bag or other watertight package.
- If a common carrier such as FedEx is used to transport the samples to the laboratory, include the carrier tracking number and identify the carrier in the "Received by" box on the COC.
- If a courier is used to transport samples to the laboratory (lab courier or GEI personnel), the courier signs the COC in the "Received by" box.
- Place a custody seal on the cooler if shipping via common carrier.
- Transport samples to the laboratory as soon as possible. It is preferable to transport the samples directly to the laboratory from the field. Samples brought back to the office for storage prior to submission to the laboratory must be kept cold (4° C).
- Unused sampling containers/media that are sent back to the lab should be included on a separate COC.
- After the samples are sent to the laboratory, the GEI copy of the COC must be forwarded to the Data Group: datagroup@geiconsultants.com.

4. Limitations

- Keep the number of people involved in handling samples to a minimum.
- Where practical, only allow people associated with the project to handle the samples.
- Always document the transfer of samples from one person to another on the COC.
- The COC should always accompany the samples.
- Give samples positive identification at all times that is legible and written with waterproof or permanent ink.
- When sending samples via a common carrier, use one COC per package.
- Where practical, avoid sending samples from more than one site with separate COCs in a single package.

5. References

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

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

6. Attachments

Attachment A - Example Chains of Custody
Attachment B - Shipping Info Pics

7. Contact

Brian Skelly
Leslie Lombardo

Chain of Custody Record

STL Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Tel: 203-929-8140

Example COC

SEVERN TRENT STL
Severn Trent Laboratories, Inc.

STL-4124 (0901)

Client: GEI	Project Manager: Dave Terry	Date: 12-31-07	Chain of Custody Number: 00452
Address: 455 Winding Brook Dr	Telephone Number (Area Code)/Fax Number: 860 368 5300 / 860 368 5307		Lab Number:
City: Glastonbury / State: CT / Zip Code: 06033	Site Contact: M. Felter	Lab Contact: Paul Hobart	Page 1 of 1
Project Name and Location (State): Carroll Gardens NY	Carrier/Waybill Number: FedEx 9383 7603 0879		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H_2SO_4	HNO_3	HCl	NaOH	ZnAc/NaOH	Analysis: VOC 8260B	SVOC 8270C	TO-15 + NAPHTHALENE	Special Instructions/ Conditions of Receipt
CGSB-01 (0-2)	12-31-07	1130				X	X						X	X		
CGSB-02 (3-4)	12-31-07	1250				X	X						X	X		
CGSB-02 (3-4) MS	12-31-07	1250				X	X						X	X		
CGSB-02 (3-4) MSD	12-31-07	1250				X	X						X	X		
CGSB-XX (5-6)	12-31-07	0800				X	X						X	X		
CGTB-123107	12-31-07	1400				TB				X			X			
CGGW-01	12-31-07	1430		X			X			X			X	X		
CGSG-01	12-31-07	0700-1500	X												X	CANISTER# 2613 REGULATOR# 779

BY NEW JERSEY: "CLP data package deliverables"

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other See Contract

QC Requirements (Specify): NYS Cat B ASP deliverable send to Lorie Mackinnon Send EDD to datagroup@geiconsultants.com

1. Relinquished By: Melissa J Felter	Date: 12-31-07	Time: 1600	1. Received By: FedEx Waybill 923117-4432	Date: 12-31-07	Time:
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments: USED FLOW CONTROLLER FOR AIR SAMPLE INCLUDED

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

EXAMPLE COC

Chain-of-Custody Record

Laboratory: Accutest

Laboratory Job # (Lab use only)

GEI Consultants
400 Unicorn Park Dr.
Woburn, MA 01801
PH: 781.721.4000
FX: 781.721.4073

Project Information

Project Name: MWRA - Low Service Storage Tank

Project Location: Stoneham, MA

Project Number: 093400

Project Manager: D. Aghjayan

Send Report to: rseigener@geiconsultants.com

Send EDD to: labdata@geiconsultants.com

MCP PRESUMPTIVE CERTAINTY REQUIRED – YES NO

If Yes, Are MCP Analytical Methods Required? YES NO NA

If Yes, Are Drinking Water Samples Submitted? YES NO NA

If Yes, Have You Met Minimum Field QC Requirements? YES NO NA

Lab Sample Number	GEI Sample ID	Collection Date	Collection Time	Matrix	No. of Bottles	Sampler(s) Initials	Preservative	PCBs	VPH Fractions Only	EPH Fractions Only	SVOCs	VOCs, % Solids**	Conductivity	RCRA 8 Metals*	TPH by GC/FID DRO
								None	MeOH	None	None	MeOH	None	None	None
	093400-LS6-S5(19'-21')	12/29/2009	9:30	SO	3	JMR			x			x			
	093400-LS6-COMP (FILL)	12/29/2009	9:30	SO	1	JMR		x		x	x		x	x	x
	093400-LS6-COMP (NATIVE)	12/29/2009	15:00	SO	1	JMR		x		x	x		x	x	x
	093400-LS8-COMP	12/29/2009	14:00	SO	1	JMR		x		x	x		x	x	x
	093400-LS9-S4 (8'-8'-5")	12/30/2009	14:30	SO	3	JMR			x			x			
	093400-LS9-COMP	12/30/2009	15:00	SO	1	JMR		x		x	x		x	x	x

Sample Handling

Samples Field Filtered
YES NO NA

Sampled Shipped With Ice
YES NO

Sample Specific Remarks

MCP Level Needed: GEI requires the most stringent Method 1 MCP standard be met for all analytes whenever possible.

Relinquished by: (signature)	Date:	Time:	Received by: (signature)
1. Joseph M. Pigeon	12/30/09	16:30	1. GEI FRIDGE
2. GEI FRIDGE	1/4/10	1310	2. Naomi Gleyzer
3. Naomi Gleyzer	1/4/10	1310	3. [illegible]
4.			4.

Turnaround Time (Business days):

Normal _X_ Other ____

10-Day ____ 7-Day ____

5-Day ____ 3-Day ____

Before submitting rush turnaround samples, you must notify the laboratory to confirm that the TAT can be achieved.

Additional Requirements/Comments/Remarks:

Please use MA Landfill List

* Please run TCLP analysis for RCRA 8 Metals results that exceed the 20 times rule.

** Please use % solids sample for VOC and VPH analysis of 093400-LS6-COMP (FILL), 093400-LS6-COMP (NATIVE), 093400-LS8-COMP, and 093400-LS9-COMP

Chain-of-Custody Record

Laboratory:

Laboratory Job # (Lab use only)

GEI Consultants
455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
PH: 860.368.5300
FX: 860.368.5307

Project Information

Project Name/Number:

Project Location:

Project Contact:

Phone Number:

Page __ of __

Send Report to:

Send EDD to: datagroup@geiconsultants.com

Preservative

Analysis

Sample Handling

Samples Field Filtered

YES NO NA

Samples Shipped With Ice

YES NO

Deliverables:

If Yes, Have You Met Minimum Field QC Requirements? YES NO NA

Lab Sample Number	GEI Sample ID	Collection		Matrix	No. of Bottles	Sampler(s) Initials	Sample Specific Remarks
		Date	Time				

Relinquished by sampler: (signature)	Date:	Time:	Received by: (signature)
1.			1.
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
2.			2.
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
3.			3.
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
4.			4.

Turnaround Time (Business days):

Normal ____ Other ____

10-Day ____ 7-Day ____

5-Day ____ 3-Day ____

Before submitting rush turnaround samples, you **must** notify the laboratory to confirm that the TAT can be achieved.

Additional Requirements/Comments/Remarks:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY



A. Line cooler with bubble wrap and large plastic bag. Use absorbent pad inside the bag if bottles contain preservatives.



B. Wipe outside of bottles and put glass in individual bubble bags & seal. Place bottles & the temperature blank into cooler. Leave room for ice in between bottles & on top.



C. Place double bagged or loose ice randomly around bottles throughout the cooler.



D. Place large bag of ice or loose ice on top of the bottles. In warm weather, the cooler should be packed with as much ice as possible.



E. Close outer bag, compress excess air out of bag, twist top and knot. If necessary, use more bubble wrap to fill the dead air spaces. Place chain of custody (COC) and other paperwork in plastic bag and seal. Place on top of cooler.



F. Close cooler, place signed and dated Custody Seals over opening. Tape over the Custody Seal and seal cooler securely. Fill out overnight shipping waybill and attach to the top or handle of the cooler. Attach Saturday delivery stickers if needed. Ship according to DOT regulations.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY



A. Line cooler with bubble wrap and large plastic bag. Use absorbent pad inside the bag if bottles contain preservatives.



B. Wipe outside of bottles and put glass in individual bubble bags & seal. Place bottles & the temperature blank into cooler. Leave room for ice in between bottles & on top.



C. Place double bagged or loose ice randomly around bottles throughout the cooler.



D. Place large bag of ice or loose ice on top of the bottles. In warm weather, the cooler should be packed with as much ice as possible.



E. Close outer bag, compress excess air out of bag, twist top and knot. If necessary, use more bubble wrap to fill the dead air spaces. Place chain of custody (COC) and other paperwork in plastic bag and seal. Place on top of cooler.



F. Close cooler, place signed and dated Custody Seals over opening. Tape over the Custody Seal and seal cooler securely. Fill out overnight shipping waybill and attach to the top or handle of the cooler. Attach Saturday delivery stickers if needed. Ship according to DOT regulations.

STANDARD OPERATING PROCEDURE

FD-004 Photo Documentation

1. Objective

Describe methods to document and retain photographic records.

Keeping a record of photographs taken is crucial to their validity as a representation of existing conditions.

2. Execution

- Photographs of a site, individual samples, or other observations should be taken using a digital camera.
- Set the camera to record the time and date for each photograph.
- All photographic records, along with the following information, should be recorded in the field notebook (SOP FD-001).
    - If applicable, the compass direction describing the direction the photograph was taken (e.g. looking southeast). This may not apply to photographs of individual samples.
    - Brief description of what the photograph is intended to show.
- The field notebook should note who took the photographs.
- The photographs should be electronically backed up on a computer or other data storage device.
- If photographs will be used in a report, memo, or letter, they should be placed on a photograph record template and the relevant information describing the photograph should be inserted into the caption section for each photograph.

3. Limitations

- Some clients and regulatory agencies require photographs of every subsurface soil sample collected. These photographs typically include a "whiteboard" which indicates the site, the boring ID, and the depth of the sample, while logging details are recorded in the field notebook. Under these circumstances, it is not necessary to include compass directions or descriptions.

4. References

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

5. Attachments

Attachment A – Example of Photo Documentation Template

6. Contact

Melissa Felter
Leslie Lombardo

Attachment A – Example of Photo Documentation Template
GEI Consultants, Inc.

Project: Project Name

Location: Project Location



Photographer: K. Barber
Date: 10/25/07
Photo No.: 1
Direction: N

Comments:
Entrance of site with tree mulching operations.



Photographer: K.Barber
Date: 10/25/07
Photo No.: 2
Direction: W

Comments:
On-site building built in 1936.

STANDARD OPERATING PROCEDURE

FD-005 Field Observation of Bedrock Outcroppings

1. Objective

Describe procedures for documentation of bedrock outcrops in the field.

2. Execution

- If available, review available surficial and bedrock geology, and USGS maps prior to conducting field observation of bedrock outcrops
- Check the magnetic declination for your site and adjust your Brunton pocket transit or similar compass accordingly.
- In the field, identify and record outcrop location on a map (e.g. topographic map, aerial photos, etc.), and, if appropriate, using latitude and longitude (or UTM coordinates) measured with a GPS (SOP FD-007).
- Record description of geology observed using the references provided in this SOP, or other guidelines approved by the Project Manager. Use sketches to supplement geology description, if appropriate.
- Measure and record strike and dip of geologic features using a Brunton compass pocket transit or similar compass, if appropriate.
- Document geological observations with digital photos.
- Collect and label rock samples, if appropriate.

3. Limitations

- Field personnel performing bedrock mapping should be trained in the fundamentals of rock classification and bedrock mapping.
- At all times follow safety procedure as defined in the site-specific Health and Safety Plans.

4. References

GEI Geotechnical Manual, dated January, 2004.

ASTM D6032-08 Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core, 2008

ASTM D2113-08, Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation, 2008

ASTM D5079-08. Standard Practices for Preserving and Transporting Rock Core Samples, 2008.

Barnes, J.W. and Lisle. R.J., Basic Geological Mapping, Fourth Edition, John Wiley & Sons, Ltd., 2004.

Compton, Robert R, "Geology in the Field, Section 3 Basic Procedures for Outcrops" July 1985.

Day, R.W., Geotechnical Engineer's Portable Handbook, McGraw-Hill, 2000.

D.U. Deere and D.W. Deere, The Rock Quality Designation (RQD) Index in Practice, Rock Classification Systems for Engineering Purposes, STP 984, ASTM, 1988,

Earth Manual, Part I, Third Edition, U.S. Department of the Interior, Bureau of Reclamation, 1998.

Engineering Geology Field Manual, Second Edition, Volume I, U.S. Department of the Interior, Bureau of Reclamation, 1998 Reprinted 2001.

Engineering Geology Field Manual, Second Edition, Volume II, U.S. Department of the Interior, Bureau of Reclamation, 2001.

Field Guide For Rock Core Logging and Fracture Analysis, Midwest Geosciences Group Press, 2005.

Hunt, R.E., Geotechnical Engineering Investigation Handbook, Second Edition, Taylor & Francis Group, LLC, 2005.

U.S. Army Corps of Engineers, Rock Foundations, EM 1110-1-2908, November 30, 1994.

U.S. Army Corps of Engineers, Chapter 4 Borehole Logging, EM 1110-1-4000, November 1, 1998.

Walker, J. D. and Cohen, H.A., The Geoscience Handbook, AGI Data Sheets, Fourth Edition, 2006.

5. Attachments

Attachment A – General Guidelines on Observing Bedrock Outcroppings

6. Contact

Melissa Felter
Heather Haley

Attachment A (FD-005)

General Guidelines on Observing Bedrock Outcroppings

- Look over the outcrop and nearby outcrops broadly in order to spot the principal bodies of rock or other materials. Walk around or over large outcrops several times and view them from various distances.
- Do all the bodies of rock appear to have once continued beyond the outcrop, or do some end there against other bodies? Do they end against faults, intrusive contacts, or unconformities? Why does the outcrop itself end where it does? Does it grade into soil or is it overlain by surficial deposits?
- Continue to study the outcrop from a moderate distance. Are the rock bodies tabular, irregular, lenticular, or some other distinctive shape?
- What are their orientations and dimensions? If they are internally layered, are the layers parallel to any of their bounding surfaces? In overall view, do any rock bodies appear variable?
- Now study the boundaries (contact surfaces) between the bodies, both at a moderate distance and up close. Are they sharp or gradational? Do they cut across grains or structures in either adjacent body? Do any rocks or deposits vary in color or texture near these contacts?
- Break off, or scoop up, samples of the main materials, and examine weathered as well as fresh surfaces with a hand lens. Identify the constituent mineral and rock grains, and note their sizes, shapes, and surface features, as well as their part in the overall fabric and porosity of the rock or deposit.
- To test for the distribution of soft mineral grains, especially carbonates, probe grains with a needle, apply dilute HCl, and examine weathered surfaces for pits and insoluble residues. Estimate the composition of each sample, in percent by volume of each kind of grain, and identify the rock or material. Even if it seems obscure, give it a provisional name.
- Now examine the rocks closely for primary fabrics and structures. Look especially for structures that establish tops and bottoms of deposited layers that were once sediments or igneous deposits. Do relations at contacts support these indications of sequence?
- Look for all features indicative of depositional current direction or direction of magmatic flow. Measure a number of them in order to judge their consistency.
- To detect deformation, see if rock layers, veins, or planar structures have been folded. If no folds are obvious, perhaps foliations, cleavages, or lineations indicate folding.
- Whether the rocks are folded or not, examine them for grains or other small bodies that have been deformed into planar or linear shapes that

give a measure of deformation. How are these grains oriented relative to other structures?

- Examine all faults, even those that displace rocks as little as a centimeter. Are there gouges or breccia along them? Any indications of actual directions of displacement? Are the faults younger than other tectonic features?
- To determine the physical state of the rocks, especially if they are sedimentary, test the degree of compaction and cementation by hefting dry samples (porous rocks are lighter than nonporous ones), by their reaction to breaking in the hands and to hammer blows, and by the rate they soak up water. Depth and strength of weathering generally increase with porosity and permeability.
- What are the typical spacings and orientations of joints in the different rocks? Are there secondary color changes, and are they related to fractures? Fracturing and weathering characteristics may help in identifying the same rock unit in other outcrops.
- Bring together all observations made thus far in order to identify rocks and structures that were originally obscure, or to refine identifications.
- Systematically measure and record: (a) the thickness of each layered unit of rock; (b) structural attitudes of all primary structures, such as bedding; and (c) attitudes of all secondary features, such as folds and faults.
- Collect rocks that seem particularly useful, either as typical samples or to resolve identifications.
- Before interpreting the various rocks and structures, be sure that you have observed all possible indications of relative ages of the rocks in the outcrop.

STANDARD OPERATING PROCEDURE

FD-006 Handheld Global Positioning Receiver Operation

1. Objective

Use handheld global positioning system (GPS) receivers to locate sample points and site features with "Mapping-Grade" accuracy.

Use handheld GPS receivers to "stake out" proposed sample point locations within the limits of "Mapping Grade" accuracy.

2. Execution

- Handheld GPS receivers provide a low-cost and user-friendly method for locating sample points and site features with a fair degree of horizontal accuracy.
- In simplistic terms, GPS works by measuring the distance from numerous orbiting satellites to a point on the earth surface. Individual satellites broadcast their real-time location in terms of x,y and z coordinates, and the distance from each satellite is measured as a function of the length of time that a time-stamped signal takes to reach the receiver. Built-in GPS software derives new points by intersecting the distances from known orbital locations – in much the same way that points are located by intersecting tape-measured distances from building corners or other pre-existing site features.
- Late-model handheld GPS receivers utilize a real-time differential correction technique called WAAS (Wide Area Augmentation System). This system was designed to provide greater confidence and reliability in using GPS data for commercial aircraft landing approaches, and the additional correction improves all GPS operations.
- Handheld GPS receivers display navigational information on a variety of standard pages. Although each manufacturer uses slightly different formats, all receivers toggle back and forth between the following visual presentations:
- A "satellite" page displays the relative orbital location of all GPS satellites that are currently being tracked by the receiver. The display may include information on the real-time geometrical strength of the solution: satellite intercepts that cross at right angles provide more accurate solutions than intercepts that cross at acute or obtuse angles.
- A "track" page that displays the travel path of the receiver while it is turned on, along with the relative location of recorded points. Many GPS models have a "track-back" function that will guide the user on the same path back to the starting point
- A "navigation" page that displays instantaneous location and the real-time direction and velocity of travel. Some units provide two pages to display this information in different formats. Most units will report the overall "course

made good" (straight-line bearing and distance from the starting point) at any point.

- A "waypoint" page that allows users to "Go To" a created point or previously recorded point by providing a straight-line bearing and distance to the point. The information is instantaneously updated as the user moves along; some units display a pointing arrow that directs the user to the direction of travel. Be careful of go-to lines that lead through swamps or over cliffs – if you will be travelling in difficult terrain have a paper copy of the USGS quadrangle and a compass on hand for navigation.
- Signal strength degrades significantly next to buildings and underneath tree canopy. Most GPS receivers have an "averaging" function to improve the accuracy of shielded locations. GPS users can also improve precision by locating points three times, at different times of the day. Two of the solutions will generally be closer to each other than to the third and can be averaged for a more reliable fix.
- Most GPS receivers default to latitude and longitude, but data is more accurate and easier to input and when expressed in UTM coordinates to the nearest meter. The handheld GPS setup will have a function somewhere to change to UTM. Most of Connecticut is in UTM Zone 18 but the easternmost parts are in Zone 19.
- Consult "Corpscon" the datum translator available from the National Geodetic Survey website. Corpscon translates instantly from latitude/longitude to UTM coordinates to state plane coordinates and provides tools to identify UTM Zones. Also consult the Trimble, Garmin and Magellan websites for technological improvements and discussion of advanced techniques.

3. Limitations

- Handheld GPS receivers operating in unobstructed locations are currently reckoned to provide 2-5 meter accuracy, meaning that the true location of measured points lie within an "error ellipse" with axes of 2-5 meters centered on the measured location. In other words, even under the best of conditions a real-time GPS solution may be as much as 20 feet off the true horizontal location of a point.
- Due to geodetic restrictions, vertical locations (elevations) have less than half the accuracy of horizontal locations, meaning that even under the best of conditions, a surface elevation displayed on a handheld GPS receiver may be off by more than 50 feet.
- Horizontal and vertical data derived from handheld GPS receivers should never be considered more than relatively accurate, and this level of uncertainty should be identified in any discussion of positional tolerance.

4. References

Trimble Website: .trimble.com
Garmin Website: .garmin.com

Magellan Website: .magellangps.com
National Geodetic Survey: ://www.ngs.noaa.gov/

5. Contact

Doug Bonoff, PLS

Section 4

Drilling Methods (DM)

STANDARD OPERATING PROCEDURES

DM-001 General Guidance on Determination of Appropriate Drilling Methods

1. Objective

There are multiple drilling methods which can be employed based on the type of stratum (e.g. overburden or bedrock) and the end use of borehole. End uses include geotechnical investigation, subsurface soil sampling, and monitoring well installation or a combination thereof.

The following text describes different methods of drilling with considerations for their use to collect groundwater and/or subsurface soil samples. Profiles of subsurface conditions encountered and well installation details must be recorded on logs. Procedures for field documentation are provided in Section 4 - Field Documentation.

2. Hollow-Stem Augers (HSAs)

Borings can be installed in unconsolidated formations using solid-stem or hollow-stem augers (HSAs). The augers are advanced by rotation and the drill cuttings are brought to the surface by travelling up the outside of the auger flights in a screw-like manner. HSAs have the advantage of allowing the well to be installed inside the hollow stem of the auger, which prevents the borehole from collapsing. Upon reaching the planned well depth, the casing and screen are placed inside the HSAs and the flights are individually removed while the annular space around the well is filled with the filter pack and grout, as appropriate. Conversely, solid-stem augers must be completely removed from the borehole before well installation, which can lead to collapse of the borehole. For this reason, solid stem augers are seldom used for installation of monitor wells.

HSAs come in a variety of sizes and allow collection of soil samples utilizing split spoons or Shelby tubes. Samples are collected ahead of the augers for determining soil/sediment type, stratigraphy, depth to the water table, and for collecting soil samples for chemical analysis. During this process, the standard penetration test (SPT, ASTM Method D 1586) can also be performed. The HSA method also has an advantage over mud-rotary drilling techniques in that drilling mud is not used. Drilling mud can contaminate the soil samples and potentially reduce the yield of the wells.

A disadvantage of the method is that HSAs cannot be used to drill into competent bedrock or through large boulders. Also, "heaving or running sands" can be forced up inside the augers as a result of strong vertical groundwater gradients, which can hamper efforts to collect soil samples or complete well installation. Furthermore, the maximum depth achievable using HSAs, which is generally shallower than other methods, is dependent not only on the ability of the rig (e.g., horsepower, rig-torque, weight of augers etc.), but also the lithology of the material drilled.

3. Rotary Drilling

Rotary drilling methods include both direct rotary and reverse-circulation rotary. Direct rotary is more commonly used in environmental investigations, whereas reverse-circulation rotary is used in drilling large-diameter water supply wells. In direct rotary drilling the borehole is advanced by rotating the drill pipe (rods) and bit to produce a cutting action. The cuttings are removed from the borehole by continuous circulation of a drilling fluid. The fluid or "mud" is pumped down the inside of the drill pipe and is circulated back to the surface on the outside of the pipe. The fluid removes the drill cuttings from the borehole and cools and lubricates the bit. Mud used during direct rotary consists of additives (e.g., bentonite), water, or air.

Reverse-circulation rotary drilling is similar to direct rotary except the drill rigs are larger and the flow of the drilling fluid is reversed. The drilling fluid moves upward inside the drill pipes and circulates back to the borehole via settling pits. The drilling fluid returns to the borehole via gravity and moves downward in the annular space between the drill pipe and borehole wall. Drilling fluids for reverse-circulation rotary are generally water and any suspended particles picked up from the surrounding formations.

Mud-rotary methods can be used to drill in both unconsolidated and consolidated (bedrock) formations. In addition, drilling mud stabilizes the borehole and limits the potential for borehole collapse. Disadvantages of using the mud-rotary method include the difficulty in determining the depth to the water table, the potential for drilling mud to impact soil samples and dragging of contamination into deeper zones since the drill cuttings are re-circulated in the borehole. Wells installed using this method typically take longer to develop than wells installed using the HSA or air-rotary methods due to the invasion of mud filtrate into the formation.

In air-rotary drilling, compressed air is directed down the inside of the drill pipe. As in mud-rotary drilling, air removes the cuttings and lubricates the bit. However, since air has no viscosity, it cannot be used to stabilize a borehole therefore, casing must be advanced in unconsolidated formations to keep the borehole open. This is why air rotary methods are best suited for drilling in bedrock formations. The percussion-type air-rotary "hammer" bit provides the best penetration rate when drilling bedrock consisting of crystalline rock. However, when drilling above the water table, an air-rotary bit can grind the soil and bedrock to a fine powder which is blown out of the hole with air and which has the potential to be inhaled. Therefore, drilling above the water table using air-rotary methods requires the addition of potable water to the borehole for dust control. In addition, the air compressor should be of the oil-less variety, or have a filter to prevent any oil from entering the borehole.

A disadvantage of using rotary methods while drilling in unconsolidated formations is the requirement of pulling the drill pipe out of the hole each time a split-spoon soil sample is collected (and the SPT is performed). This adds up to considerable amounts of time when deep wells are being installed or when continuous split-spoon

sampling is being performed. As stated above, split-spoons used to collect soil samples can become contaminated when they are advanced down a mud-filled borehole.

A special type of rotary drilling is bedrock coring, wherein a special core bit and barrel are used to retrieve relatively undisturbed core samples of the bedrock. Coring allows better characterization of bedrock lithology and other features including orientation of fractures and bedding planes, which can control contaminant migration. Core barrels can either be unoriented or oriented. An oriented core is scribed with respect to magnetic north. Although more expensive than collecting an unoriented core, this method gives the true orientation of the features encountered in the core.

Drilling fluids are generally air (air-rotary) or bentonite and/or water (mud-rotary). Water added to a borehole must be of potable quality. The source of the potable water used during the installation (and development) of monitor wells should be documented (e.g., in the Remedial Investigation Report).

Bentonite is high swelling clay with sodium montmorillonite as its primary clay mineral. Bentonite is added to water to increase the viscosity of the drilling fluid so that drill cuttings can be removed from the borehole more effectively. At the same time, the viscosity must be low enough to allow cuttings and coarse-grained particles to settle out once they are circulated out of the hole. Bentonite also adds weight to the drilling fluid, which helps to maintain borehole stability.

4. Sonic Drilling

The method involves driving a core barrel using vibration, rotation, and a downward force to collect soil samples. A sonic drill rig looks and operates very much like a conventional top-drive rotary or auger rig. The main difference is that a sonic drill rig has a specially designed, hydraulically powered drill head or oscillator, which generates adjustable high-frequency vibrational forces. The oscillator uses two eccentric, counter-rotating balance weights or rollers that are timed to direct 100 percent of the vibrational energy at 0 and 180 degrees. There is an air spring system in the drill head that insulates or separates the vibration from the drill rig itself. The sonic head is attached directly to the drill pipe or outer casing, sending the high-frequency vibrations down through the drill pipe to the bit.

A core barrel is advanced using vibration, rotation, and downward force to collect continuous soil cores up to 20 feet in length. The bit at the end of the core barrel contains carbide teeth allowing the core barrel to be advanced through most overburden, soft bedrock, and minor obstructions such as bricks and boulders. Once the core barrel has been advanced, a secondary or "over-ride" casing is advanced down to the same depth as the inner core barrel. The over-ride casing keeps the borehole from collapsing while the inner core barrel is removed. Once the core barrel is removed, the soil core is pushed out of the core barrel through the use of

vibration and either air or water pressure. Soil core diameters are dependent on the size of core barrel used and range from 3 to 12 inches. The use of multiple over-ride casings of increasing diameter allows the borehole to be telescoped down through multiple confining units. The setup used in sonic drilling makes this drilling method amendable to collecting soil cores and installing wells in angled boreholes. With only the bottom of the inner and outer core barrel exposed to the aquifer at any given time, determining the location of the water table can be difficult.

While this drilling method has the capability of drilling through and providing samples of coarse gravels, boulders, and tight clays, these situations will result in slow drilling or advancement of the core barrel. The result is a hotter core barrel and a longer contact time between the core barrel and the encased soil core. The aforementioned conditions will increase the probability that the sonic method will raise the temperature of the soil core and facilitate VOC and SVOC loss.

The ability to quickly install deep borings and wells, while generating a large-diameter continuous soil core, makes this drilling technique invaluable when continuous soil sampling is needed to assess deep or complex geological situations. However, sonic drilling's high cost, relative to other drilling methods, may be prohibitive for small projects or shallow boreholes. The higher cost of the drilling method should be weighed against the cost savings incurred due to its faster drilling rate and high quality of the soil core produced.

5. GeoProbe®-Direct Push

The method involves hydraulically pushing hollow rods into the subsurface for the purpose of collecting soil and/or groundwater samples (e.g., Geoprobe®). The method can be used to collect discrete soil samples or install small-diameter wells used to collect groundwater samples.

Advantages of the direct-push method include the relatively quick collection of groundwater samples and, when used along with a mobile laboratory, collection of data in “real” time. The method allows for collection of multiple samples in a day with the potential for achieving contaminant delineation in one mobilization of the field equipment. The data can also be used to select locations of permanent monitor wells.

Disadvantages of the method include the fact that the data quality achieved is often suitable only for screening purposes. Direct-push methods typically result in very turbid samples since an oversize borehole is not produced and a filter pack is not used. Turbid samples can produce higher metal concentrations in groundwater samples since metals are typically adsorbed onto soil particles. Use of direct-push methods can also cause cross-contamination since contamination from shallow zones may be driven down to deeper zones. Due to the narrow diameter of the direct-push rods, samples are often collected with peristaltic pumps. When samples are collected for volatile organic compounds (VOCs) using peristaltic pumps, some

of the volatiles may be lost due to the pressure drop produced by the suction lift. In such cases, the VOC data must be qualified accordingly. For this reason, use of the peristaltic pump for collecting groundwater samples for VOC analysis is not recommended and approval for its use should first be obtained from the project manager or geologist.

Another disadvantage of using direct-push technology for collecting groundwater samples is the potential to breech confining units. To prevent this, soil sampling using direct-push technology or conventional split-spoon sampling techniques should first be performed to identify the presence, depth and lateral extent of confining units. Pushing through confining units should be avoided if the presence of dense, non-aqueous-phase liquid (DNAPL) or very soluble compounds such as Methyl Tertiary Butyl Ether (MTBE) are suspected or the contaminant plume appears to be diving in the aquifer.

6. Contact

Gary Fuerstenberg

STANDARD OPERATING PROCEDURE

DM-002 Hollow-Stem Auger

1. Objective

Describe standard operating procedures for drilling of overburden soil borings using hollow-stem augers.

2. Execution

- Confirm that the appropriate measures have been taken for clearance of potential subsurface utilities. The responsibility for clearance may vary, depending on the client.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned or pressure-washed. Record observations in the field notebook (See SOP FD-001).
- Observe that the augers are vertical when the first section is advanced into the ground.
- Use a 140-lb hammer to drive the sampler, unless conditions necessitate using a 300-lb hammer (see SOPs SM-001, *Split-Spoon Sampling* and SM-0003, *Soil Classification,* for details). Count and record the number of blows per 6-inch increments, confirming blow counts with driller if necessary).
- Decontaminate the split-spoon sampler after each use (see *Equipment Decontamination,* SOP QA-001) or use another decontaminated split-spoon sampler.
- Ensure that the drillers advance the augers only after they have inserted the auger plug (to prevent soil from entering the augers while advancing to the next sample interval).
- Request that the drillers remove the auger cutting bit/plug and insert the split-spoon sampler into the interior of the augers. Measure the stick-up of the rods attached to the sampler to ensure that the nose of the spoon is in virgin soil below the augers.
- Watch for signs of a soil strata change at depth during drilling (i.e., change in blow counts, change in soil color, soil wetness, soil contamination, bouncing of the drill rig, etc.). If important to the investigation, stop drilling and collect a soil sample.
- If subsurface soil samples are being collected with split-spoon samplers, ensure that the drillers use a 30-inch drop of the 140-pound hammer. The number of blow-counts for each 0.5 foot penetration provides important geotechnical data.
- Repeat until the borehole has been drilled to the desired depth.
- If a monitoring well is not installed in the soil boring, fill the boring with either cement/bentonite grout or properly-tamped and hydrated bentonite. Check with Project Manager and/or the appropriate regulatory personnel before using drill cuttings to backfill the boring.

- If a monitoring well will be installed, refer to SOP DM-007.
- Complete boring log and, if necessary, well installation logs (SOP SM-003, *Soil Classification*).
- Record boring locations on a site map and in a field notebook sketch. If the boring location will not be surveyed, measure each location from on-site reference points and record the information in the field notebook so that the location can be plotted on site figures.

3. Limitations

- In areas of significant soil contamination, hollow-stem augers may cross-contaminate upper soil layers as contaminated cuttings move up the auger flights. The potential also exists for contaminated augers to carry contamination to deeper soil strata
- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and evaluate health and safety conditions. If the borehole is to be advanced below the contaminated strata, use telescoping techniques (see SOP DM-008 *Monitoring Well Telescoping Techniques*) to avoid cross-contaminating underlying geologic strata.
- When drilling below the groundwater table in fine to medium sands, the potential exists for the phenomenon of "running sands" or "blow in" to occur. Frequent measurements inside the hollow-stem augers after the drill bit/plug is removed will indicate if running sands are present. If sands start to flow into the auger, pour clean water into the augers and keep the augers filled during sampling.
- If necessary, arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site. Containers should be labeled.
- Plan the drilling program to drill borings from the least- to most-contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at each planned soil boring location. Alternative locations will need to have utility clearance.
- Down-hole drilling equipment should be steam cleaned or pressure-washed between holes unless otherwise directed by the project manager.
- Record when standard operating procedures are deviated from. The drilling inspector should also record any detected odor from the boring and depth encountered.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91

5. Attachments

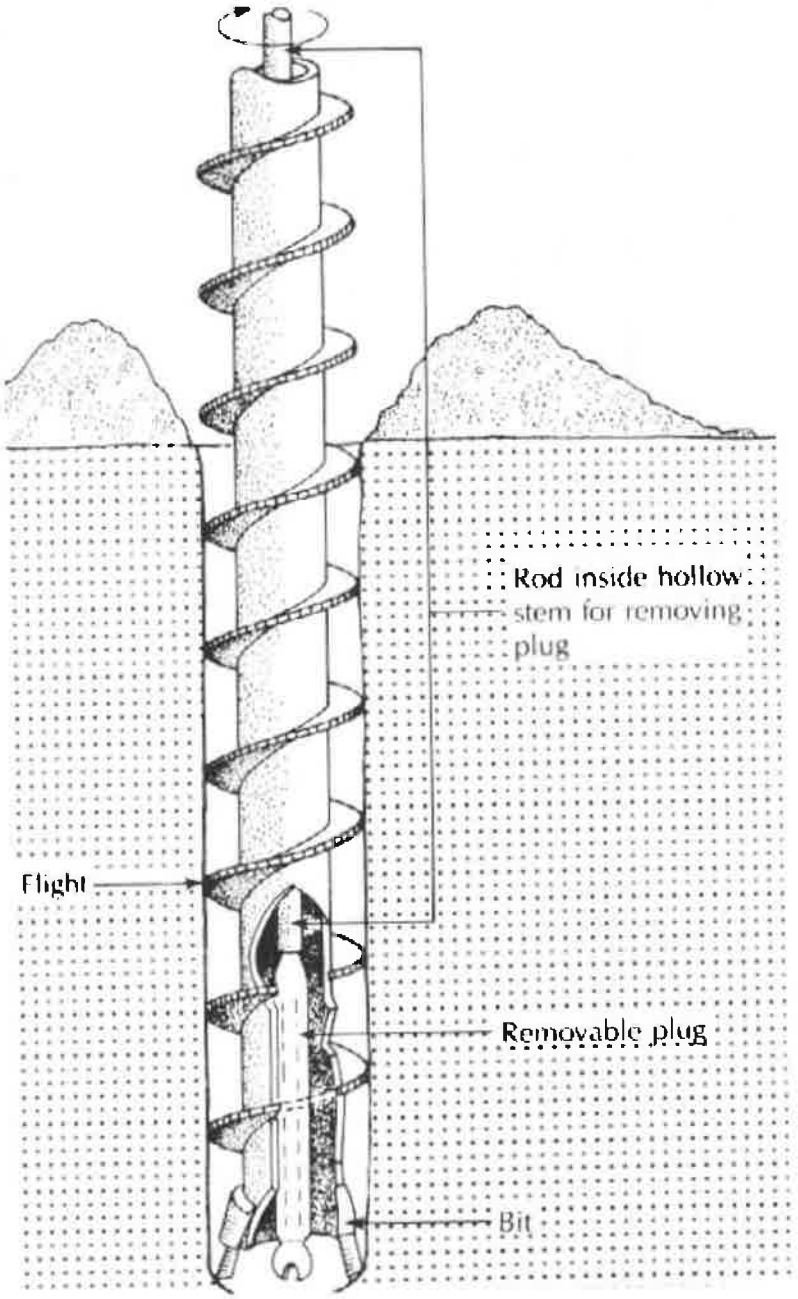
Attachment A – Hollow-Stem Auger

6. Contact

Gary Fuerstenberg
Cathy Johnson

SOP DM-002

Attachment A – Hollow Stem Auger



GEI Consultants

STANDARD OPERATING PROCEDURE

DM-004 Sonic Drilling

1. Objective

Describe common sonic drilling procedures.

Prior to drilling confirm that utility clearance has been completed and that the drilling rig has been appropriately decontaminated.

2. Execution

- Collect soil cores in runs of 5 to 10 feet. Some sonic rigs can collect a 20 foot sample, but the process generates a significant amount of heat that may degrade sample quality.
- Classify and sample the soil located within the liner.
- Excess soil should be placed in a 55-gallon drum for disposal.
- The core barrel should be cleaned with tap water following each use.
- The core barrel is then advanced within the isolation casing to collect the next soil core interval.
- Add water between the inner core barrel and the outer override casing. This will reduce friction between the casings and adsorb heat.
- Maximize drilling advance rate. The faster the core barrel is advanced, the less likely the core barrel will heat up. Drilling with a 3-inch diameter core barrel and a 5-inch diameter override casing, instead of the standard 4-inch core barrel and 6-inch over-ride casing, may increase advance rates and reduce the potential for soil core heating.
- If a significant decrease in drilling advance rate is observed, stop drilling and remove soil that has accumulated in the core barrel. Resume drilling through the resistant material (gravel, boulder, hard clay, etc.). When the resistant material has been penetrated and the drilling advance rate increases, stop drilling and remove what material has accumulated in the core barrel.
- Wash down the core barrel with cool water to cool the core barrel and associated casing, and resume drilling.
- If a well is to be installed in the borehole, the sandpack and grout are placed as the core-barrel and over-ride casing(s) are selectively vibrated out of the ground. The vibratory action should facilitate settlement of the sandpack and grout. Upon completion, no casing is left in the ground other than the well casing and screen.

3. Limitations

- Disturbance of the soil core is most likely to occur during removal of the soil core from the core barrel. The soil cores are usually vibrated out of the core barrel into plastic bags approximately 5 feet in length. As the plastic bags are

a little larger than the soil core itself, fragmentation of the soil core may occur as the core is extruded into the bag or while the bagged core is being moved in an unsupported manner. Soil conditions that are prone to disturbance include wet or dry zones that contain little or no fines, and well graded sands that contain significant volumes of water.

- If integrity of the soil core is of concern, the following procedures should be implemented:
    - Measures should be taken to ensure that the core, from the time it is extruded from the core barrel, is rigidly supported through the use of some type of cradle or carrying device.
    - The core should not be removed from its cradle until all sampling of the core has been completed. Acrylic liners are available for some core sizes and can be used to hold the core together upon removal from the core barrel.
    - If the soil is to be sampled for volatile organic compounds (VOCs), acrylic liners must be used.
    - Sampling of the soil core for VOCs or semi-volatile organic compounds (SVOCs) must be approved on a case by case basis. Proposals for VOC or SVOC soil core sampling must include provisions to minimize core fragmentation and heat generation, such as:
        - Acetate liners in the core barrel so that the soil core does not have to be extruded out of the core barrel.
        - Limit the length of soil core generated during a given downhole run.
        - Implement practices to reduce the residence time of the soil core in the core barrel.
- For the analysis of SVOCs, the use of the acetate liners is not required.
- The large diameter of the core barrel enables ground water sampling equipment to be placed inside the core barrel so that discrete depth groundwater samples can be collected during borehole advancement.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

5. Contact

Melissa Felter

STANDARD OPERATING PROCEDURE

DM-006 Geoprobe® Direct Push Boring

1. Objective

Describe standard operating procedures (SOP) for drilling of overburden soil borings using Geoprobe® and MacroCore® technologies.

2. Execution

- Confirm that appropriate measures have been taken for clearance of potential subsurface utilities. The responsibility for clearance may vary, depending on the client.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been decontaminated (QA-001). Record condition of all down-hole drilling equipment.
- Make sure the sampler is fitted with a piston rod assembly to block the sample tube until the desired subsurface sample interval is attained. Upon reaching the target sample depth, the piston tip will be released and the discrete sampler device is then advanced to collect the representative sample. This reduces the volume of slough that is collected.
- When the sampler is brought to the ground surface, it should be opened immediately, and the length of recovery should be measured and recorded.
- Log the soil sample using USCS procedures (SOP SM-003). Collect analytical samples if necessary (SOP SM-001).
- Decontaminate the cutting shoe if necessary (SOP QA-001 Equipment Decontamination) and have driller reassemble the parts with a new liner.
- Repeat the procedure described above until refusal or the boring is terminated.
- Periodically verify that depths cited by drillers are accurate.

3. Limitations

- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and re-evaluate health and safety conditions.
- Arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site (see SOP SC-003, *Investigation Derived Waste Management*).
- If possible, plan the drilling program to drill borings from the least to most contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at soil boring locations. These locations must also have been cleared by the state or local utility service prior to drilling.

4. References

ASTM D6001-05 Guide for Direct Push Water Sampling for Geoenvironmental Investigations, April 2005

Geoprobe Systems, "Geoprobe MacroCore MC-5 1.25-inch Light Weight Center Rod Soil Sample System SOP", Technical Bulletin No. MK 3139, November 2006

5. Attachments

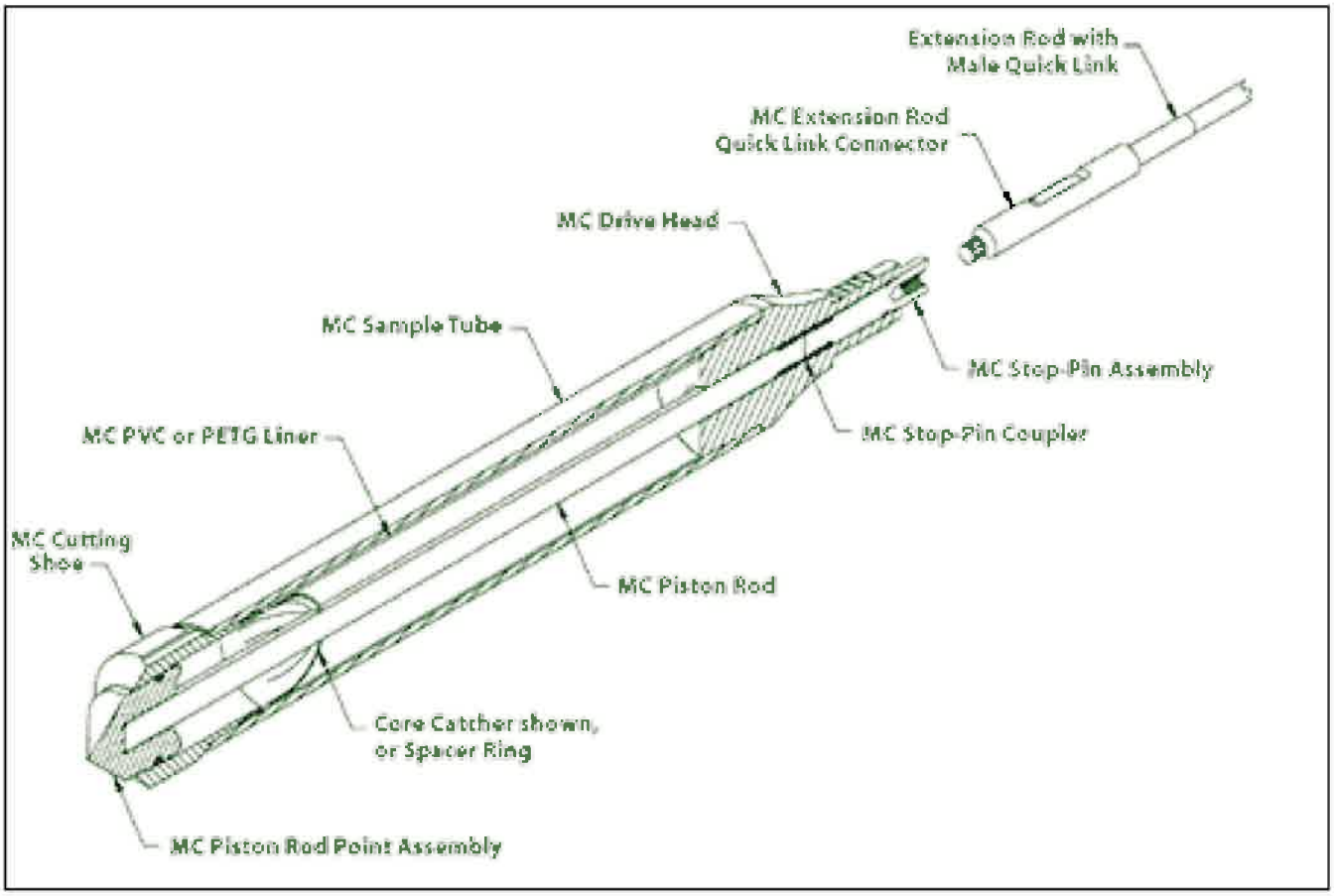
Attachment A – Geoprobe® with Macrocore® Sampler Assembly

6. Contact

Melissa Felter
Cathy Johnson

SOP DM-006

Attachment A – GeoProbe® with Macrocore® Sampler Assembly



Above: Diagram of a Macrocore® sampler

Right: A track-mounted GeoProbe ® Rig



GEI Consultants

STANDARD OPERATING PROCEDURE

DM-007 Monitoring Well Construction and Installation

1. Objective

Describe installation procedures for overburden monitoring wells screened across or below the groundwater table.

Well dimensions (well diameter, screen length, and screen slot-diameters) will be specified in the Work Plan. This SOP assumes the monitoring wells will be constructed of flush-joint PVC pipe and the screened section will have factory-slotted openings.

2. Execution

Attachment A provides a diagram of typical shallow, intermediate, and deep groundwater monitoring well construction detail. A Groundwater Monitoring Well Installation Log is in Attachment B.

- Measure and record the depth of the completed soil boring before beginning the well installation.
- If possible, measure the depth to groundwater in the borehole over a 10 to 15 minute period to ensure that the groundwater elevation has approximately stabilized. Compare the saturated soil depth estimated from split-spoon samples to the measured water level in the borehole. If drilling water has been used during boring advancement, pump the water out of the borehole to the static water depth, based on examination of the soil samples, and monitor the recovery of groundwater until the level has stabilized.
- If it is not possible to accurately measure the depth to groundwater in the borehole due to low permeability in the formation, use the saturated soil depth observed in the collected samples or measured water depth in a nearby existing monitoring well to estimate the depth to water in the borehole.
- For shallow monitoring wells, select the monitoring well screen and riser lengths so that the slotted section of the screen intersects the groundwater table. Screen lengths of 15 feet or less are preferred and 10 foot screens are most common. If the water table is seasonally high or low or if the well is in a location where the water table is likely to be tidally influenced, appropriately place the screened section to allow for the screen to intersect likely future water tables.
- For intermediate or deep wells screened entirely below the water table, select the monitoring well screen and riser lengths as described in the Work Plan. Screen lengths of 10 feet or less are preferred.
- If the borehole is deeper than the desired well depth or the bottom of the well is close to a change in soil strata, then fill the base of the borehole with bentonite. Keep in mind that bentonite swells when hydrated, and that filter

sand should be placed at the bottom of the borehole above the bentonite before installing the well.

- Prevent well materials from contacting foreign substances during installation. Precautions may include requiring the driller to wear clean gloves while handling well materials and requiring that well materials not be placed onto the ground or pavement without a protective barrier such as polyethylene sheeting being present
- Confirm that the driller installs a minimum one-inch sump with a bottom cap to the bottom of the well screen. See the Work Plan for locations that may require larger sumps.
- Monitoring wells can be constructed of either 1, 1.5, 2 or 4 inch inner diameter (ID) Schedule 40 threaded flush-jointed PVC. Refer to the work plan for the site-specific requirements. Flush-threaded well materials should be used. Do not allow the driller to use glues, as they typically contain solvents that could affect on groundwater quality.
- Stainless steel well materials may be used if required in the Work Plan. Select slot size based on grain size of the formation and on requirements in the Work Plan.
- Confirm that the driller places at least 12 inches of clean uniformly graded medium quartz filter sand pack into the base of the borehole, if required in the Work Plan.
- The driller should remove the drilling casing/augers from the borehole slowly, at a maximum of 2-foot intervals, at the same time that filter sand is added. The drillers should take frequent measurements of the depth to sand.
- Confirm that the driller has added adequate sand to surround the area around the slotted section. The filter sand should extend at least 2 feet above the top of the slotted section.
- The driller should place a bentonite seal above the filter pack. If the seal is above the water table, use at least 5-gallons of potable water to hydrate the bentonite before grouting the remaining annular space, or otherwise backfilling the remaining annular space as discussed with the Project Manager. Tamp seal. It should extend 1 to 2 feet above the filter sand.
- If required by the Work Plan, the driller should use bentonite-cement and grout the annular space from the top of the bentonite seal to the ground surface. Bentonite cement grout should be placed using tremie methods. Grout should be mixed in approximately the following proportions: 7.5 gallons water to one 94-lb bag of cement to 2-4 lbs of pulverized bentonite. The grout must be mixed using a pump (such as one on the rig) to ensure proper mixing.
- The drillers should cut the monitoring well riser at an angle or make "V"-notch in the riser pipe as a benchmark for surveying and groundwater measurements. The driller should cut the well riser so that the top of the well will be approximately 3 inches below the top of protective casing. The top of

the riser should be close enough to the top of the surface casing to allow reading of depth markings on a water level indicator tape.

- The protective surface casing is either a flush-mounted roadbox or a steel "stick up" pipe. The base of either type of casing should extend at least 1 foot into the grout below the ground surface (below the frost line) whenever possible.
- The protective casing should be set by placing cement in the annular space between the protective casing and the borehole up to the ground surface. If possible, the driller should slope the cement radially away from the protective casing at the ground surface to promote surface water runoff.
- In areas of high traffic or areas of parking lots and/or roadways where plowing occurs, set the roadbox flush with the ground surface to avoid damage to the well.
- If the well is installed in a high-traffic area and is completed with a steel "stick up" pipe, additional protection such as steel pole bumpers around the steel "stick up" pipe may be necessary.
- If possible a locking cap should be placed on the steel "stick up" pipe. If the surface casing is flush mounted, a locking expansion plug should be placed, if possible, inside the top of the well riser pipe.
- All well locations should be photodocumented in accordance with SOP FD-004 Photodocumentation.
- Label the outside of the protective well casing with a paint pen. If the well is not going to be surveyed, measure the location to nearby landmarks so that the well may be located in the future and plotted on figures. Make sure to enter this information in the field notebook). If possible, place a brightly colored stake or other identifier adjacent to the well.
- Develop the well (see SOP DM-009, *Monitoring Well Development*).

3. Limitations

- Do not screen across different hydrostratigraphic units (for example, outwash sands, confining layers or till) unless specified in the Work Plan or approved by the Project Manager.

- If the formation is composed of a material that is uniformly coarser than the filter sand, the grain size of the filter sand should be increased. Consideration should also be given to changing the slot size on the well screen. Differences in average grain size should generally not be greater than a factor of two to four times.

- Do not use drill cuttings to backfill during monitoring well installation unless specified by the work plan or project manager.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91.

5. Attachments

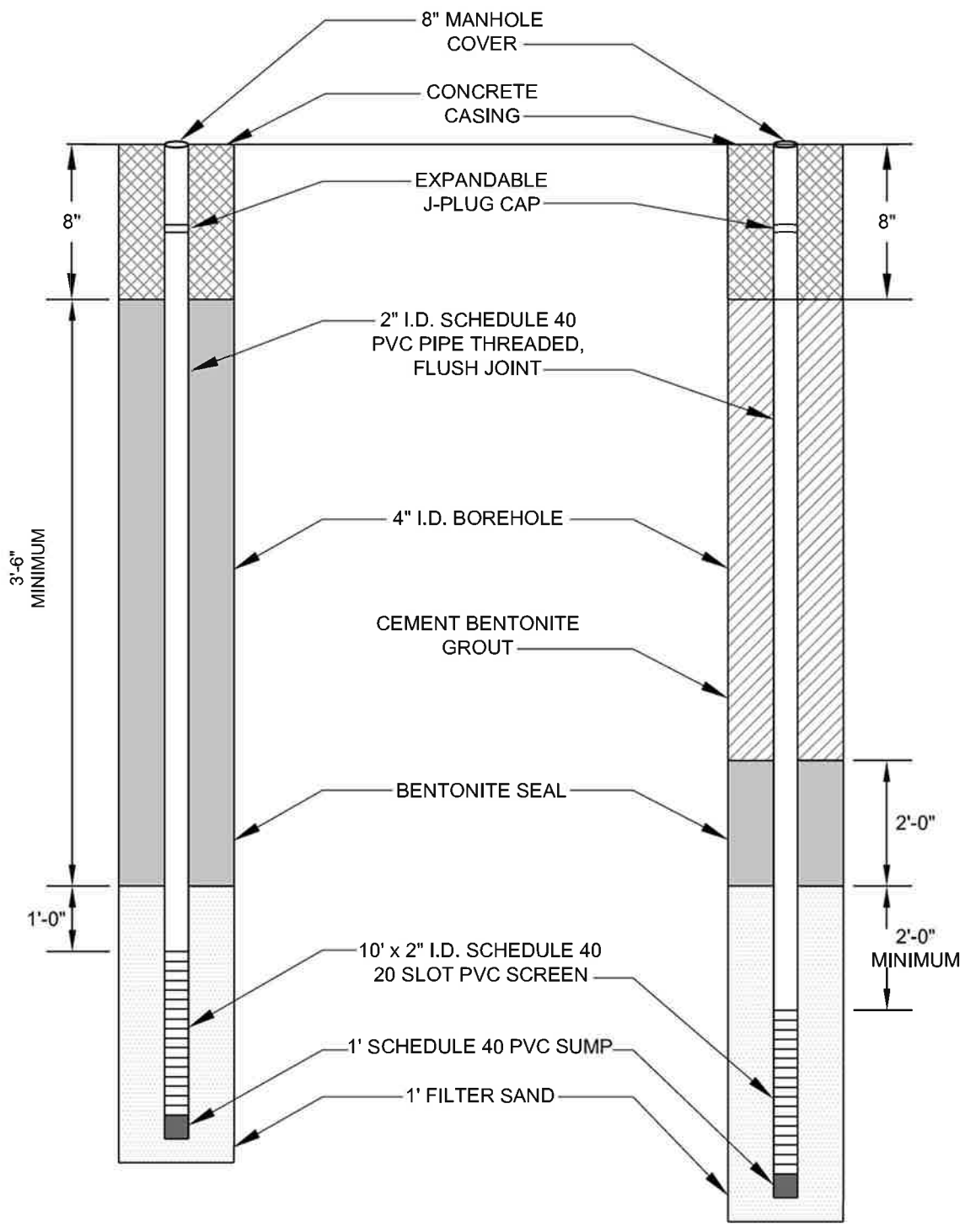
Attachment A – Typical Shallow, Intermediate, and Deep Groundwater Monitoring Well Construction Detail

Attachment B – Groundwater Monitoring Well Installation Log

6. Contact

David Terry
Anne Leifer

Attachment A - Well Detail



NOT TO SCALE

GEI Consultants

TYPICAL SHALLOW, INTERMEDIATE AND DEEP GROUNDWATER MONITORING WELL CONSTRUCTION DETAIL

June 2008

I:\GEI\SOPs\ Well Detail.dwg \Jun 10, 2008

Groundwater Well Installation Log

Well ID

Project _____ **GEI Proj. No.** _____

City / Town _____ **Location** _____

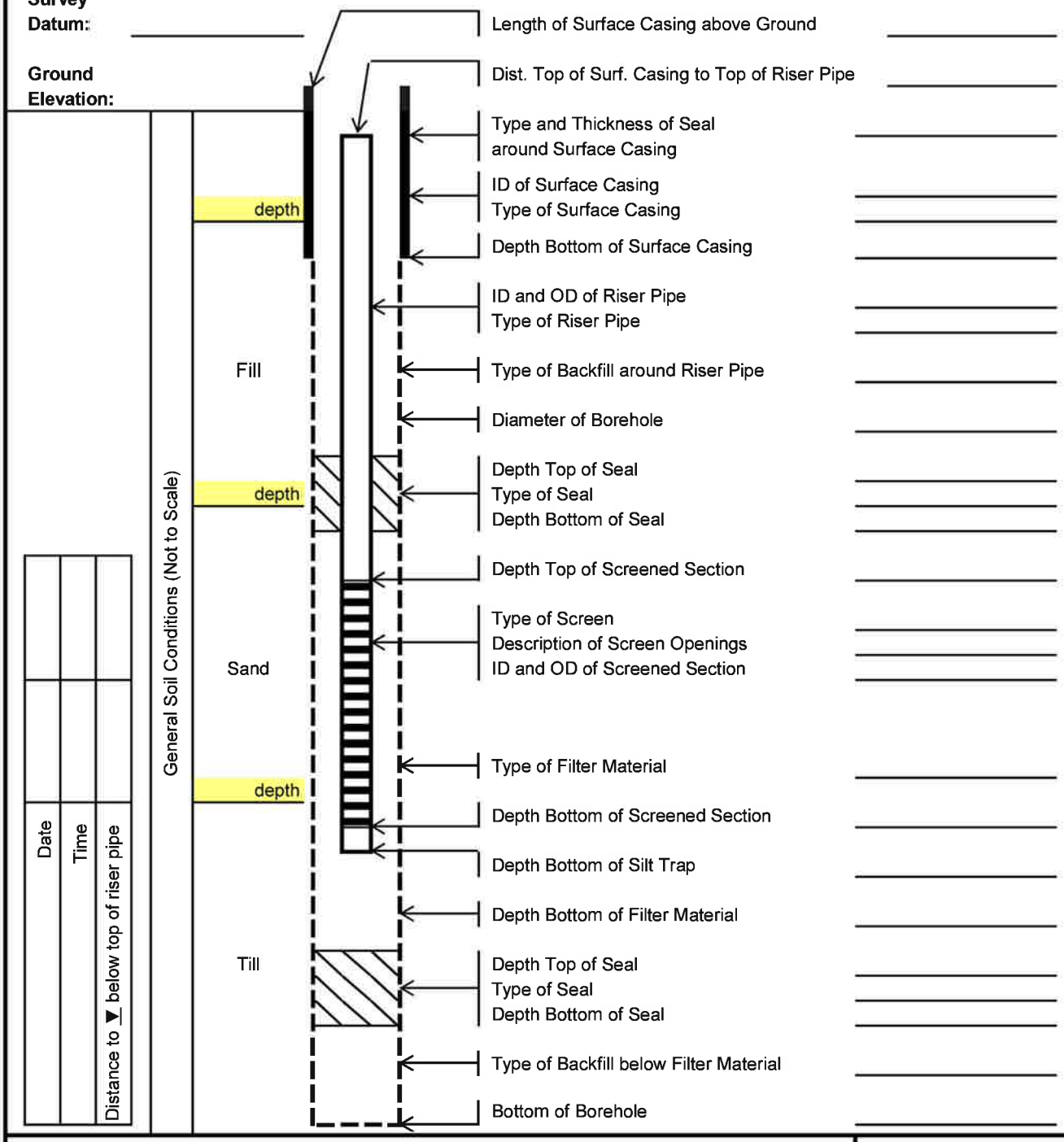
Client _____ N _____

Contractor _____ E _____

Driller _____ **GEI Rep.** _____ **Install Date** _____

Survey Datum: _____

Ground Elevation: _____



Notes:

GEI Consultants

STANDARD OPERATING PROCEDURE

DM-009 Monitoring Well Development

1. Objective

Describe standard procedures to remove fluids from monitoring wells (introduced during drilling) and maximize the movement of groundwater into the well by removing fine particles in the well and sand pack around the screen.

2. Execution

To prevent cross contamination between monitoring wells, use dedicated equipment and/or appropriately decontaminated equipment to perform monitoring well development. See SOP QA-001 Equipment Decontamination and the Work Plan for more information.

For deep or large diameter monitoring wells, it may be necessary to use a re-usable pump system, such as a Grundfos pump, to develop monitoring wells.

- Calculate the volume of water in the monitoring well (one well volume) using the following table:

Well diameter (inches)	Volume (gal/ft)
1	0.04
1.5	0.09
2	0.16
3	0.36
4	0.65
6	1.50

The equation used to establish these volumes is presented in Section 4.

- Calculate or estimate the amount of water introduced to the borehole during drilling. At a minimum, this is the amount of water that should be removed during development. Removing less water than was introduced and allowing additional time for the surrounding formation to clear of injected drilling fluids may be considered as an alternative if the volume of introduced water was large.

- Record the volume of water purged in the field notebook or on the Monitoring Well Sampling Form (Attachment A).

- Collect a sample of water from the monitoring well with the selected submersible pump (e.g. 12-volt whale pump or Grundfos pump), a bailer, or a

Waterra system. Record the physical properties (color, turbidity, odors, etc.) of the sample.

- The volume of water that should be removed will depend on the work plan, local regulatory guidance, and/or the volume of water that was introduced during drilling and well installation. Typical guidance for the removal volume includes:
    - Ten well volumes.
    - The volume of fluid added during drilling.
    - The volume required to remove enough suspended particles so that the turbidity of the water is less than 50 nephelometric turbidity units.

If needed, pump the ground water into a 5-gallon pail so that the volumetric flow rate and total water volume from the pump or bailer can be calculated.

Measure the groundwater level in the well during development to assess if the pumping rate is sufficient to create a drawdown in the well.

Observe the groundwater every few well volumes during the pumping and record the physical properties (color and turbidity).

If required by the Work Plan, conduct surging in the monitoring well. See the Work Plan for the method of well surging to be used. If surging is necessary, do so only after initial pumping at the well has occurred and fine sediments have been removed.

Slowly move the surge block up and down in the well. Periodically remove the surge block and purge the groundwater until it is relatively clear again. Start at a slow pace and progress to a faster surging action through time.

3. Limitations

Always remove groundwater with fine particles from the well before surging. The fine particles may be forced into the well screen by the surging action. They may also damage the pump.

If the ground water in the monitoring well is contaminated, the water removed during well development may need to be placed in a properly-labeled drum and disposed of in accordance with local, state, and federal regulations (see SC-003 Investigation Derived Waste).

If the soils around the well screen are composed of fine-grained silts and clays, over-pumping and mechanical surging is not recommended since these more vigorous

techniques can cause mixing of the fines into the filter pack. To develop these wells, use of a bailer is recommended.

There are occasions when the turbidity of groundwater cannot be meaningfully reduced. On these occasions, a minimum of ten volumes should be removed, and the Project manager should be consulted.

Sampling of groundwater should generally not occur within one week after development. In some regions or regulatory jurisdictions, a minimum of two weeks may be required before sampling. If no water was introduced to the formation during drilling, this waiting period may be shortened if required by the project. See the Work Plan for additional information.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90.

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49.

"The Methods & Mechanics of Well Development, Part 2 of 5," National Drillers Buyers Guide, March 1993, p. 17.

Massachusetts Department of Environmental Protection, "WSC-310-91Standard References for Monitoring Wells, Section 4.5 Decommissioning of Monitoring Wells", January 1991

U. S. EPA Environmental Response Team Standard Operating Procedure SOP: 2044 ," Monitor Well Development" REV: 0.1, 10/23/01

5. Attachments

Attachment A - Monitoring Well Sampling Form

6. Contact

Gary Fuerstenberg
Anne Leifer

GEI Consultants

MONITORING WELL SAMPLING RECORD

PID Reading _____ Job Name _____

Job Number _____ By _____ Date _____

Location _____ Measurement Datum _____

Well Number _____

Pre-Development Information Time (start) _____

Water Level _____ Total Depth of Well _____

One Purge Vol _____ Three Well Volume _____

Water Characteristics

Color _____ _____ Clear _____ Cloudy

Odor _____ None _____ Weak _____ Moderate _____ Strong

Any films or immiscible material _____

Volume (gal)	Time	pH	Temp (°C)	Spec. Conductance (µS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) _____ pH _____

Temperature (°C) _____ Specific Conductance (µS/cm) _____

DO Concentration (mg/L) _____ ORP (mV) _____

TDS _____

Post Development Information Time (Finished) _____

Water Level _____ Total Depth of Well _____

Approximate Volume Removed (gal) _____

Water Characteristics

Color _____ _____ Clear _____ Cloudy

Odor _____ None _____ Weak _____ Moderate _____ Strong

Any films or immiscible material _____

Comments

STANDARD OPERATING PROCEDURE

DM-010 General Guidance on Monitoring Well Abandonment

1. Objective

Describe methods to abandon a monitoring well.

The goal of monitoring well abandonment is to seal the borehole so it cannot act as a conduit for movement of contaminants or liquids from the ground surface to the water table or between aquifers.

General procedures for well abandonment are provided below but do not supersede state or local regulations. Make sure all well abandonment procedures adhere to appropriate regulations.

2. Execution

The following methods for abandoning unconsolidated (overburden) and consolidated (bedrock) monitoring wells should be performed by a licensed drilling contractor, if required by law or regulatory authorities. The following listed methods are general guidance for abandoning monitoring wells. The Work Plan and state and local requirements should be reviewed for additional requirements.

2.1 Unconsolidated (overburden) Monitoring Wells

Unconsolidated (overburden) monitoring wells should be abandoned in the following manner, see the Work Plan for additional requirements:

- Remove the protective casing and concrete pad.
- If possible, overdrill the monitoring well casing and sand pack using hollow-stem augers or casing to at least one foot below the depth of the boring/well as indicated in the soil boring log.
- If possible, remove the monitoring well riser, sand pack, bentonite seals and grout.
- Once the well materials have been removed, add cement/bentonite grout using tremie methods starting at from the bottom of the borehole as the augers or casing are removed.
- If the well materials cannot be removed by overdrilling, the riser should be cut off at a depth of between two and five feet below the ground surface and the remaining well materials may be filled with grout using tremie methods. The grout mixture will be as specified for the well installation (see SOP DM-001 General Guidance on Determination of Appropriate Drilling Methods)
- Add grout to the point where the riser was cut off or to a depth of approximately two feet below the ground surface. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

2.2 Consolidated (bedrock) Monitoring Wells

Consolidated (bedrock) monitoring wells or open holes will be abandoned in the following manner. See the Work Plan for additional requirements:

- Remove the protective casing and concrete pad;
- Remove the monitoring well materials from the hole. If the materials cannot be removed, cut off the well riser between two feet to five feet below grade. If feasible, cutting off the riser at five feet is optimal.
- Add cement/bentonite grout via tremie methods from the bottom of the well up to the ground surface. The grout mixture should be as specified for the well installation SOP DM-001 General Guidance on Determination of Appropriate Drilling Methods
- Add grout to the point where the riser was cut off or to a depth of approximately 2 feet below ground surface. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

3. References

Environmental Protection Agency, Region 4, "Environmental Investigation Standard Operating Procedures and Quality Assurance Manual, Chapter 6 – Design and Installation of Monitoring Wells," November 2001.

Massachusetts Department of Environmental Protection, "313 CMR 3.00, Registration of Well Drillers and Filing of Well Completion Reports".

Massachusetts Department of Environmental Protection, "Standard References for Monitoring Wells, Section 4.6 Decommissioning of Monitoring Wells", January 1991

4. Contact

Gary Fuerstenberg
Anne Leifer

Section 5

Sample Collection and Field Screening (SC)

STANDARD OPERATING PROCEDURE

SC-001 Environmental Sample Types and Sampling Strategies

1. Objective

Describe types of samples and strategic approaches to sample locations.

Refer to Attachment A for guidance on compatible sampling materials.

2. Sample Types

Grab Samples

A grab (or discrete) sample is a single aliquot (part of the sampled media) collected from a single location at a specific time.

Surface soil samples are typically "grab" samples. Volatile organic samples are always grab samples because the least amount of sample disturbance is necessary.

Composite Samples

Composite samples are non-discrete samples composed of more than one aliquot collected from different sampling locations and/or at different points in time. Analysis of composite samples produces an average value.

Composite samples are frequently collected to characterize waste soil that has been stockpiled for eventual disposal. Several grab samples are collected from the stockpile and are blended together into a single sample.

Screening Samples

Screening samples may be grab or composite in nature. However, they offer potential advantages such as rapid results and low cost. The trade-off is that they may only provide results within a range and/or they may have elevated detection limits. Screening samples are most often used to evaluate presence/absence and/or indications of the potential magnitude of impacts.

3. Sampling Strategies

Generally, there are three sampling strategies: random, systematic, and judgmental sampling.

- Random sampling involves collection of samples in a non-systematic fashion from the entire site or a specific portion of a site.
- Systematic sampling involves collection of samples based on a grid or a pattern which has been previously established.
- Judgmental sampling is the collection of all other samples. This sampling might be from areas most likely to be contaminated, areas most likely to be clean, or areas where information is lacking.

Often, a combination of these strategies is the best approach depending on the type of the suspected/known contamination, the uniformity and size of the site, the level/type of information desired, etc.

4. Attachments

Attachment A - General Guidelines for selecting equipment

5. Contacts

Jerry Zak
Ryan Hoffman

General Guidelines for selecting equipment on the basis of construction material and target analyte(s)

[✔, generally appropriate for use shown; Si, silica; Cr, chromium; Ni, nickel; Fe, iron; Mn, manganese; Mo, molybdenum; CFC, chlorofluorocarbon; B, boron]

Construction material for sampling equipment		Target analyte(s)	
Material	**Description**	**Inorganic**	**Organic**
		Plastics[1]	
Fluorocarbon ploymers[2] (other varies available for differing applications)	Chemically inert for most analytes	✔ (potential source of fluoride)	✔ (Sorption of some organics)
Polypropylene	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Polypropylene (linear)	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Polyvinyl chloride (PVC)	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Silicone	Very porous. Relatively inert for most inorganic analytes	✔ (potential source of Si)	**Do not use**
		Metals	
Stainless steel 316 (SS 316)	SS-316-metal having the greatest corrosion resistance. Comes in various grades. Used for submersible pump casing.	✔ (Potential source of Cr, Ni, Fe, and possible Mn and Mo) **Do not use** for surface water unless encasted in plastic.	✔ Do not use if corroded[3]
Stainless steel 304	Similar to SS-316, but less corrosion resistant	**Do not use**	✔ Do not use if corroded[3]
Other metals: brass, iron, copper, aluminum, galvanized and carbon steels	Refrigeration-grade copper or aluminum tubing are used routinely for collection of CFC samples	**Do not use**	✔ Routinely used for CFCs Do not use if corroded[3]
		Glass	
Glass, borosilicate (laboratory grade)	Relatively inert. Potential sorption of analytes	✔ **Do not use** for trace element analyses. Potential source of B and Si	✔

[1]Plastic used in connection with inorganic trace-element sampling should be uncolored or white. Tubing used for trace metal sampling should be cleaned by soaking in 5-10 percent HCl solution for 8-24 hours, rinsing with reagent water (metals free) and allowed to air dry in mercury-free environment. After drying, the tubing is doubled-bagged in clear polyethylene bags, serialized with a unique number, and stored until used.

[2] Fluorocarbon polymers include materials such as Teflon™, Kynar™, and Tefzel™ that are relatively inert for sampling inorganic or organic analytes. Only fluoropolymer should be used for samples that will analyzed for mercury because mercury vapors can diffuse in or out of other materials, resulting in either contaminated or biased results.

[3] Corroded/weathered surfaces are active sorption sites for organic compounds.

STANDARD OPERATING PROCEDURE

SC-002 Environmental Sample Handling

1. Objective

Describe appropriate environmental sample handling procedures.

The procedures include collection and transport of environmental samples to a laboratory for chemical analysis. Appropriate sample handling should ensure that samples are properly:

- labeled and documented;
- preserved;
- packaged; and
- transported

2. Execution

- Prior to mobilizing to the field, select a shipper or arrange for a courier for sample delivery to the laboratory. If using a shipper (i.e., FedEx or UPS) determine the time constraints for pickup requests, the location and hours of the nearest shipping office, and any size/weight restrictions.
- A waterproof or permanent ink pen should be used for all labels. The label should have an adhesive backing and be placed on the jar or bottle, not on the cap. In addition, clear packing tape can be placed over the sample label to secure it to the bottle as moisture from the samples can loosen the label adhesive.
- Record the following information on the label and in the field notebook (See SOPs FD-001 and FD-003):
    - Project number
    - Sample identification (i.e. MW-201 or SS-2)
    - Date and time (military time) of collection
    - Sampler's initials
    - Analysis methods
    - Preservative, if present
- Pre-preserved laboratory jars are preferable and should be used whenever practicable. If sample jars are not pre-preserved, add preservative as appropriate.
- At each sampling location, samples should be collected in order of volatility, most volatile first. Samples collected for volatile analysis should be placed in sample containers immediately upon retrieval of the sample.
- Aqueous samples for volatile analysis should be collected without air bubbles.
- The collection and preservation method of soil samples for volatile analysis may depend on project, client, or state regulatory requirements. Check with your Project Manager and/or SOPs SM-001 and SM-002 where appropriate.

- Care must be taken to avoid getting soils on the threads of sample jars, which can cause a faulty seal.
- If compositing samples in the field, specify the basis for composite (i.e. volume, weight, spoon recovery, etc.) and record in the field book the procedure for compositing the sample.
- Once samples have been collected and labeled, place samples in a cooler with sufficient bagged ice or freezer packs (blue ice) (if allowed) to chill samples to 4°C. If using ice, use double-bagged ice.
- Complete the chain-of-custody (COC) (SOP FD-003).
- If transporting the samples by way of a shipper:
    i. The sample cooler should have water drains securely sealed with duct tape, both on the inside and outside of the cooler.
    ii. Place a layer of packing material on the bottom of the cooler as a cushion.
    iii. Individually wrap each sample bottle with bubble packing or suitable packing material and place the wrapped bottles upright in the cooler with sufficient packing material between samples to avoid breakage.
    iv. Methanol preserved samples for volatiles analysis should be packed so they remain upright with the soil completely covered by the methanol during transport.
    v. Place a layer of packing material on top of the sample bottles.
    vi. Place bagged ice or freezer packs on top of the packing material. Fill the remaining space in the cooler with packing material to eliminate the possibility of vertical movement of samples.
    vii. Place the completed and signed chain-of-custody form in a sealable plastic bag and place on top of the packing material in the cooler, or tape it to the inside lid of the cooler.
    viii. Fill out the appropriate shipping or courier forms and attach to the top or handle of the cooler. If necessary, place the proper shipping labels on the cooler. Have the courier sign the COC form (or write pickup by FEDEX, UPS, etc. with date and time). Place a signed and dated custody seal on the cooler.
- All samples should be submitted to the laboratory as soon as possible. In many cases, same day shipping will be required by the client or the project manager. Be clear on this before beginning the field work.
- A copy of the waybills should be kept by the field supervisor to track shipments if necessary.

3. Limitations

- If samples are shipped on a Friday, call the laboratory ahead of time to confirm that personnel will be at the laboratory to receive and log-in the samples.
- During warm weather, make sure to use plenty of ice in the shipping container.

- Field personnel should be aware of analyses which have short hold times and schedule sampling events and shipping accordingly. Shipment of samples for analyses with short hold times must be arranged for in advance. Refer to the project work plan, quality assurance project plan, or state/federal regulations for holding time and preservative information. Contact the laboratory ahead of time when shipping samples with short hold time to ensure the lab is prepared for these analyses.
- For glassware containing preservatives (e.g., HCl, HNO_3), take care not to overfill the container, thus flushing the preservative out of the bottle.
- Never composite samples for VOCs in the field. Collect individual aliquots and direct the laboratory to perform compositing, if needed.
- Collection of aqueous samples should not be performed over the opening of a monitoring well. Preservatives from overfilling, a marker pen or other objects could fall into the well.
- If the recharge volume for a monitoring well is low, completely fill all volatile vials and then collect the minimum sample volume required for each remaining analysis.
- During subsurface soil sampling, if the recovery from the split-spoon sample is inadequate, if appropriate, resample the bottom of the borehole to obtain proper sample volume.
- Laboratories will homogenize and test the contents of the sample container, unless directed otherwise. Samples should not contain rocks, twigs, leaves, etc… unless these materials are of interest.

4. References

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

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

Preservation Techniques for Volatile Organic Compound (VOC) Soil Sample Analyses, WSC#99-415. Massachusetts Department of Environmental Protection.

5. Contacts

Jennifer Belonsoff
Leslie Lombardo

STANDARD OPERATING PROCEDURE

SC-003 Investigation Derived Waste

1. Objective

Describe characterization and management of Investigation Derived Waste (IDW) resulting from site investigation activities.

IDW is solid and/or aqueous waste generated during environmental site investigations.

2. Execution

- Determine the suspected contamination type and impacted media based on previous investigations, available analytical data, and/or site history.
- Consider the following when selecting IDW management option(s):
    - Anticipated volume of IDW to be generated during on-site activities
    - Potential contaminants and their concentrations
    - Proximity to population centers and the potential for unauthorized site access
    - Potential exposures to workers
    - Potential for environmental impacts
    - Community concerns
    - Potential storage areas
    - Regulatory constraints
    - Potential on-site treatment options
    - Duration of storage
    - Client concerns or requirements
- Review IDW Management Options summarized in Attachment A for each media suspected of contamination.
- Select IDW Management Option(s) prior to the commencement of field activities that will generate waste materials.
- Include the selected IDW Management Option(s) in the Field Plan or other project documents.

Considerations and guidelines for IDW management for specific field tasks are provided below.

2.1. Test Pit Excavation

- Segregate contaminated soil from uncontaminated soil using visual and/or field screening methods.
- Use appropriate barrier (such as two layers of 6-ml plastic sheeting) for temporary stockpiling of contaminated soil adjacent to test pit.

- Backfill test pits with uncontaminated soil, unless otherwise directed by project manager.
- If directed by the Project Manager to return contaminated soil to the test pit, backfill soil in the same order as the soil was excavated from the test pit.

2.2. Boring/Monitoring Well Installation

- For auger borings, segregate contaminated soil (determined by visual and/or field screening methods) from uncontaminated soil during drilling. Segregate residual contaminated soil from split-spoon sampling.
- Auger cuttings or sediment generated by drive and wash may be spread around the ground surface at the boring location if it is acceptable to the client and the governing regulatory agency. If not, IDW may be placed in an appropriate area or container pending characterization and appropriate disposal. (A useful rule of thumb is to assume generation of one 55-gallon drum of cuttings for each 20 feet drilled with 7-¼-inch-I.D. augers).
- Segregate contaminated drilling fluid from uncontaminated fluid for rotary wash borings.
- Drilling fluid management options include pouring the drilling fluid on the ground near the boring location, if acceptable to the client and governing regulatory agency, or containerizing the fluid in drums or tanks.

2.3. Well Development/Sampling

Contaminated groundwater removed from wells by pumping or bailing for the purpose of well development and sampling may be poured on the ground near the well, if it is acceptable to the client and the governing regulatory agency. Otherwise, it should be containerized in drums or tanks.

2.4. Decontamination Fluids

Decontamination fluids may be poured on the ground in the vicinity of the well if approved by the project manager. Alternatively, the fluids may be containerized in drums or tanks.

2.5. Disposable Personal Protective Equipment

Disposable personal protective equipment (PPE) should be managed like any other IDW. However, with the clients' and project manager's approval, it may be removed from the site and disposed of as ordinary rubbish if it has not come into contact with contaminated materials.

3. Limitations

- The simplest IDW management option is to return the IDW to its source location.
- However, the selected IDW management options must meet state/federal regulations and have the client's approval. Consult with state/federal policies for IDW-related matters.

- The client is responsible for the disposal of IDW, should disposal be necessary.

4. References

Guide to Management of Investigation - Derived Wastes (April 1992), United States Environmental Protection Agency, Publication 9345.3-03FS.

Standard References for Monitoring Wells, Massachusetts Department of Environmental Protection, Publication No. WSC-310-91.

5. Attachments

Attachment A - Summary of Investigation Derived Waste Management Options
Attachment B - CTDEP Waste Guidance

6. Contacts

David Terry
Leslie Lombardo

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS
GEI Consultants, Inc. Standard Operating Procedures
Management of Investigation - Derived Waste

Type of IDW	Generation Processes	Management Options	Remarks
Soil	Boring/monitoring well installation Test pit excavation Soil sampling	Return to source location immediately after generation	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Spread around boring, test pit, or original source location	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Containerize and temporarily store on site	Can temporarily store in stockpiles or covered containers (i.e. drums, roll-off containers). Stockpiles must be underlain by plastic sheeting and covered with plastic sheeting. Plastic sheeting must be secure. Storage consistent with state/federal regulations.
		Send to off-site, treatment or disposal facility within appropriate timeframes	Requires proper shipping documents (i.e. manifest, Bill of Lading, etc.), analytical characterization
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Store temporarily awaiting laboratory analysis.	Storage consistent with state/federal regulations. Can temporarily store in stockpiles or covered containers (i.e. drums, roll-off containers). Stockpiles must be underlain by plastic sheeting and covered with plastic sheeting. Plastic sheeting must be secure.
Sediment/Sludge	Sludge pit sampling Sediment sampling	Return to source immediately after generation	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Store temporarily on site.	Storage consistent with state/federal regulations.
		Send to off-site facility within 90 days	Requires manifests, analytical characterization
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS
GEI Consultants, Inc. Standard Operating Procedures
Management of Investigation - Derived Waste

Type of IDW	Generation Processes	Management Options	Remarks
Aqueous liquids (groundwater, surface water, drilling fluids, other wastewater)	Well installation/development Well purging during sampling Ground water discharge - pump tests Surface water sampling	Pour onto ground close to well	Non-hazardous liquids only. Should not exhibit a sheen or separate phase product. Do not discharge to the ground up-gradient of the source location. Ensure that it is permissible by local, state, and Federal regulations Is acceptable to the client, the governing regulatory agency, and the project manager.
		Store temporarily on site	If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Send to off-site commercial treatment unit within appropriate timeframes	Refer to State regulations for appropriate timeframe. Requires appropriate shipping documents (i.e., manifest, Bill of Lading), analytical characterization
		Send to POTW	Obtain appropriate discharge permit(s)
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. Consistent with final remedial action
		Discharge to surface water	OK if it complies with state and federal regulations. Obtain appropriate discharge permit(s).
Decontamination fluids	Decontamination of PPE and equipment	Store temporarily on site	If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Send to off-site facility within appropriate timeframes	Requires manifests, analytical characterization
		Store for future treatment and/or disposal. Storage consistent with state/federal regulations.	Consistent with final remedial action
Disposable PPE	Sampling, drilling, and test pit excavation observation, other on-site activities	Store temporarily on site	Dispose of appropriately after characterization
		Place in on-site industrial dumpster	Project-specific determination required – must be acceptable to client and project manager
		Send to off-site facility within 90 days	Project-specific determination required
		Store for future treatment and disposal.	Storage consistent with state/federal regulations. Project-specific determination required

Notes:

1) PPE - personal protective equipment
2) POTW - publicly owned treatment works
3) Generation processes listed here are provided as examples.
   IDW may also be generated as a result of other site activities.
4) RCRA Container/Waste Pile/Tank requirements:
   Containers; 40 CFR 264 Subpart I and 265 Subpart I
   Waste Piles; 40 CFR 264 Subpart L and 265 Subpart L
   Tanks; 40 CFR 264 Subpart J and 265 Subpart J

Connecticut Department of Environmental Protection

Connecticut's RCRA "Contained-In" Policy

Characterization of Contaminated Soil and Groundwater

Policy
RCRA hazardous waste determinations for contaminated soil and groundwater may compare contaminant concentrations with the characterization criteria below. If the concentrations are below these criteria then the soil and groundwater do not need to be managed in Connecticut as RCRA hazardous waste. If the concentrations are above these levels then the soil/water must be treated, stored, transported, and disposed in the same manner as hazardous waste.

Purpose
To simplify the management of non-hazardous contaminated soil and groundwater and to encourage remediation of contaminated sites.

Applicability
This policy applies to contaminated soil and groundwater managed in Connecticut. It does not establish cleanup criteria. When contaminant concentrations are below the levels described in this policy, but are greater than applicable Connecticut Remediation Standard Regulations ("RSR") criteria, then the soil and groundwater must be handled as non-hazardous contaminated soil and groundwater subject to applicable RSR polluted soil reuse requirements and to Connecticut solid waste requirements.

Contaminant	Soil Characterization Criteria	Groundwater Characterization Criteria
Characteristically hazardous waste **"D codes"**	Non-hazardous if below levels in Toxicity Characteristic Table in 40 CFR 261.24 ("TC Table")[1]	Non-hazardous if below levels in Toxicity Characteristic Table in 40 CFR 261.24 ("TC Table")
Listed hazardous waste **"F,K,P,U codes"** See 40 CFR 261.33 for **"P"** & **"U"** See 40 CFR 261 Appendix VII to identify constituents for which **"F"** & **"K"** wastes are listed.	Non-hazardous if below the lower of A and B: **(A)** Industrial/Commercial Direct Exposure Criteria in RSR[2] **and** --- [choose one method from B]: **(B) either** TC Table[1] **or** 100 x GA Pollutant Mobility Criteria in RSR[3] **or** 100 x Groundwater Protection Criteria in RSR[4]	Non-hazardous if below 100 x GA Groundwater Protection Criteria in RSR

1. via Toxicity Characteristic Leachate Procedure ("TCLP")
2. via mass analysis
3. via mass analysis or leachate analysis
4. via leachate procedure (eg: TCLP or Synthetic Precipitation Leachate Procedure

STANDARD OPERATING PROCEDURE

SC-004 Headspace VOC Screening

1. Objective

Describe methods to obtain site-specific measurement of the total volatile organic compound (VOC) concentrations present in the headspace of a jar containing soil.

This information can be used for several purposes:

- Segregate soil based on degree of contamination.
- Identify samples for quantitative analysis of VOCs.
- Evaluate the presence or absence of VOCs in soil.

2. Execution

- A photoionization detector (PID) or flame ionization detector (FID) instrument is used to measure VOCs in jar headspace (JHS) screening.
- Select the appropriate instrument, lamp, and calibration gas for the site-specific contaminants. Calibrate the instrument in accordance with the manufacturer's instructions before JHS screening begins. Record the type of calibration gas, detector, lamp, and results of calibration in the field notebook.
- Note the highest VOC concentration that the instrument measures in air in the work area before performing JHS screening. Record this as the initial background concentration.
- Half-fill a clean, glass jar with the soil. Quickly cover the open top with one or two sheets of clean, aluminum foil and screw on the cap to tightly seal the jar. Label the jar with the sample location and sample depth.
- Allow headspace development for at least 10 minutes at an ambient temperature of 50°F or greater. Vigorously shake the jar for 15 seconds at the beginning and end of the headspace development period. When ambient temperatures are below 50°F, place the jar in a heated vehicle or building during the headspace development period.
- After headspace development, remove the screw cap to expose the foil seal. Quickly puncture the foil seal with the instrument's sampling probe and insert it to a point at about one-half of the headspace depth.
- Record the highest VOC concentration that the instrument displays as the JHS concentration. The highest concentration should occur between 2 and 5 seconds after probe insertion.

3. Limitations

- The instruments may work poorly in the rain and in freezing temperatures. Under such conditions, operate the instrument in a heated vehicle or building if possible.

- Prevent water and soil particles from entering the tip of the instrument probe. Use a filter on the instrument's probe.
- Measure background VOC conditions and perform JHS screening away from non-site-related VOC sources, such as vehicle and heavy equipment exhaust.
- The VOC concentration on the instrument's display may vary when the air contains high VOC concentrations or high moisture.
- JHS screening is a guide that helps the screener to segregate soils into broadly defined categories. JHS screening results may differ by orders of magnitude from laboratory testing results.
- Note that states may have specific procedures for field monitoring. In Massachusetts, the Massachusetts Department of Environmental Protection (DEP) requires that screening of gasoline-contaminated soil be performed in accordance with Attachment II of the DEP's policy #WSC-94-400 Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. Consult this procedure or any relevant guidance documents for assistance.

4. References

Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. (April 1994), Massachusetts Department of Environmental Protection, Policy #WSC-94-400.

5. Contacts

Lynn Willey
Leslie Lombardo

Section 6

Solid Matrix Sampling (SM)

STANDARD OPERATING PROCEDURE

SM-001 Soil Sampling Techniques Including Split-Spoon

1. Objective

Describe standard procedures for the collection of surface and subsurface soil samples.

The definition of "surface" soil varies considerably between regulatory organizations. Surface soils may be classified as soils between the ground surface and 2 inches below ground surface, ground surface and 6 inches below ground surface, and even as much as ground surface and 24 inches below ground surface.

The definition of subsurface soil will vary in relation to the definition of surface soil. In general, subsurface soil is everything deeper than surface soil.

Refer to state-specific regulations for the definitions of surface and subsurface soils.

2. Execution

2.1. Surface Soil Sampling

Collection of surface soil samples can be accomplished with tools such as spades, shovels, trowels, scoops, etc. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required.

- Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
- Using a decontaminated stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
- If volatile organic compound (VOC) analysis is to be performed, transfer the sample directly into an appropriate labeled sample container with a stainless steel lab spoon, small diameter core device, or equivalent and secure the cap tightly.
- Place the remainder of the sample into a decontaminated stainless steel, plastic, or other appropriate container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval.
- Either place the sample into appropriate labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the container and mix thoroughly.
- When compositing is complete, place the sample into appropriate labeled containers and secure the caps tightly.

2.2. Sampling with Hand Augers and Thin Wall Tube Samplers

Several types of augers are available; these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are generally better for direct sample recovery because they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and generally cannot be used below a depth of approximately three feet.

2.2.1 Auger Sampling

- Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.
- Attach the decontaminated auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
- After reaching the desired depth, carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole.

2.2.2 Thin-Walled Core Sampling

- Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
- Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.
- Remove the tube sampler, and unscrew the drill rods.
- Remove the cutting tip and the core from the device.
- Discard the top of the core (approximately 1 inch), as this may represent material knocked down from the sides of the boring and not the layer of interest. Place the remaining core into the appropriate labeled sample container.

One type of thin-wall sampler is depicted in Attachment A (this is typically used with a mechanical drill rig).

For either method, If VOC analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, small diameter core sampler, or equivalent and secure the cap tightly. VOC samples should be collected first to minimize the potential for losing volatiles prior to sample collection.

Place the remainder of the sample into a stainless steel, plastic, or other appropriate container and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the container and mix thoroughly.

When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow previous steps, making sure to decontaminate the auger and tube sampler between samples.

Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

2.3. Sampling at Depth with a Split-Spoon (Barrel) Sampler

Split-spoon sampling is generally used with a mechanical drill rig to collect undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split-spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split-spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted. A diagram of the split-spoon sampler assembly is provided as Attachment A.

When split-spoon soil sampling is performed to gain geologic information, work should be performed in accordance with ASTM D1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". The following procedures are used for collecting soil samples with a split-spoon:

- Select the size (length and diameter) of split-spoon sampler based on the amount of soil that is needed for characterization. The ASTM standard for N-values is 1 3/8 - inch I.D (2-inch O.D.). Specify spoon size and basket type to driller prior to mobilization to the site. Split spoon samplers are typically available in 1 3/8 – and 3 – inch I.D. sizes. A larger barrel may be necessary to obtain the required sample volume. Note on the boring log where larger split spoon barrels are used because the ASTM standard penetration test does not apply when driving split spoons larger than 1 3/8 I.D. (2-inch O.D.).

- Select a soft or stiff basket for the spoon (a softer basket generally works better for loose or soft material).
- Prior to hammering the split spoon to collect the sample, verify that the split-spoon is seated at the beginning of the desired sample interval. If it is seated above the interval, have driller clean out the hole prior to sampling. Record all depth measurements relative to ground surface.
- Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top. See diagram in Attachment A.
- Place the sampler in a perpendicular position on the sample material.
- For all soil samples, use a 140-lb hammer falling 30 inches to drive the sampler, unless conditions necessitate using a 300-lb hammer.
- Record in the site fieldbook or on field data sheets the length of the tube used to penetrate the material being sampled, the split-spoon inside and outside diameters, and the hammer weight,
- Count and record the number of blow counts per 6-inch increments (confirming blow counts with driller if necessary).
- Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The length of recovery and soil type should be recorded on the boring log. If a soil sample is desired, a decontaminated stainless steel knife or spatula should be used to divide the tube contents in half, longitudinally. If possible, avoid collecting soil that has come in contact with the walls of the spoon, and soil at the top of the spoon.
- Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.
- Note any material in the nose (shoe) of the spoon.
- Immediately collect a sample for VOCs (if required by the site-specific field sampling plan) by collecting soil from the entire length of the split spoon, unless otherwise specified by the project manager. When the most impacted interval is sampled for laboratory analysis, screen the spoon with the field instrument first, then collect the soil sample for VOC analysis from the appropriate interval.

3. Limitations

- Weather conditions (e.g., frozen ground) may prevent the collection of samples and should be considered prior to sample collection.
- Tools plated with chrome or other materials should not be used.
- Be aware of local laws regarding subsurface utility clearance prior to conducting subsurface investigations. Contact DigSafe or local utility companies as required.
- Be aware of the length of the drill string, the sample depth, and the required stickup of the drill string to ensure accurate sample interval measurement.
- If drilling with hollow-stem augers, the removal of the drill string from the hole, prior to attaching the split-spoon sampler, may cause soils to be sucked up

into the augers (blow-in running sands). Upon recovery, determine if there is blow-in in the split spoon sampler. In general, blow-in is more unconsolidated than the rest of the sample and lacks stratification (do not include blow-in for recovery of sample collection).

- If soils consist of loose sands or soft clay, the drill string and sampler may advance slightly under its own weight, giving a false depth for soil collection.
- Never sample more than two spoons consecutively without advancing the augers unless material is tight. Do not let the split spoon penetrate more than it can hold.
- In many instances, groundwater will fill the auger and the split-spoon.

4. References

ASTM D1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". 2008.

United States Environmental Protection Agency, SOP 2012 "Soil Sampling", Revision 0.0, February 18, 2000.

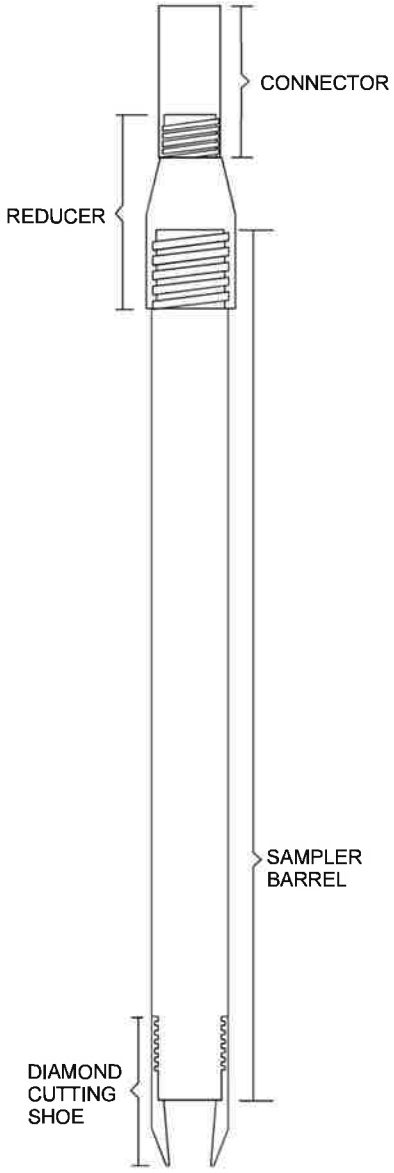
5. Attachments

Attachment A - Sampler Design Assembly

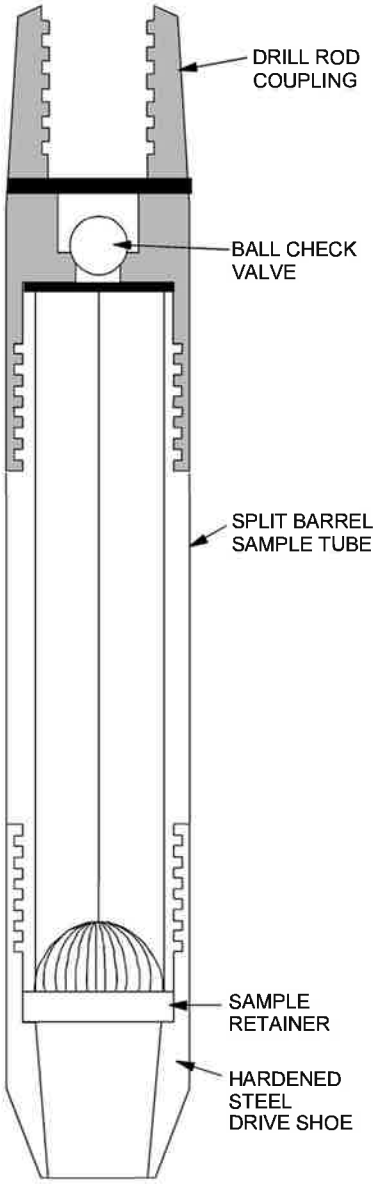
6. Contacts

Gary Fuerstenberg
Mark Ensign

THIN WALL HQ CORE SAMPLER
(2" width x 60" length)



SPLIT-SPOON SAMPLER
(2" width x 24" length)



STANDARD OPERATING PROCEDURES SM-001	GEI Consultants	**THIN WALL AND SPLIT-SPOON SAMPLERS**
NEW ENGLAND AND ATLANTIC REGIONS	June 2011	Attachment A

I:\STANDARD\DETAILS\SUBSURFACE\SAMPLERS\SPLIT-SPOON.ppt

STANDARD OPERATING PROCEDURE

SM-003 Classification of Soil Samples in the Field

1. Objective

Describe methods to classify soil samples collected in the field in a consistent manner.

2. Execution

- Describe soil samples according to *ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and* Attachments A and B. This standard is the basis for the Unified oil Classification System.
- Identify and record the soil in terms of the major and minor constituents (i.e., sand gravel, silt, clay), Unified Soil Classification Symbol, sample structure, plasticity and dilatancy for fine-grained soils, color, local or geologic name if known (e.g., Boston Blue Clay or glacial till), odor, presence of iron or other staining, and presence of organic matter, shells, debris, or other unusual characteristics of the same.
- If a soil split-spoon sample contains more than one soil type (for example, the upper portion is silty sand and the lower portion is clay) describe each type separately.
- Record sampler type, blow counts, soil description, etc. on the boring log (see Attachment C).
- GEI consistently applies one modification to the ASTM standard: Use "widely graded" and "narrowly graded" instead of "well-graded" and "poorly graded," respectively.

3. Limitations

Certain projects or clients will require the use of other classification systems. Other classification systems should not be used unless specifically required by the client. If the client requires that we use the Burmister method, obtain the details from the client. An example breakdown is shown below, but some clients (MassDOT, for example) have their own breakdown.

- "and" = 35-50%
- "some" = 20-35%
- "little" = 10-20%
- "trace" = 1-10%

- Describing soil samples is often difficult during cold or wet weather. Make sure your field notes describe these conditions. When possible, collect archive samples and verify sample descriptions in the office.

- The ASTM Standard Practice for Classification of Soils for Engineering Purposes (D2487) may be used in conjunction with the Visual-Manual Method to confirm the soil classification. D2487 includes laboratory testing.

4. References

ASTM D2487-06e1, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM, 2006.

ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM, 2009.

Field Guide for Soil and Stratigraphic Analysis, Midwest Geosciences Group Press, 2001-2005.

Coarse-Grained Soils Visual-Manual Descriptions, GEI Consultants, Soil Description Chart.

Fine-Grained Soils Visual-Manual Descriptions, GEI Consultants, Soil Description Chart.

5. Attachments

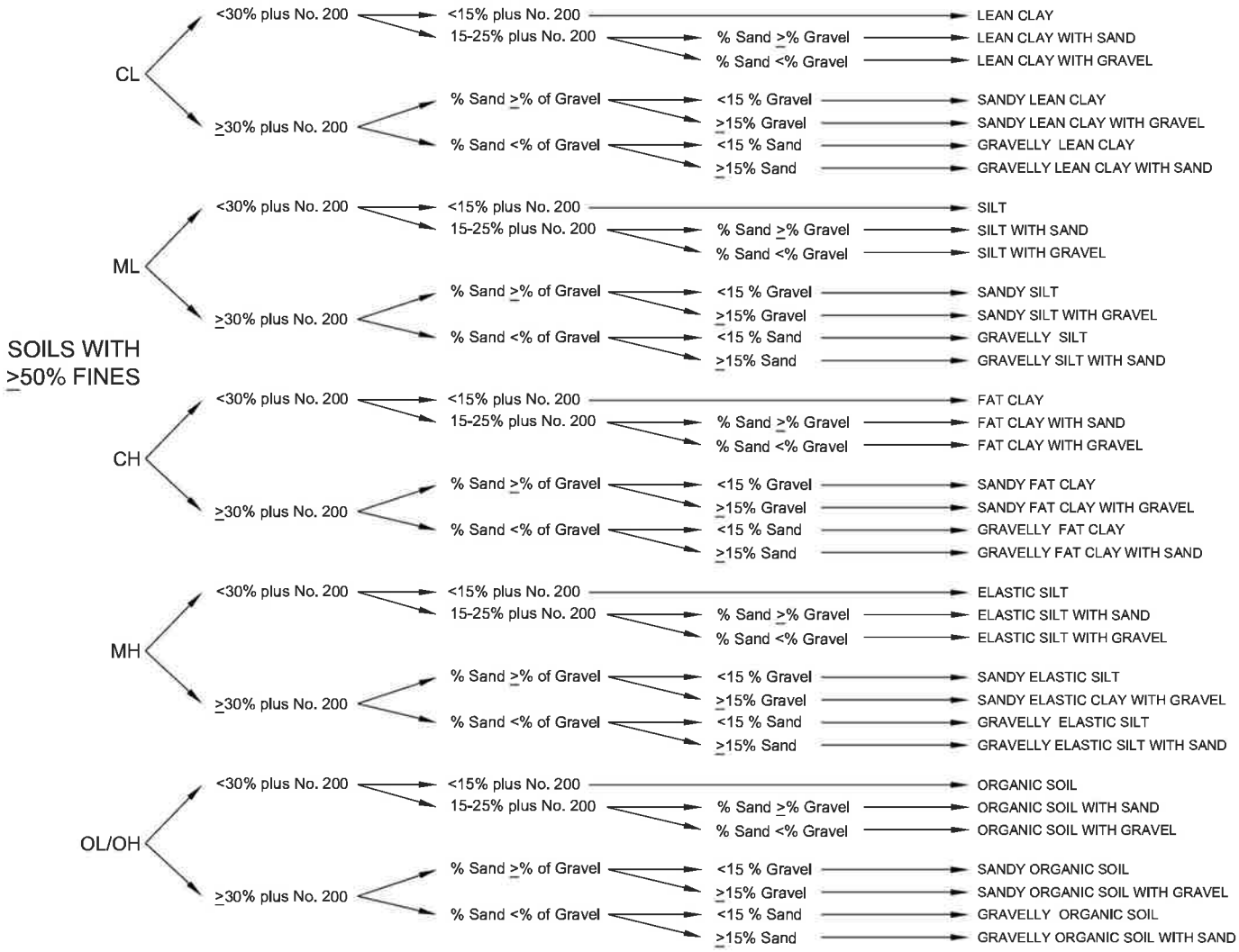
Attachment A – GEI Soil Description Charts (2007)
Attachment B – Visual Manual Descriptions with example boring log
Attachment C – Describing the Plasticity of Soil Samples

6. Contacts

Lynn Willey
Cathy Johnson

GEI Consultants

FINE-GRAINED SOILS
VISUAL-MANUAL DESCRIPTIONS



ID OF INORGANIC FINE SOILS FROM MANUAL TESTS

Symbol	Name	Dry Strength	Dilatancy	Toughness*
ML	Silt	None to low	Slow to rapid	Low or thread cannot be formed
CL	Lean Clay	Medium to high	None to slow	Medium
MH	Elastic Silt	Low to medium	None to slow	Low to medium
CH	Fat Clay	High to very high	None	High

1. GROUP NAME and (SYMBOL)
2. Describe fines, sand, and gravel components, in order of predominance. Include plasticity of fines. Include percentages of sand and gravel.
3. Color
4. Sheen, odor, roots, ash, brick, cementation, torvane and penetrometer results, etc.
5. "Fill," local name or geologic name, if known

PEAT

Peat refers to a sample composed primarily of vegetable matter in varying stages of decomposition. The description should begin: PEAT (PT) and need not include percentages of sand, gravel or fines.

CRITERIA FOR DESCRIBING PLASTICITY

Description	Criteria
Nonplastic ML	A 1/8-in. (3 -mm) thread cannot be rolled at any water content
Low Plasticity ML, MH	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit *
Medium Plasticity MH, CL	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High Plasticity CH	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

* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

COARSE-GRAINED SOILS

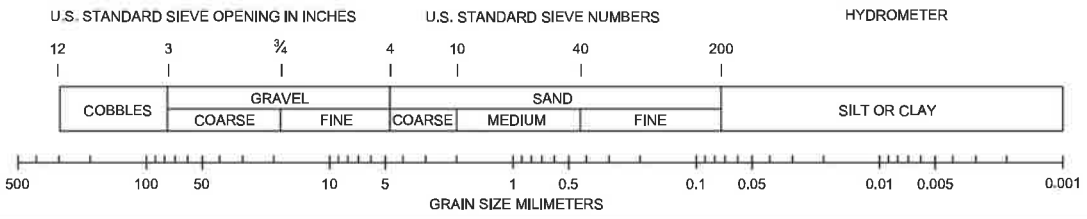
VISUAL-MANUAL DESCRIPTIONS

GEI Consultants

TYPICAL SOIL COLORS

- YELLOW
- OLIVE
- LIGHT BROWN
- BROWN
- REDDISH BROWN
- RED
- GRAY
- BLACK

			GROUP SYMBOL	GROUP NAME
GRAVEL (% Gravel > % Sand)	≤5% Fines	WIDELY GRADED	GW	<15% Sand → WIDELY GRADED GRAVEL
				≥15% Sand → WIDELY GRADED GRAVEL WITH SAND
		NARROWLY GRADED	GP	<15% Sand → NARROWLY GRADED GRAVEL
				≥15% Sand → NARROWLY GRADED GRAVEL WITH SAND
	~10% Fines	WIDELY GRADED	Fines = ML or MH → GW-GM	<15% Sand → WIDELY GRADED GRAVEL WITH SILT
				≥15% Sand → WIDELY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH → GW-GC	<15% Sand → WIDELY GRADED GRAVEL WITH CLAY
				≥15% Sand → WIDELY GRADED GRAVEL WITH CLAY AND SAND
		NARROWLY GRADED	Fines = ML or MH → GP-GM	<15% Sand → NARROWLY GRADED GRAVEL WITH SILT
				≥15% Sand → NARROWLY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH → GP-GC	<15% Sand → NARROWLY GRADED GRAVEL WITH CLAY
				≥15% Sand → NARROWLY GRADED GRAVEL WITH CLAY AND SAND
	≥15% Fines		Fines = ML or MH → GM	<15% Sand → SILTY GRAVEL
				≥15% Sand → SILTY GRAVEL WITH SAND
			Fines = CL or CH → GC	<15% Sand → CLAYEY GRAVEL
				≥15% Sand → CLAYEY GRAVEL WITH SAND
SOILS WITH <50% FINES				
SAND (% Sand ≥ % Gravel)	≤5% Fines	WIDELY GRADED	SW	<15% Gravel → WIDELY GRADED SAND
				≥15% Gravel → WIDELY GRADED SAND WITH GRAVEL
		NARROWLY GRADED	SP	<15% Gravel → NARROWLY GRADED SAND
				≥15% Gravel → NARROWLY GRADED SAND WITH GRAVEL
	~10% Fines	WIDELY GRADED	Fines = ML or MH → SW-SM	<15% Gravel → WIDELY GRADED SAND WITH SILT
				≥15% Gravel → WIDELY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH → SW-SC	<15% Gravel → WIDELY GRADED SAND WITH CLAY
				≥15% Gravel → WIDELY GRADED SAND WITH CLAY AND GRAVEL
		NARROWLY GRADED	Fines = ML or MH → SP-SM	<15% Gravel → NARROWLY GRADED SAND WITH SILT
				≥15% Gravel → NARROWLY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH → SP-SC	<15% Gravel → NARROWLY GRADED SAND WITH CLAY
				≥15% Gravel → NARROWLY GRADED SAND WITH CLAY AND GRAVEL
	≥15% Fines		Fines = ML or MH → SM	<15% Gravel → SILTY SAND
				≥15% Gravel → SILTY SAND WITH GRAVEL
			Fines = CL or CH → SC	<15% Gravel → CLAYEY SAND
				≥15% Gravel → CLAYEY SAND WITH GRAVEL





1. GROUP NAME and (SYMBOL)
2. Structure , if any. (stratified layer thicknesses, lenses, varves, gradational changes)
3. Describe sand, gravel and fines components, with percentages, in order of predominance. Include max gravel size. For test pits give percent cobbles and boulders, by volume, and include max size.
4. Color
5. Sheen, odor, roots, ash, brick, cementation, reaction with HCL, etc.
6. "Fill," local name or geologic name, if known

Describing the Plasticity of Soil Samples

M. Paster – November 2008

References ASTM D 2487 – Soil descriptions – lab
ASTM D 2488 – Soil descriptions – field
ASTM D 4318 – Atterberg limits testing

GEI Practice for Boring and Test Pit Logs

Describe the fines as:

Non-plastic
Low plasticity (The GEI laminated sheets incorrectly use "slightly plastic" for "low plasticity.")
Medium plasticity
High plasticity

Example: ~25% low plasticity fines

Toughness and dry strength:

You should use these tests to help decide how plastic the fines are. Record the results in the remarks column of the field log, but not in the soil description and not necessarily in the typed log.

On final logs, if Atterberg limits tests have been performed:

Do not use the descriptive terms non-plastic, low plasticity, etc. for samples on which Atterberg limits tests have been run. Instead, just give the percentage of fines and then report the actual Atterberg limits at the end of the description.

For example, the end of a silty sand description might be:
. . . ~25% fines, ~10% gravel max size ½ inch, gray. PL=23, LL=35.

(Atterberg limits tests are performed on the fraction of the sample finer than the No. 40 sieve, not just the fines. So the Atterberg limits data applies to the sample, not just to the fines.)

Hints:

High plasticity soils are rare in New England. If you think it's high plasticity, it's probably medium. Some Boston blue clay and some Connecticut River varved clays are high plasticity, but if you think you've found some, check with the project manager.

In New England, if ~10% fines or more, generally stick with GM, SM, ML, and CL. Occasionally GC, SC, CH. Don't use MH unless you have Atterberg limits data.

Estimating plasticity in the field, GEI guidance based on ASTM D 2488:

Plasticity	1/8-inch thread	Dry strength	Toughness
non	Cannot be rolled at any water content.	Dry specimen crumbles when handled.	Only slight pressure needed to roll thread near plastic limit.
low	Thread can barely be rolled.	Dry specimen crumbles with some finger pressure.	Slight to medium pressure needed to roll thread near plastic limit.
medium	Thread is easy to roll. Not much time needed to reach plastic limit.	Dry specimen crumbles with considerable finger pressure.	Medium pressure needed to roll thread near plastic limit.
high	Takes considerable time rolling and kneading to reach plastic limit.	Dry specimen cannot be broken with finger pressure.	Considerable pressure needed to roll thread near plastic limit.

Non-plastic vs. low plasticity:

ASTM D 2488 (soil descriptions - field) defines non-plastic and low plasticity based on the 1/8-inch thread as shown in the table above.

ASTM D 4318 (Atterberg limits testing) indicates that a sample should be called non-plastic for either of the following cases:

- The liquid limit test (dropping the cup) or the plastic limit test (rolling out the thread) cannot be performed because the plasticity is too low.
- The plastic limit is greater than or equal to the liquid limit.

Unfortunately, there are some soils that are low plasticity based on D 2488 (a thread can be rolled), but are non-plastic based on D 4318 (the liquid limit cannot be measured or PL≥LL).

GEI considers these soils to have low plasticity, because that is how they "look" and "feel." We want to document this information so that other people will have a better feel for what the soil looks like and how it behaves. So, if the soil was low plasticity based on D 2488, but non-plastic based on D 4318, that should be explained in the letter or report, and possibly in a note on the log.

BORING LOCATION Mople Ave Sidewolk
GROUND ELEVATION (NGVD) _____
GROUNDWATER EL. _____ DATE _____

DATE START/FINISH 2/14/07 - 2/15/07
DRILLED BY Geologic: M. Costigon
LOGGED BY T. Kohl/M. Yoko TOTAL DEPTH (FT) 25

B101

PG. 1 OF 1

EL. FT.	DEPTH FT.	SAMPLE TYPE and NO.	SAMPLE BLOWS PER 6 IN.	SAMPLE PEN IN.	SAMPLE REC IN.	PID JAR HS / REMARKS	GRAPHIC LOG	SOIL AND ROCK DESCRIPTIONS
	0						FILL	4" povement
		S1	13-9 17-14	24	0	0.5 ppm		S1: Redrove 0.5 to 3.5 ft. Recovery 11": WIDELY GRADED SAND (SW) ~85% sond, ~10% grovel to 1", <5% nonplostic fines, brown. Contoins brick frogments ond osh. Fill.
	2.5					hord drilling 3 to 4 ft, possible boulder		
	5	S2	7-7 11-13	24	8	2.0 ppm		S2: NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) ~65% mostly fine sand, ~25% grovel to 3/4 inch ~10% non-plostic fines, brown. Fill.
	7.5	S3	9-10 2-1	24	16	0.0 ppm	ORGANICS	S3 (0-10"): Similor to S2.
	10							S3 (10"-16"): ORGANIC SILT (OL) ~100% slightly plostic fines, dork groy, orgonic odor, contoins white shell frogments.
	12.5	S4	WOH 1-2 1	24	15	0.0 ppm		
	15					hord drilling ot 15.5 ft		S4: Similor to S3, bot 6".
	17.5	S5	20-35 50/3"	15	8	Top of rock ~19 ft. Roller bit to 20 ft.	TILL	S5: SILTY SAND WITH GRAVEL (SM) ~60% mostly fine sond, ~25% slightly plostic fines, ~15% grovel to 1/2 inch, olive. Glociol Till.
	20						ROCK	C1: SCHIST, hord, slight weothering ot joint surfoces, joints ot ~30 degrees from horizontol ond generolly porollel to foliotion, groy. Morlborough Formotion.
	22.5	C1	RQD 70%	60	54	lost ~10 gollons drill fluid from 23 to 25 ft		
	25							Bottom of Boring 25 ft
	27.5							Truck-mounted drill rig. 4-inch cosing to 19 ft. Sofety-hommer with rope ond cothead for SPT. Bockfilled with drill cuttings.
	30							

BLOWS PER 6 IN.–140 LB. HAMMER FALLING 30 IN. TO DRIVE A 2.0 IN. OD SPLIT SPOON SAMPLER
PEN–PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC–RECOVERY LENGTH OF SAMPLE
RQD–LENGTH OF SOUND CORES > 4 IN./ LENGTH CORED, %
S–SPLIT SPOON SAMPLE
U–UNDISTURBED SAMPLES, UF–FIXED PISTON UO–OSTERBERG
▽ GROUNDWATER

NOTES:
1: Groundwoter ot 10 ft depth ot stort of doy 2/15/07.

PROJECT 07999-0
DATE

GEI Consultants

EXAMPLE SOIL DESCRIPTIONS

SANDY SILT (ML) ~60% slightly plastic fines, ~40% mostly fine sand, 1" thick layer of fine to medium sand with <20% fines, gray.

LEAN CLAY (CL) ~90% moderately plastic fines, ~10% fine sand, olive. Boston Blue Clay. Sv = 0.5, 0.5, 0.8 tsf, Qp = 1.0, 1.5, 1.6 tsf

Stratified CLAYEY SAND (SC) and WIDELY GRADED SAND (SW) SC layers 1 to 2 inches thick consist of fine sand with ~30% moderately plastic fines, gray. SW layers 1 to 4 inches thick consist of fine to coarse sand, ~10% gravel to 1/2 inch, <5% fines, brown. Hydraulic Fill.

EXAMPLE ROCK DESCRIPTIONS

(0-9"): GRANITE, hard, one piece, joint surface slightly weathered, pink.
(6-60"): PHYLLITE, joints ~ 45° generally parallel to foliation, 9" to 44" moderate to severe jointing and joint weathering. 44" to 60" single piece, green-gray.

ARGILLITE, medium hard, moderately weathered joints, gray. Cambridge Argillite.

GEOPROBE AND ROTOSONIC

When SPTs are not performed, note sample density (sands) or stiffness (clays) in description.

CRITERIA FOR DESCRIBING DILATANCY OF FINE-GRAINED SOILS

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.

SPT: Standard Penetration Test

30-inch drop with 140-lb hammer
1 3/4 to 2 1/4 turns around cathead
2-inch O.D. split spoon sampler

ENV'L TERMINOLOGY FOR SOIL DESCRIPTIONS

- **Ash** - Typically silt-size to medium sand-size.
- Do not use the term "cinders." This is not a technical term. Instead, use "ash," "burnt wood," "burnt material," or a similar term.
- **Coal-like material** - If it looks like coal but you aren't sure.
- **Clinker** - Vitrified (glass-like) or heat-fused material. Often burned impurities in coal. Often looks like pumice, but heavier.
- **Slag** - Similar to clinker, but normally refers to residue from metal ore processing.

- **Sheen** - Iridescent petroleum-like sheen. Not to be used for a "bacterial sheen," which can be distinguished by its tendency to break up on the water surface at angles. Petroleum sheen will be continuous and will not break up.
- **Stained** - Use with a color ("brown-stained") to indicate that the soil is stained a color other than its natural (unimpacted) color.
- **Coated** - Soil grains are coated with NAPL (oil, tar, etc.). There is not enough NAPL to saturate the pore spaces. ("Split spoon sampler coated with brown oil." "Soil grains coated with gray substance with slight gasoline-like odor.")
- **Saturated** - The entire sample pore space is saturated with NAPL. If you use this term, be sure it is not water saturating the pore spaces. Depending on viscosity, the NAPL may drain from a soil sample. ("Sample saturated with green, sticky substance.")
- **Blebs** - Discrete spherical of NAPL in a soil matrix that was not visibly coated or saturated. ("Occasional blebs of reddish-brown tar.")
- **Oil** - Exhibits a petroleum odor, different from MGP odors.
- **Tar** - Exhibits an MGP odor (e.g. naphthalene-like odor).

- **Odors** - Use terms such as "naphthalene-like odor" or "petroleum-like odor." Use modifiers (strong, moderate, slight) to indicate odor intensity.

STANDARD OPERATING PROCEDURE

SM-004 Test Pit Excavation

1. Objective

Describe methods for excavating test pits and documenting findings.

The test pit is used to characterize geologic strata, subsurface conditions and provide access for collection of representative soil samples from these strata.

2. Execution

- Before digging begins, proper permits and notifications must be obtained, in accordance with applicable rules or regulations.
- Make sure that utility clearance has been conducted. Contact the property owner to determine the location of underground utilities. Verify, with the contractor that local/regional utility clearance service has been contacted. Ask subcontractor to provide local/regional utility clearance service authorization number and record this in the field notebook. Show the contractor the approximate excavation area, and have the contractor confirm that the area is suitable for excavation. Clearance may require marking of subsurface explorations prior to contacting utility clearance service.
- Have contractors pressure wash or steam clean equipment before beginning field activities, if necessary.
- Observe the contractor excavating the designated area.
- If contamination is suspected, have the contractor place excavated material on plastic sheeting.
- During excavation, monitor ambient air for contaminants of concern identified in the site-specific Health and Safety Plan. Record readings in field notebook (see SOP FD-001 Field Notebook).
- Record in a field book or test pit log:
    - Test pit dimensions,
    - Soil classifications (see SOP SM-003 Soil Classification)
    - Visual and olfactory indications of contamination
    - Subsurface structures
    - Obstructions to excavation
    - Any other observations relevant to the project objectives
    - Take photographs of excavation and completed test pit walls, etc. (SOP FD-004 Photodocumentation).
- Record technical information on a PDA, test pit log form, or a field book.
- Label sample bottles (see SOP SC-002 Sample Handling).
- Screen soil samples for contaminants of concern and record results in the field notebook or test pit log.
- Collect soil samples from the test pit as designated in the work plan including sidewalls and bottom at designated depths, at strata changes, or based upon

field screening using remote sampling equipment (backhoe bucket, stainless steel remote sampler, etc.). Do not enter a test pit unless side slopes satisfy Occupational Safety and Health Administration (OSHA) regulations and other health and safety concerns have been addressed.

- Transfer soil samples to the appropriate glassware according to soil sampling SOPs (SOP SM-002 VOC Soil Collection and Preservation Method, etc.).
- Store samples on ice in a cooler (see SOP SC-002 Sample Handling and SOP FD-003 Chain-of-Custody).
- Backfill excavation as soon as possible with material as described in the field plan. Place the excavated material back in the excavation in approximately the same strata it came from.
- Segregate contaminated soil as necessary (see SOP SC-003 IDW). Properly identify segregated material and secure as described in the work plan.
- Measure dimensions of excavation and record in the field notebook or test pit log. If sampling locations are to be surveyed, mark the corners and provide surveyor with location ID.
- Sketch dimension and location of the test pit relative to a site reference point and record in the field notebook. Note the sample locations by number on a cross-section sketch and plan view sketch.

3. Limitations

- Never enter the excavation unless it is shored or the sidewalls are sloped in accordance with OSHA regulations and all proper personal protective safety precautions have been considered and implemented.
- Terminate excavation if the flow of groundwater into the excavation adversely affects the stability of the excavation (i.e., slumping). Make sure to note in the field notebook or test pit log the depth to ground water.
- Terminate excavation if drums, tanks, or other potential sources of contamination are observed. Record visible drum markings, labels, and any other pertinent information on the test pit log and in the field notebook. Photograph drums and materials. Consult with the project manager before filling the excavation.
- Do not leave an open test pit unattended.

4. References

Earth Manual (1968), United States Department of the Interior, Bureau of Reclamation, United States Government Printing Office, Washington, D.C., pp. 134-139.

OSHA Standards for Excavations, Department of Labor, Federal Register, 29 CFR Part 1926, Aug. 9, 1994.

5. Contacts

Douglas Bonoff
Mark Ensign

Section 7

Groundwater (GW)

STANDARD OPERATING PROCEDURE

GW-001 Water Level and NAPL Measurement

1. Objective

Describe procedures to measure the depth to water and non-aqueous phase liquid (NAPL) thickness in an open borehole, cased borehole, monitoring well or piezometer.

2. Equipment and Materials

Field forms and/or field notebook.

- Decontamination fluids
- Bailer
- Weighted cotton string
- Oil/Water interface probe
- Water level meter (if oil/water interface probe is not available)

Water level and NAPL measurements can be collected by a variety of methods. A water level meter is used to collect depth to water measurements however an oil/water interface probe or other methods must be used to gauge NAPL depths. An electronic oil/water interface meter, consists of a cable divided into incremental measurements of 0.01 feet, and probe that consists of an infra-red circuit that detects the presence of a liquid, and a conductivity circuit that differentiates between conductive liquid (water) and non-conductive liquid (LNAPL or dense non-aqueous phase liquid [DNAPL] product). Typically, a steady tone and light indicate a non-conductive liquid (e.g. product) and an intermittent tone and light indicate a conductive liquid (e.g. water). Refer to the manufacturer's instructions for details. Alternately, water level and NAPL measurements can be collected using a water level meter, clear bailer and weighted cotton string. Each method of data collection is described below.

3. General Information

- The water level in a monitoring well or piezometer should be allowed to stabilize for a minimum of 24 hours after development or construction before groundwater elevation and/or NAPL measurements are collected. The water level in a borehole can be measured during drilling; however, this should be noted in the field notebook.
- Water levels in multiple wells should be collected within the shortest timeframe practicable.
- Water and NAPL levels should be measured from the designated survey point as specified by the surveyor or highest point (or "V" notch) on the PVC. If the well is new, mark the datum point with an indelible marker and note reference location in

field book. Discuss with the project manager what reference point should be used to collect water measurements for specific sites.

- Water level and/or NAPL measurements should be made before any water is removed from wells because doing so may influence groundwater levels in the area of the investigation.
- Measurements should be made approximately three times to confirm the measurement. Each time a measurement is made it should be determined to the nearest one-hundredth of a foot (0.01).
- Water level and/or NAPL measurements should first be collected at the wells that are least contaminated and proceed towards the wells that are most contaminated. Decontaminate the water level meter or oil/water interface probe prior to initial use and after use at each location. If NAPL is encountered at a well where it was previously not observed, contact your project manager before continuing.
- Refer to the oil/water interface probe or water level meter instruction manual for guidance on indicator signals, as these may differ by manufacturer.

4. Execution

4.1 Water Level and NAPL Measurements Using Interface Probe

- Open wells to the atmosphere and allow them to equilibrate prior to collecting LNAPL depth measurements.
- LNAPL Depth (if present): Measure the LNAPL/air interface by slowly lowering the interface probe to the LNAPL surface. Be ready to stop as soon as the probe signals the LNAPL surface.
- Record the depth to LNAPL.
- Groundwater Depth: Continue slowly lowering the probe until it signals the presence of water.
- Record the depth to water.
- The LNAPL thickness is determined by subtracting the water depth from the LNAPL depth.

The depth and thickness of DNAPL can sometimes be determined by slowly lowering the interface probe past the LNAPL (if present) and water layers. Record the depth to the DNAPL layer. Finally, measure the depth to the well bottom.

The DNAPL thickness is determined by subtracting the DNAPL depth from the depth to well bottom.

- Decontaminate the interface probe and tape according to SOP QA-001.
- Dispose of any NAPL-impacted debris properly.
- Check with the Project Manager if you are uncertain of the appropriate disposal method.

4.2 LNAPL Measurements Using Clear Bailer

If LNAPL is suspected at a site, an oil/water interface probe should be used when gauging water level and NAPL measurements. However, a water level meter and a clear bailer may be used instead to estimate approximate LNAPL thickness if an oil/water interface probe is not available.

- Open wells to the atmosphere and allow them to equilibrate prior to collecting LNAPL depth measurements.
- Slowly lower the water level meter until contact with fluid is indicated by the meter.
- Record the depth to fluid measurement.
- Lower a clear bailer into the well and slowly into the LNAPL. Do not submerge the bailer.
- Slowly raise the bailer out of the well and measure LNAPL thickness in the bailer using a ruler or tape measure.

Calculating Depth to Groundwater

The depth to water can be calculated as follows:

DTW = DTF + PT
DTW = Depth to Groundwater
DTF = Depth to Fluid
PT = Measured Product Thickness

Calculating Corrected Depth to Groundwater

Once the LNAPL thickness is known and the depth to groundwater is known, the corrected depth to groundwater can be calculated.

Corrected DTW = Static DTW – (PT x G)
DTW = Depth to Ground Water
PT = Measured Product Thickness
G = Specific Gravity (density of free product / density of water)

4.3 DNAPL Measurements Using Weighted Cotton String

A weighted cotton string may be used to estimate approximate DNAPL thickness.

- Secure cotton string.
- Secure clean steel nuts and/or washers.

- Tie the string to the nuts/washers, so that there is adequate weight.
- Lower the weighted string into the well slowly, until a firm bottom is sensed.
- Remove the weighed string and measure the DNAPL coated portion of the string.
- Record the thickness.
- Dispose of any NAPL-impacted debris properly. Check with the Project Manager if you are uncertain of the appropriate disposal method.

5. Health and Safety Considerations

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed job safety analysis (JSA) should be completed prior to the start of work.

6. Considerations

- Weak batteries in water level and oil/water interface meters frequently produce weak or gradual auditory and/or visual responses, making it difficult to accurately determine when the probe of the unit has come in contact with ground water or NAPL. As such, it is recommended that electronic ground water-level indicators be tested before they are brought out into the field.
- Electronic oil/water interface meters do not respond to distilled water. Do not use de-ionized water to test these units.
- Wells that are not vertical may result in probe contact with the side of the well casing providing a false measurement. Once the probe has come in contact with ground water in the well, water may be trapped by capillary action between the probe and the well casing. If this happens, the unit may continue to signal even after the probe has been raised above the ground water surface. The deeper the well, the more likely this problem may occur. To correct this, the cable should be raised several feet above the water and shaken to remove water from the probe. A new ground water-level measurement should then be collected. If the signals from the unit are not abrupt or reproducible, the probe and tape may need to be retrieved and dried off before trying again.
- Accumulation of sediment, organic material, or floating debris in the probe may also result in gradual or non-reproducible readings. Wells that are constructed with metal inner casings may lead to difficulties in collecting reproducible ground water-level measurements because the inner sides of the well casing are conductive.

- In some cases, a rubber grommet or metal centralizer may need to be placed on the probe so that it cannot contact the inner casing.
- Well gauging equipment should be properly decontaminated between wells and piezometers to avoid cross contamination.
- Water levels in wells may be influenced by changes in river stages, pumping of nearby wells, precipitation, tides, etc.
- Using a bailer to estimate LNAPL thickness can result in inaccuracies because successful use of the bailer is dependent upon the expertise of the operator and assumes the check valve does not leak upon retrieval.
- The optical sensor on interface probes may become damaged if solvents are used to clean NAPL from the probes.
- The optical sensor may become smeared when used to measure NAPL, rendering pinpoint accuracy to an estimate at best.
- Close attention to decontamination procedures will improve accuracy, operational life, and reduce the risk of cross contamination with other wells.
- LNAPL thickness can be affected by fluctuations in the water table. In some cases, an LNAPL's thickness may decrease when the water table rises, while its thickness increases as the water table drops. In other cases, fluctuating water tables may cause sudden appearances and disappearances of LNAPL layers.
- Monitoring points with LNAPL can pose a problem when measuring the level of groundwater. Floating LNAPL can depress the groundwater level in a monitoring well or piezometer and distort the measurement. Therefore, the Corrected Depth (CD) formula shown above should be applied to groundwater level measurements in monitoring points where LNAPL are present:
- Some interface probes are factory-calibrated based on an assumed conductivity of NAPL and water, both of which may vary. An interface probe that is functioning properly may not be able to discern different NAPLs at all sites.
- An interface probe may not successfully provide both LNAPL and DNAPL measurements in the same well because the probe is coated by LNAPL and loses its ability to detect DNAPL.
- DNAPL, in particular, may be only slightly heavier than water, or may be neutrally buoyant. As a result, it can be easily disturbed. Once it is disturbed, meaningful measurements can be difficult or impossible to obtain. As such, all tapes or probes used for measurements should be used slowly.

7. References

U.S. EPA Environmental Response Team Standard Operating Procedures SOP: 2043,"Water Level Measurement" REV: 0.0, 2/11/00

U.S. EPA Environmental Response Team Standard Operating Procedures SOP: 2044," Monitor Well Development" REV: 0.1, 10/23/01.

8. Contacts

Brian Conte – (860) 368-5412 Glastonbury
Mark Ensign – (781) 721-4010 Boston
Ryan Hoffman – (781) 721-4091 Boston

STANDARD OPERATING PROCEDURE

GW-002 Non-Aqueous Phase Liquid (NAPL) Recovery

1. Objective

Provide procedural guidance for routine recovery of non-aqueous phase liquids (NAPL).

2. Equipment and Materials

The following materials and equipment may be necessary for this procedure:

- SOP GW-001 Water Level and NAPL Measurement
- Oil/water interface probe
- Appropriate pump and required tubing/piping
- Double check valve bailers and string
- Drums or buckets for NAPL collection
- Proper personal protective equipment (PPE) including gloves and protective eyewear
- Drum labels
- Field data sheets or logbooks
- Decontamination supplies and plastic sheeting
- Additional equipment identified by site-specific work plan and health and safety plan (HASP)

3. General Information

Refer to SOP GW-001 and record the depth to NAPL and depth to water measurements If you are using an oil/water interface probe, first check to see if the unit is functioning correctly. Note: De-ionized water will not provide a correct reading. Check the interface probe battery and replace if necessary.

Interface probes usually distinguish between NAPL and water by sounding solid or intermittent tones. See the manufacturer's instructions for details.

4. Execution

4.1 General Measurement Procedures

Using an oil/water interface probe will provide a depth to water and a depth to NAPL in each monitoring well. Refer to probe manual to determine changes between liquid types (water, light non-aqueous phase liquid [LNAPL] and dense non-aqueous phase liquid [DNAPL]). To achieve accurate depth measurements, ensure the oil/water interface

probe is decontaminated (GEI SOP QA-001) prior to and between each measurement taken at each well.

To calculate the volume of NAPL in monitoring wells with well diameters specified below, use the following respective equations:

Light non-aqueous Phase Liquid (LNAPL) Volume

$$LNAPL\,V = (DTW - P_1) \times C$$

Dense Non-Aqueous Phase Liquid (DNAPL) Volume

$$DNAPL\,V = (TD - P_2) \times C$$

Where, V = Volume
DTW = Depth to Water
TD = Total Depth
P_1 = Depth to LNAPL
P_2 = Depth to DNAPL

Conversion factors (C) for wells based on well diameter size are noted in the table below.

Well Diameter (inches)	Conversion Factor (liters)	Conversion Factor (gallons)
2	0.6178	0.1632
4	2.4711	0.6528
6	5.561	1.469

Note: Well diameter sizes are noted for outer diameter. Conversion factors assume Schedule 40 PVC riser and screen, if well is constructed of different material appropriate conversion factors must be used to calculate accurate NAPL volume.

Once measurements have been taken and calculations have been made, collection of NAPL may commence.

4.2 NAPL Collection Procedures

Collection of NAPL shall be accomplished using common recovery techniques or technologies including:

- Peristaltic pump
- Bailer

Some projects require on-going NAPL recovery efforts. For these projects installation of dedicated recovery methods should be considered.

Special care shall be taken to prevent any recovered NAPL from spilling or coming into contact with the ground and sampling personnel. This includes the use of proper personal protective equipment (PPE), including gloves and protective eyewear (Tyvek® if necessary), along with plastic sheeting set beneath the pump, tubing, and collection

container (sealed top 55-gallon drum or 5-gallon bucket with lid), and the surrounding work area. A site-specific work plan, HASP and job specific job safety analysis need to be developed prior to the start of work. The specific operating procedures for common recovery methods are discussed in the following sections.

4.2.1 Sampling and Recovery via Peristaltic Pump:

LNAPL

- Take and record the required measurements prior to commencing pumping.
- Cut a length of poly tubing (T1) that is long enough to extend approximately 12-inches beyond the LNAPL layer. Cut an additional length of poly tubing (T2) that will be connected to the discharge side of the peristaltic pump silicone tubing that is long enough to extend from the pump to the NAPL collection container. Cut a length of silicone tubing (approximately 8-inches) for use in the peristaltic pump head.
- Insert the silicone tubing into the peristaltic pump head. Check the flow direction of the pump to ensure that the pump will be removing fluid and not pumping air into the well when removal begins.
- Insert T1 into the intake side of the silicone tubing. Lower the intake side into the well and secure in place just below the top of LNAPL.
- Insert T2 into the discharge side of silicone tubing and secure to the NAPL collection container with a clamp.
- Turn pump flow rate to lowest setting. Turn the pump on and slowly increase the pump rate to begin LNAPL removal from the well. Use the oil/water interface meter to measure the depth to LNAPL. Lower the intake tubing as necessary until all of the LNAPL has been recovered from the well.
- Once the LNAPL has been recovered from the well, collect and preserve a sample if required, in accordance with laboratory standards.
- Following completion of LNAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

DNAPL

- Take and record the required measurements prior to commencing pumping.
- Cut a length of poly tubing (T1) that is long enough to extend to the bottom of the well including additional length to attach to the pump intake. Cut an additional length of poly tubing (T2) that will be connected to the discharge side of the

peristaltic pump silicone tubing that is long enough to extend from the pump to the NAPL collection container. Cut a length of silicone tubing (approximately 8-inches) for use in the peristaltic pump head.

- Insert the silicone tubing into the peristaltic pump head. Check the flow direction of the pump to ensure that the pump will be removing fluid and not pumping air into the well when removal begins.
- Insert T1 into the intake side of the silicone tubing. Lower the intake side into the well and secure in place just above the bottom of the well.
- Insert T2 into the discharge side of silicone tubing and secure to the NAPL collection container with a clamp.
- Turn pump flow rate to lowest setting. Turn the pump on and slowly begin to remove DNAPL from the well. DNAPL removal will be complete when the pump begins to discharge water. Use the oil/water interface meter to check the DNAPL thickness during the removal process. Take care not to pump an excessive amount of water.
- Once the DNAPL has been purged from the well, collect and preserve a sample if required, in accordance with laboratory standards.
- Following completion of DNAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

4.2.2 Sampling and Recovery via Double Check Valve Bailer:

LNAPL

- Take and record the required measurements prior to commencing bailing.
- Ensure the work area is covered in plastic sheeting to avoid potential spills of water and/or NAPL.
- Tie the bailer to a piece of string that will allow the bailer to reach just below the LNAPL layer. Use the oil/water interface meter to determine the appropriate depth.
- Using slow and controlled motions while lowering (and raising) the bailer to the appropriate depth, commence bailing LNAPL out of the well and draining the bailer directly into collection container.
- Once the LNAPL has been purged from the well, collect and preserve a sample, if required, in accordance with laboratory standards.

DNAPL

- Take and record the required measurements prior to commencing bailing.
- Ensure the work area is covered in plastic sheeting to avoid potential spills of water and/or NAPL.
- Tie the bailer to a piece of string that will allow the bailer to reach the bottom of the well.
- Using slow and controlled motions while lowering (and raising) the bailer to the bottom, commence bailing DNAPL out of the well and draining the bailer directly into collection container.
- Once the DNAPL has been purged from the well, collect and preserve a sample, if required, in accordance with laboratory standards.

4.3 Waste Management and Disposal

Investigation derived waste should be managed in accordance with GEI SOP SC-003. DNAPL waste management and disposal should be evaluated on a site by site basis.

4.4 Troubleshooting Information

If there are any performance problems with the oil/water interface probe which result in inability to achieve the proper measurements presented in Section 5.1, or if there are any problems with the peristaltic pump, consult the appropriate section of the probe instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

Lower temperatures can affect the ability to pump and/or bail NAPL. Weather should be taken into consideration when scheduling gauging and recovery sampling events.

4.5 Data and Records Management

All information pertaining to maintenance of the oil/water interface probe and the peristaltic pump shall be maintained in the project file. Field measurements (depth to water, NAPL, etc.) and all calculations (NAPL column length, volume of NAPL, etc.) shall be recorded on the appropriate field data sheets or in the logbook consistent with GEI SOP Section 5.

4.6 Limitations

- NAPL gauging and recovery can be challenging and requires adaptive thinking. A variety of measurement and collection techniques may be necessary to properly execute the work.
- Exposure to NAPL can accelerate the required maintenance/replacement intervals for tools and equipment.

5. Health and Safety Considerations

The health and safety considerations for the work associated with this standard operation procedure, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed JSA should be completed prior to the start of work.

6. References

U.S. EPA. Ground Water Issue: Dense Non-aqueous Phase Liquids, EPA/540/4-91-002, March 1991.

7. Contact

Jerry Zak (860) 368-5404 Glastonbury

STANDARD OPERATING PROCEDURE

GW-003 Low Flow (Low Stress) Groundwater Sampling

1. Objective

Describe methods to collect groundwater samples most likely to produce results that represent aquifer conditions.

Low-flow purging is limited to wells that, with sustained pumping, exhibit no continuous drawdown.

2. Execution

- Prior to groundwater sampling consult with the project manager to confirm that the type of pump is appropriate and consistent with the approved work plan.
- Record activities in the field notebook (see SOP FD-001 Field Notebook) and on a Monitoring Well Sampling Record such as the examples in Attachment A. Use a separate form for each sampling location and event. You may forego the forms and record all information in the field notebook if the Project Manager approves.
- Calibrate pH, temperature, Specific Conductance (SC), turbidity, Dissolved Oxygen (DO), and Oxidation-Reduction Potential (ORP) on the meter(s). Use calibration methods provided by the manufacturer of the equipment. Note that appropriate calibration for dissolved oxygen requires a water saturated air environment, along with measured temperature and barometric pressure.
- Begin with the monitoring well believed to have the least contaminated groundwater and proceed systematically to the well with the most contaminated groundwater. Check the well, the lock, and the locking cap for damage or evidence of tampering.
- Slowly and gently measure the depth to water with a water level probe and/or oil-water interface probe. Do not measure depth to well bottom at this time (wait until sampling has been completed). Measure water level in accordance with SOP GW-001 Water Level Measurement.
- Attach new polyethylene or Teflon lined tubing to the sampling pump and the flow-through cell that contains the meter probes.
- Slowly and gently insert new polyethylene or Teflon lined tubing to the pump intake (or use dedicated tubing that remains in the well) and to the middle of the saturated screened interval or to the pre-determined sampling depth.
- The tubing intake should be kept at least two (2) feet above the bottom of the well to prevent disturbance or suspension of any sediment or Non-Aqueous Phase Liquid (NAPL) present in the bottom of the well. Record the depth of the pump intake.

- If possible, position your sampling equipment and tubing so that it is in the shade. The goal is to minimize the effect of sunlight raising the temperature of water being collected.
- Start the pump on the lowest setting and increase slowly until flow begins. Adjust the pumping rate so that drawdown in the well is minimal (0.3 feet or less, is desirable but not mandatory). Use a pumping rate between 100 to 1,000 milliliters per minute (mL/min) (or approximately 0.1 to 1 quarts per minute). Measure flow rate on the pump or using a graduated container every 3 to 5 minutes and record. The minimum purge volume will be twice the combined volumes of the sampling string (i.e. pump, tubing, and flow-through cell).
- While purging, record water levels every 3 to 5 minutes and monitor and record the water quality indicator parameters: pH, temperature, specific conductance (SC), dissolved oxygen (DO), and turbidity. If specified in the field sampling plan also include ORP.
- Purging is complete when, after three consecutive measurements, the water quality parameters have stabilized as follows:

    - pH (+/- 0.1 standard units)
    - temperature (+/- 3%)
    - SC (+/- 3%)
    - turbidity (+/- 10% if >5 NTU; if 3 values are <5 NTU, consider the values as stabilized)
    - DO (+/-10% if >0.5 mg/L; if 3 values are <0.5 mg/L, consider the values as stabilized)
    - ORP (+/- 10 mV)

- Dispose of purge water according to the field plan.

Sample Collection:

- Following purge, remove the discharge tubing from the flow-through cell. Do not disturb pump and tubing between stabilization and sample collection.
- Fill sample containers directly from the sampling device in order of decreasing volatility (i.e., Volatile Organic Compounds (VOC) samples are collected first; see SOP SC-002 Sampling Handling). Fill all containers from the discharge end of the tubing. Collect samples at a flow rate equal to the steady state purge rate.
- If not using a dedicated pump, remove sampling device and decontaminate (see SOP QA-001 Equipment Decontamination). Discard used tubing.
- Store samples in a cooler on ice for transport to the laboratory.
- Measure depth to bottom of well.

- Secure the well cap.

3. Limitations

- Prior to departure for the field, obtain available information on well construction for use in field investigation (i.e., screen and riser material, well diameter and depth, screened interval, optimum sampling depth, etc.).
- If possible, when using dedicated equipment, install equipment into well at least 24 hours before sample collection to minimize disturbance of the water column and/or suspension of sediments or NAPL on bottom.
- If water quality indicator parameters do not stabilize after removing 3 to 5 well volumes or 2 hours, contact the Project Manager. Three options will be available: 1) continue purging until stabilization; 2) discontinue purging and do not sample; or 3) discontinue purging and sample.
- The key indicator parameter for VOCs is DO. The key indicator parameter for all other samples is turbidity.
- Fill all sample containers with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.
- Consult with the project manager before field filtering samples for metals if using low-flow sampling.
- Be aware of any preservatives in the sample bottles and handle with care, in accordance with the Health and Safety Plan.

4. References

Standard Reference for Monitoring Wells (April 19, 1991), Massachusetts DEP, DEP Publication No. WSC-310-91.

Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground Water Sampling (1994), M.J. Barcelona, H. A. Wehram, and M.D. Varljen, Ground Water, Vol. 32, No. 1, 12-22.

Low-Flow Purging and Sampling of Ground Water Monitoring Wells with Dedicated Systems (1995), R.W. Puls, and C.J. Paul, Groundwater Monitoring and Review, Summer 1995 116-123.

Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (2010), EQASOP-GW 001 Low Stress (Low Flow) SOP, Revision 3, U.S. Environmental Protection Agency, Region I, January 19, 2010.

Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling, (1998), Ground-Water Sampling SOP, Final, U.S. Environmental Protection Agency, Region II, March 16, 1998.

RCRA Ground-Water Monitoring: Draft Technical Guidance, (1993), U.S. Environmental Protection Agency, EPA/530-R-93-001.

To Filter, or Not to Filter, That is the Question, (1997), Special Topics Subcommittee Letter Report EPA-SAF-EEC-LTR-97-011, April 29, 1997, Meeting, U.S. Environmental Protection Agency, Science Advisory Board Environmental Engineering Committee, September 5, 1997.

Should Filtered or Unfiltered Groundwater and Surface Water Samples be Collected for the Risk Assessment?, (1995), MCP Q&A: Subparts I and J, Special #4, Bureau of Waste Site Cleanup, Massachusetts Department of Environmental Protection (DEP), February, 1995.

5. Attachments

Attachment A - Monitoring Well Sampling Record

6. Contacts

Brian Conte
Saskia Oosting

MONITORING WELL SAMPLING RECORD

PID Reading _____ Job Name _____

Job Number _____ By _____ Date _____

Location _____ Measurement Datum _____

Well Number _____

Pre-Development Information Time (start) _____

Water Level _____ Total Depth of Well _____

One Purge Vol _____ Three Well Volume _____

Water Characteristics

Color _____ _____ Clear _____ Cloudy

Odor _____ None _____ Weak _____ Moderate _____ Strong

Any films or immiscible material _____

Volume **(gal)**	**Time**	**pH**	**Temp (°C)**	**Spec. Conductance (µS/cm)**	**Turbidity (NTU)**	**DO Conc. (mg/L)**	**ORP (mV)**	**TDS**

Total Volume Removed (gal) _____ pH _____

Temperature (°C) _____ Specific Conductance (µS/cm) _____

DO Concentration (mg/L) _____ ORP (mV) _____

TDS _____

Post Development Information

Time (Finished) _____

Water Level _____ Total Depth of Well _____

Approximate Volume Removed (gal) _____

Water Characteristics

Color _____ ____ Clear ____ Cloudy

Odor ____ None ____ Weak ____ Moderate ____ Strong

Any films or immiscible material _____

Comments

Low-Flow Groundwater Sampling Form

Project number and name _____ Sampling personnel _____ Sample date _____ Well ID _____

Well location description: _____

Well Construction

Well diameter _____

Well measurement point _____

Roadbox condition _____

Well screen interval _____

Well depth _____

Sampling Information

Initial depth to water _____ Time: _____

Sample intake depth _____

Pump type and ID _____

Stabilized flow rate _____

Stabilized flow rate = flow rate with no further drawdown

Samples Collected

VOCs 8260	
SVOCs 8270	
VPH	
EPH	
Metals	
PCBs	
Other	

Field values at time of sample collection:

Time: _____ Depth to water: _____

Sp.Cond. _____ mS/cm

DO _____ mg/L

ORP _____ mV

pH _____ s.u.

Temp. _____ °C

Turb. _____ NTU

Cumulative Time (min.)	Volume (gal)	Water depth (ft)	Temp. (°C)	Sp.Cond. (mS/cm)	D.O. (mg/L)	pH (s.u.)	ORP (mV)	Turb. (NTU)
Typical Groundwater Values			5 to 15	0.05 to 5	0 to 4	5 to 7	-100 to +500	aim for <10

Notes: _____

Sample Information:

Sample ID _____

Sample Time: _____

Color: _____

Turbidity: _____

Field Filtered YES / NO Analyses: _____

Filter type: _____

Odor/Sheen/NAPL _____

Duplicate Collected YES / NO

If yes, duplicate ID: _____

Purge water disposal? to ground drummed other:

Well Volume Conversion:

Diam. (in)	Factor (gal/ft)
1	0.04
1.5	0.09
2	0.16
4	0.65
6	1.50

well volume =
3.14 x (r)^2 x 7.48 gal/ft
where r = 1/2 diameter in ft

Stabilization Criteria:
Sp.Cond. +/- 3%
DO +/- 10%
ORP +/- 10 mV
pH +/- 0.1 Std Units
Temp. +/- 3%
Turb. +/- 10% if values >1 NTU

Guidance:

1 Position tubing at midpoint of saturated screened interval

2 Minimize drop in water level and purge until parameters are stable

3 Disconnect flow thru cell during sampling

4 Call Project Manager if issues arise (e.g. stabilization takes more than 2 hrs, well goes dry, odd data).

5 For VPH and VOC samples, if stabilization flow rate is less than 200 ml/min, contact PM

STANDARD OPERATING PROCEDURE

GW-004 pH and Temperature Measurement

1. Objective

Describe methods for measuring the pH and temperature of liquids using a combination pH/temperature meter.

2. Execution

Calibration

- Calibrate the meter according to the equipment manufacturer's instructions at the beginning of each day of use. Calibration for pH shall be performed using at least two buffer solutions. Solutions chosen should be similar to the expected pH of the liquids tested (pH 7 and 4 buffer solutions are preferred in most cases for groundwater or surface water measurements).
- Check calibration at the end of the day by reading the two solutions used in calibration. Also perform additional field checks as needed based on observed readings (i.e., inconsistent readings). Record measurements and time of measurement in the field book or sample sheet. If the readings are outside +/– 0.2 pH units, recalibrate the meter.

Sample Measurement

- Immediately prior to testing a sample, decontaminate testing container and probe assembly with one rinse of distilled water. Do not use methanol to rinse the probe. Methanol rinses could damage the probe.
- Gently dry the probe with a paper towel and shake beaker to remove excess solution. Visually inspect the bottom of the probe to ensure that liquid or sediment is not trapped between outer casing and probe.
- Pour the sample into the testing container and insert both temperature and pH probe. Stir sample for 30 seconds using both probes. Let the probes equilibrate in the sample solution for another 30 seconds. Measure and record the temperature. Measure and record pH reading after stabilization or 60 seconds, whichever is sooner. A reading has stabilized if pH units have not changed +/– 0.1 pH units during a 30 second period.
- Record pH to the nearest 0.1 unit and temperature to the nearest whole number.

3. Limitations

- Coatings and particulates may affect the response of the probe; more thorough cleaning using a weak alconox solution and distilled water rinse

and gently wiping the probe surface with a paper towel may be required to clean the surface of the probe.

- Temperature affects both the response of the instrument to pH and the actual pH of the sample. The Automatic Temperature Compensation (ATC) function compensates for the variation in the response of the meter only. Therefore, the pH must always be reported with temperature.
- The probe is a fragile thin glass bulb surrounded on three sides by a plastic casing. Care must be taken in handling the probe to avoid breakage.
- Do not use buffer solutions past their expiration date.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-005 Turbidity Measurement

1. Objective

Describe calibration and use of a Hach nephelometer/turbidimeter.

The meter is used to measure turbidity of liquids by quantifying how much light passes through them. Turbidiity readings are required to be read using a portable (e.g Hach) instrument directly from the tubing before going through the flow-through cell.

This SOP is specific to a Hach turbidimeter. Follow manufacturer's recommendations for other meters.

2. Execution

i. Turn the meter "ON".
ii. Rinse the sample cell 3 times with distilled water.
iii. Fill the cell to the fill line with distilled water and then cap the cell.
iv. Wipe off excess water and streaks with a non-abrasive lint-free paper or cloth (preferably lens paper).
v. Open the cover and insert the cell (arrow to the front) into the unit and close the cover.
vi. Press "READ" and wait for the 'light bulb' icon to go off. Record the reading.
vii. Using the Gelex standards, repeat steps above. Record all measurements (note anomalies).
viii. Fill the cell with sample liquid to the fill line (about 15 mL) and replace the cap on the cell.
ix. Wipe off excess water and any streaks with a non-abrasive lint-free paper or cloth (lens paper).
x. Press "I/O" and the instrument will turn on. Place the meter on a flat, sturdy surface. Do not hold the instrument while making measurements.
xi. Insert the sample cell, arrow to the front, in the instrument. Close the lid.
xii. Select manual or automatic range selection by pressing the range key.
xiii. Use signal average mode if the sample causes a noisy signal (display changes constantly). Select signal averaging mode by pressing the "Signal Average" key.
xiv. Press Read. The display will show "---- NTU" and then the turbidity in NTU. Record the result after the lamp symbol turns off.
xv. Rinse the cell with distilled water.
xvi. Confirm the validity of the sample measurement by double-checking with one of the Gelex standards.

xvii. Periodically check the turbidity meter during the day by using the Gelex secondary standards provided.
xviii. Perform a post calibration at the end of the day and record all measurements.

3. Limitations

If the turbidity measurements are for National Pollutant Discharge Elimination System (NPDES) reporting purposes, all samples with values above 40 NTU must be diluted with turbidity free water (e.g. distilled water) and sample turbidity is calculated by multiplying the reading of the diluted sample by the dilution factor.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-006 Specific Conductance Measurement

1. Objective

Describe standard methods to measure conductivity of water using a field conductivity meter.

2. Execution

- Calibrate the meter according to equipment manufacturer's instructions at the beginning of each day of use. Calibration shall be performed using a standard KCl or other solution recommended by the manufacturer.
- Record the make, model, and serial or identification number of the instrument and calibration information in the field notebook.
- Check calibration at the end of the day by measuring the standard used in calibration and record in field book. Also perform additional field checks as needed based on observed readings (i.e., inconsistent readings). If the readings are outside +/- 0.02 mS/cm, the meter must be recalibrated. Initial calibration should be conducted under the same conditions (i.e., temperature, and location) of field testing.
- Immediately prior to testing a sample, decontaminate testing container and probe assembly with distilled water.
- Gently dry the probe with a paper towel and shake container to remove excess solution.
- Pour sample into the container and insert probe. Stir sample with the probe for approximately 10 seconds. Let the probe equilibrate in the sample solution for another 30 seconds. Measure conductivity and record in the field notebook.
- Record conductivity to the nearest whole number.

3. Limitations

- Oily coatings and particulates may affect the probe's response; more thorough cleaning using a weak alconox solution and distilled water rinse and gently wiping the probe surface may be required to clean the surface of the probe.
- If sample liquid is contaminated, (e.g. stained, conductance >0.75 mS/cm), rinse probe with distilled water immediately after measuring sample to minimize fouling of probe.
- Do not use calibration solutions past their expiration date.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contact

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-007 Dissolved Oxygen Measurement

1. Objective

Describe calibration and field use of dissolved oxygen meter.

2. Execution

- Place instrument in the intended operating position (vertical, tilted, or horizontal) before it is prepared for use and calibrated.
- Recalibration may be necessary when the instrument operating position is changed.
- Attach the prepared probe to the Probe connector of the instrument and adjust the retaining ring finger tight. Check that membrane is intact and check for presence of air bubbles under membrane. If bubbles are present or membrane is damaged, prepare probe again according to manufacturer's instruction.
- Place approximately 1/8 inch of water into the bottom of the calibration cup. Place the probe into the cup and engage only one thread of the calibration cup onto the probe to ensure that the DO probe is readily vented to the atmosphere. Make sure the DO and temperature probes are not in contact with the water. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for the temperature to equilibrate.
- Calibrate meter according to the procedures outline in the instrument manual. Calibrate probe to a zero oxygen solution provided by manufacturer, and water saturated air.
- The calibration procedure may require correction factors or input of site-specific barometric pressure and temperature. Correction factors can be found at:

  http://water.usgs.gov/owq/FieldManual/Chapter6/6.2_v2.1.pdf

- Otherwise, use appropriate instruments at the site to determine temperature and pressure.
- Perform Dissolved Oxygen Measurement using the following procedure:
  i. Submerge probe in flow-through chamber or water body.
  ii. Gently raise and lower probe in sample.
  iii. Allow sufficient time for probe to stabilize to sample temperature and dissolved oxygen.
  iv. Read and record the temperature and the value of the dissolved oxygen in mg/L.
  v. Document field analysis data and general observations in the field log book or groundwater sampling sheet.

3. Limitations

- Collect DO measurements in the field during sampling. Storing samples in containers will alter the DO concentration of the sample.
- Detection Limit (DL) = 0.1 mg/L for 0-10 mg/L range; do not record values less than Detection Limit: a zero reading is recorded < 0.1 mg/L.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-008 Temporary Groundwater Sampling Points

1. Objective

To define the procedures for installation of temporary groundwater sampling points (hereafter referred to as well point) for measuring depth to groundwater and collecting groundwater samples. Well points may aid in the placement of permanent monitoring wells.

A well point is a small diameter (1-2 inch) probe constructed of continuously wrapped stainless steel or wrapped stainless steel gauze screen over perforated carbon steel pipe. No filter or gravel pack is used in the installation.

Well point installations are not the only type of temporary monitoring wells. Alternative temporarily well constructions should be discussed with the project manager and may be more appropriate based on-site conditions.

2. Execution

2.1. Installation

- The well point can be placed with the use of a conventional hollow-stem auger rig, Geoprobe®, slide hammer, jack hammer, rotary hammer, or by hand.

- The well point may be driven through the unsaturated zone only in known "clean" soils. Driving the well point through contaminated soil may carry contamination downward with the point resulting in analytical sample results which are biased high. In areas with contamination above the desired screening zone, the well points should be installed with the aid of either hollow-stem augers or Geoprobe®, to “case off” contamination from the upper layer.

- If the well point is to be installed in an oversized (20% larger than the well point) pre-drilled hole, the hollow-stem augers or bull drive point must be advanced to a point which is just above the targeted sample zone. The well point is then placed in the hole and advanced beyond the bottom of the hole by hammering or pushing into place. The use of pre-drilled holes will reduce clogging of well point screens when driving.

- If the well point is used for piezometeric data, make a survey mark on top of the casing as a reference point for water level measurements.

- Caution must be used when using well points in areas of contaminated soil. Possible cross contamination may be introduced to the screen as it passes through the zone of contamination.

2.2. Sampling Procedures

Development of a well point is not required prior to sampling. Sampling of groundwater or collecting piezometric data must be performed by one of several recommended methods described in this manual.

After sample collection, (See Groundwater Sampling SOP) the well point is removed by back hammering or pulling the tool out with the rig hydraulics.

3. References

ASTM D6001 - 05 Standard Guide for Direct-Push Water Sampling for Geoenvironmental Investigations

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

Ground Water and Wells. Johnson Division, UOP Inc.; St. Paul, Minn. 1982. p277-294.

Ground Water Manual - A Water Resources Technical Publication; U.S. Dept. of Interior, Bureau of Reclamation. Government Printing Office, Washington DC 1977.

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91.

4. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-010 Slug Tests

1. Objective

Describe methods to use slugs, pressure transducers, and data loggers to collect data that will support calculation of horizontal hydraulic conductivity of distinct geologic strata.

General Information

Slug tests are performed on single monitoring wells to estimate the hydraulic conductivity of the aquifer in which the well is screened. The test consists of adding or removing a known volume (slug) to or from the well to instantaneously change the water level. Subsequently, the recovery of the water level back to the static water level is measured. The resulting data are used to determine the hydraulic conductivity of the aquifer test zone using an appropriate analytical method.

Falling head tests can only be performed in fully-penetrating wells (well screened completely below the water table). Rising head tests can be performed in both fully- and partial-penetrating wells.

2. Execution

2.1 Setup

- Determine how water levels will be recorded. If the geologic materials in the test zone are expected to be slightly permeable (e.g., a glacial till or clay), then measurements may be recorded manually with an electronic water level indicator. If the geologic materials in the test zone are expected to be moderately- or highly-permeable (e.g., outwash sands), record measurements using a pressure transducer attached to an automatic data logger.

  The remainder of this SOP assumes that an automatic data logger is being used to measure water levels.

- Check to see if test equipment functions prior to leaving for the site.
- Decontaminate the transducer and cable using alconox and distilled water. Do not use methanol. Do not use transducer in wells containing non-aqueous phase liquid (NAPL).
- Make initial water level measurements
- Test wells in the following order: from the least contaminated to the most contaminated, and from low to high expected permeability, where possible.
- Measure the static water level (i.e., depth to water) in the well to be tested manually using an electronic water level indicator. Record all

measurements taken during the test in the field log book or on the attached log form.

- Install the pressure transducer as far below the deepest point of insertion of the slug bar or bailer as possible. Allow the transducer to thermally equilibrate for 15 to 30 minutes (to allow instrumentation wiring to expand/contract) before measurements are taken.
- Secure the transducer cable at ground surface with tape or weight to keep the transducer at a constant depth.
- Cover sharp edges of the well casing with duct tape to protect the transducer cables.
- Transducer measurement setup: For wells screened in sand and silty sand, a linear setting of one reading per second is generally used. In coarser soil where full recovery may occur over a few seconds, a linear setting for more frequent readings is necessary. If a transducer is used for silt and clay, a linear setting of one reading per minute, or a logarithmic setting, may be used to avoid risk of exceeding the memory capacity of the transducer.

2.2 Field Procedure – Rising Head Test

In this test, a slug is inserted in the well prior to the test and the water level is allowed to return back to static level. The test is then started by removing the slug from the well and immediately measuring rising water levels. In wells where recovery is slow, this test can be performed by pumping or bailing water from the well and immediately starting measurements.

- Record the initial water level and other setup information on the attached form.
- Fully submerge the slug bar or bailer into the water column of the well.
- Allow the water level in the well to return to static condition after both the slug and transducer have been inserted. The transducer readout should indicate the height of water above the transducer.
- When the water level in the well has returned to static condition, start the transducer ("Start Test" if using Win Situ software). Periodically view graphical data during the test, to confirm adequate data collection.
- Rapidly remove the slug bar or bailer from the water column and well. Avoid moving or pulling up the transducer cable when removing the slug.
- Continue recording water levels with the transducer until the water level has recovered to within 15 percent of the original static water level relative to the initial test displacement (85 percent recovery), or until one hour has elapsed. If less than 50 percent recovery has been achieved after one hour, continue to collect measurements every 10 to 20 minutes.
- Where possible, repeat the test to establish the repeatability of measurements and calculated hydraulic conductivity results.
- As soon as practicable, download data stored in the transducer and transfer data.

2.3 Field Procedure – Falling Head Test

In this test, a slug is inserted in the well at the start of the test and the falling water levels are measured immediately. In wells where recovery is slow, this test can be performed by adding water to the well and immediately starting measurements.

- Record the initial water level and other set up information on the attached form.
- Allow the water level in the well to return to static conditions after the transducer has been inserted. The transducer readout should indicate the height of water above the transducer.
- When the water level in the well has returned to a static condition, begin recording transducer readings ("Start Test" if using Win Situ software).
- Fully submerge the slug bar or bailer into the water column of the well.
- Periodically view graphical data during test, to confirm adequate data collection. The transducer should continue to record water levels until the water level has recovered to within 15 percent of the original static water level relative to the initial test displacement (85 percent recovery), or until one hour has elapsed. If less than 50 percent recovery has been achieved after one hour, continue to collect a measurement every 10 to 20 minutes.
- Where possible, repeat the test to establish the repeatability of measurements and calculated hydraulic conductivity results.
- As soon as practicable, download data stored in the transducer and transfer data.

3. Additional Information

- Do not perform hydraulic conductivity tests on wells that have not previously been developed and allowed to equilibrate.
- It is critical to either add or remove the slug to the well as quickly as possible and to start collecting depth-to-water measurements immediately.
- The early-time data is critical because the rate of recovery of head in the well is exponential. Collect measurements frequently at the start of all variable head tests.
- The time required for a slug test to be completed is a function of the volume of the slug, the hydraulic conductivity of the formation, and the type of well completion. The slug volume should be large enough that a sufficient number of water level measurements can be made before the water level returns to equilibrium conditions. Two bailers connected in series can be used to increase the slug volume, provided the water column is deep enough.
- Decontaminate all down well equipment before using it in the well.

- NAPL will damage the transducer. Gauge recovery manually in these instances.
- Where possible, take periodic water level readings manually during recovery. The manual data are used to check for transducer noise or movement.
- If using automatic data loggers, download the data as soon as possible. Batteries in the data loggers may run down and result in a loss of data.
- Be prepared to containerize water generated from rising head tests if the water is contaminated.
- Where possible, take more than one pressure transducer to site. This will provide backup and allow testing of multiple wells simultaneously.

4. Calculations

The simplest interpretations of piezometer recovery are Hvorslev (1951) and Bouwer and Rice (1976). The analyses assume a homogenous, isotropic medium in which soil and water are incompressible. Spreadsheets and software are available to calculate hydraulic conductivity from slug test data according to the methods below.

Hvorslev's expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln (L/R)}{2 L T_0} \qquad for\ L/R > 8$$

where:
K = hydraulic conductivity [ft/sec]
r = casing radius [ft]
L = length of open screen (or borehole) [ft]
R = filter pack (borehole) radius [ft]
T_0 = Basic Time Lag [sec]; value of t on semi-logarithmic plot of $H\text{-}h/H\text{-}H_0$ vs. t, where H-h/H-Ho = 0.37
H = initial water level prior to removal
of slug
H_0 = water level at t = 0
h = recorded water level at t > 0

(Hvorslev, 1951; Freeze and Cherry, 1979)

The Bouwer-Rice expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln (R_e/R) \ln(h_o/h_t)}{2 L t}$$

where:
r = casing radius [ft]
t = time of drawdown measurement since start of test [sec]

h = drawdown of water in well at time = t [ft]
h_o = drawdown of water in well at t = 0 (initial drawdown) [ft]
L = length of open screen (or borehole) [ft]
R_e = effective radius (radius of influence) [ft]
R = gravel pack radius [ft]

Both the Hvorslev and Bouwer-Rice methods can be applied for partially-penetrating wells. Hvorslev is generally applicable only to fully penetrating wells.

5. References

Bouwer, H., "The Bouwer and Rice Slug Test – An Update," Ground Water, vol. 27(3), 304, 1989.

Butler, James, J., Jr. "Improving the Quality of Parameter Estimates Obtained from Slug Tests", Ground Water, Vol. 34, No. 3, May-June 1996.

Butler, James J., Jr., "The Design, Performance, and Analysis of Slug Tests", Kansas Geological Survey, Lewis Publishers, 1997.
Chirlin, G.R. (1989), A Critique of the Hvorslev Method for Slug Test Analysis: The Fully Penetrating Well.

Fetter, C.W. (1994), Applied Hydrogeology, 3rd edition.

Freeze, R. Allen and John A. Cherry, 1979. Groundwater, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Hvorslev, M.J., "Time Lag and Soil Permeability In Ground-water Observations," U.S. Army Corps of Engrs. Waterways Experiment Station Bulletin No. 36, 1951.

Lambe, T.W, and R.V. Whitman (1969), Soil Mechanics.

Sanders, Laura L., "A Manual of Field Hydrogeology", Prentice-Hall, Inc., 1998.

U. S. EPA ENVIRONMENTAL RESPONSE TEAM STANDARD OPERATING PROCEDURES SOP: 2043,"Water Level Measurement" REV: 0.0, 10/03/94.

U. S. EPA ENVIRONMENTAL RESPONSE TEAM STANDARD OPERATING PROCEDURES SOP: 2046,"Slug Tests" REV: 0.0, 10/03/94

6. Attachments

Attachment A – Slug Test Data Form

7. Contacts

Andy Adinolfi
Saskia Oosting

Attachment A. Slug Test Data Form

SITE ID: _____ SLUG TYPE (solid/bailer/pumped)

LOCATION/WELL ID _____ SLUG DIAMETER: _____

DATE: _____ SLUG LENGTH: _____

FIELD PERSONNEL: _____ METHOD:

_____ RISING HEAD _____

DATALOGGER TYPE: FALLING HEAD _____

_____

_____

COMMENTS:

_____

_____

==========

SETUP

Time _____
Depth to Water - Initial Static (before installing troll/slug) _____
Confirm well recovers to static after installing slug, or note otherwise

_____

==========

MANUAL CONFIRMATORY MEASUREMENTS

ELAPSED TIME (min.)	DTW	ELAPSED TIME	DTW
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Form based on:
USEPA, 1994; Sanders, 1998.

STANDARD OPERATING PROCEDURE

GW-011 Constant Head Permeability Testing

1. Objective

Describe procedures for performing constant head borehole permeability testing in granular soils. Constant head permeability testing is used when the soil permeability is sufficiently high for testing to be practical.

2. Execution

- All borehole permeability testing shall be performed below the static groundwater table. As the boring is advanced, attempt to determine the static groundwater level by:
  - Observing the water content of samples collected from the boring to identify the transition from moist to saturated soil.
  - For higher permeable soils, allowing the water level in the borehole to stabilize before performing the test.
  - If the borehole is left open overnight or for an extended period, measure the static groundwater level in the borehole at the beginning of the next day.
  - Measure the water level in nearby observation wells or piezometers.
  - If a well or piezometer is installed in the borehole, measure the water level in the well or piezometer after the water level has stabilized.
- Advance the drill casing to the top of the test zone and clean the borehole to the bottom of the casing.
- Obtain a split spoon sample in the test zone below the bottom of the casing.
- Advance the borehole 2 feet below the bottom of the casing using a side discharge roller bit. The roller bit should be only slightly smaller than the inside diameter of the casing. Record the diameter of the casing and the diameter of the roller bit. Avoid jetting the borehole walls or bottom during cleaning. Continue flushing the borehole until return water is clear.
- Measure the depth to groundwater in the borehole over a 10 to 15 minute period to observe if the groundwater elevation has approximately stabilized. Compare the saturated soil depth estimated from split-spoon samples to the measured water level in the borehole.
- Using a weighted tape, sound the bottom of the borehole to verify that the hole is cleaned to the correct depth and caving hasn't occurred. If more than 3 inches of wash remains in the borehole, lower the roller bit back to the bottom of the borehole and continue to clean the borehole.
- Measure and record the depth to the bottom of the borehole to the nearest 0.05 feet.
- Determine the length of the test zone (L = distance from the bottom of the casing to the bottom of the borehole) to the nearest 0.05 feet and record on the field form.
- Add clean water to fill the casing.

- Using a calibrated flow meter, adjust the flow rate into the casing so the water level remains within 0.5 inches of the top of the casing. Once the water level has stabilized, take a flow meter reading at the start of the test (time=0). Record the inflow volume at regular intervals (generally 1 minute) for a period of 10 minutes.
- Check the depth to the bottom of the borehole after completion of the test to check for caving.
- Record all measurements and observations on the Borehole Permeability Test Field Data Form.

3. Limitations

Site-specific conditions must be evaluated to determine appropriate test intervals. Test interval shall be determined by the Project Manager or their designee.

4. References

GEI Procedure No. 44, Borehole Permeability Testing in Granular Soils

U.S. Department of the Interior Bureau of Reclamation Ground Water Manual, Chapter 10: Permeability Tests in Individual Drill Holes and Wells.

5. Attachments

Attachment A - GEI Borehole Permeability Test Field Data Form – Constant Head

6. Contacts

Steve Hawkins
Kari Weber

BOREHOLE PERMEABILITY TEST - CONSTANT HEAD
FIELD DATA FORM

PROJECT:	BORING :
LOCATION:	PROJ NO.:
CLIENT:	TEST NO.:
PERF'D BY: DATE:	PAGE NO.:
CALC'D BY: DATE:	GROUND
CHECKED: DATE:	SURF. EL.:

STANDPIPE/RISER DETAILS

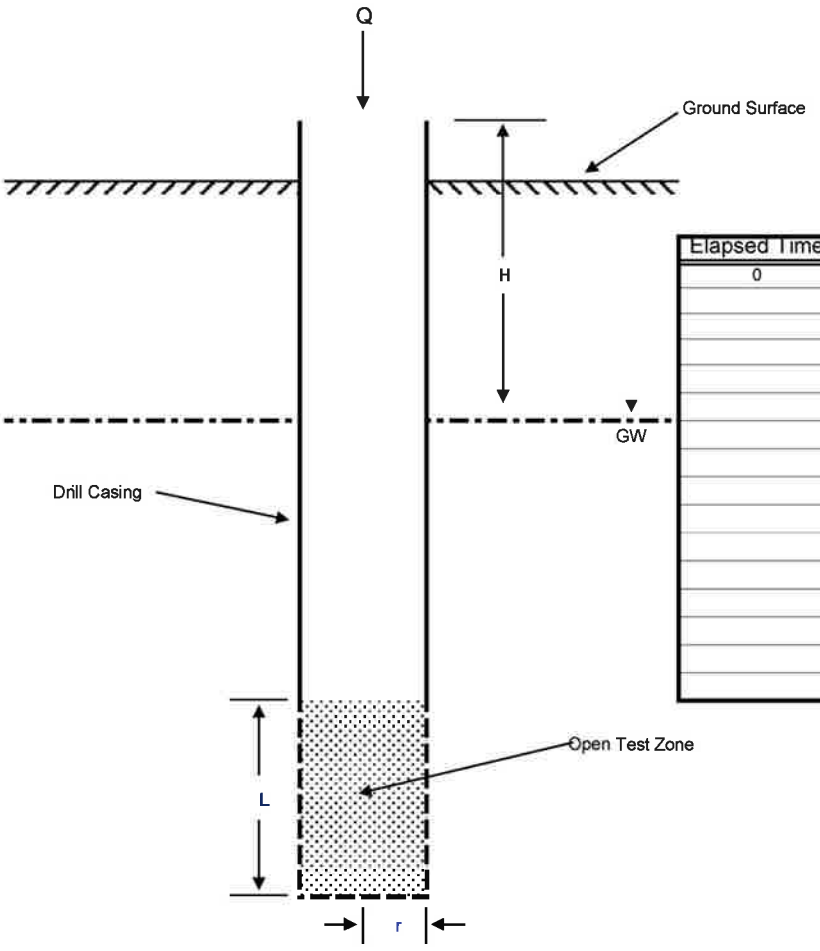
Riser inside diameter,d,inches: _____
Riser length, feet: _____
Riser stick up above ground surface, feet: _____
Groundwater depth below ground surface, H, feet: _____

Test Start Time: _____
Test End Time: _____

TEST INTERVAL DETAILS

Depth to bottom, feet (below ground surface): _____
Depth to top, feet (below ground surface): _____
Length, L, inches: _____

Water flow to achieve constant head, Q: _____ (volume/time)



Elapsed Time	Inflow	Overflow
0		

NOTES: 1. Based on the Constant Head Permeability Test SOP:
Created for the CT River Levee Projects, GEI Consultants
October 2008.

GEI Consultants

STANDARD OPERATING PROCEDURE

GW-014 Dense Non-Aqueous Phase Liquid (DNAPL) Measurement and Recovery

1. Objective

Provide procedural guidance for routine gauging and recovery of dense non-aqueous phase liquids (DNAPL) related to former manufactured gas plant (MGP) operations.

2. Execution

2.1 Equipment and materials

The following materials and equipment are necessary for this procedure:

- Oil/water interface probe
- Appropriate pump and required tubing/piping
- Double check valve bailers and string
- Drums or buckets for NAPL collection
- Proper PPE including gloves and protective eyewear
- Drum labels
- Field data sheets or logbooks
- Decontamination supplies and plastic sheeting
- Additional equipment identified by site-specific work plan and HASP
- Example specifications of DNAPL management equipment is included as Attachment A.

2.2 General Measurement Procedures

Using an oil/water interface probe will provide a depth to water and a depth to product in each monitoring well. Refer to probe manual to determine changes between liquid type. To achieve accurate depth measurements, ensure the oil/water interface probe is decontaminated (GEI SOP QA-001 prior to and between each measurement taken at each well.

To calculate the volume of product in monitoring wells with these specifications, take the following measurements:

- Total well length
- Depth to water
- Depth to product (s) – c1 and c2

Using the following equations, determine the length of the water column and the length of the product column:

[1] (a) – (b) = Water column length (d)
[2] (a) – (c1) = Product column length (e) dense non-aqueous phase liquid (DNAPL)

Calculate the volume of DNAPL product in the well using the following equation:

DNAPL for a 2" diameter well
[4] (e) x 0.1632 = Volume (gallons) of product in well
(e) x 0.6178 = Volume (liters) of product in well

DNAPL for a 4" diameter well
[4] (e) x 0.6528 = Volume (gallons) of product in well
(e) x 2.4711 = Volume (liters) of product in well

DNAPL for a 6" diameter well
[4] (e) x 1.469 = Volume (gallons) of product in well
(e) x 5.561 = Volume (liters) of product in well

Once measurements have been taken and calculations have been made, collection of dense non-aqueous phase liquid (DNAPL) may commence.

2.3 DNAPL Collection Procedures

Collection of DNAPL shall be accomplished using common recovery techniques or technologies as follows:

- Peristaltic pumps
- Bailers
- Positive displacement down hole pumps (e.g. Hammerhead, Blackhawk pumps, etc)

Special care shall be taken to prevent any purged DNAPL causing a spill and coming into contact with the ground and sampling personnel. This includes the use of proper personal protective equipment (PPE), including gloves and protective eyewear (Tyvek® if necessary), along with plastic sheeting set beneath the pump, tubing, and collection container (sealed top 55-gallon drum or 5-gallon bucket with lid), and the surrounding work area. A site-specific work plan, HASP and job specific job safety analysis need to be developed prior to the start of work. Examples of DNAPL specific management equipment and tools are included as Attachment A. The specific operating procedures for common recovery methods are discussed in the following sections.

2.3.1 Sampling and recovery via peristaltic pump with dedicated tubing:

- Take and record the required measurements prior to commencing pumping.
- Connect the dedicated tubing to the peristaltic pump with the long end of the silicon tubing set to discharge water and product directly into either a 5-gallon bucket or a 55-gallon closed-top drum, ensuring that the entire set-up is underlain by plastic sheeting.
- Begin purging the well, occasionally checking the depth to water and depth to product.
- Once the DNAPL has been purged from the well, a sample will be collected and preserved if required, in accordance with laboratory standards.

- Following completion of NAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

2.3.2 Sampling and recovery via double check valve bailer:

- Take and record the required measurements prior to commencing bailing.
- Ensure the entire work area is covered in plastic sheeting to avoid potential spills of water and/or product.
- Tie the bailer to a piece of string that will allow the bailer to reach the bottom of the well.
- Using slow and controlled motions while lowering (and raising) the bailer to the bottom of the well, commence bailing product out of the well and draining the bailer directly into either a 5-gallon bucket or a 55-gallon closed-top drum.
- Once the NAPL has been purged from the well, collect and preserve the analytical sample, if required, in accordance with laboratory standards.

2.3.3 Sampling via piston-style pumps (HammerHead, Blackhawk etc)

For significant accumulations of DNAPL a variety of dedicated pumping technologies exist. Refer to manufacturer-specific operating procedures and site specific means and methods.

2.4 Waste Management and Disposal

Investigation derived waste should be managed in accordance with GEI SOP SC-003. Additional care should be taken with DNAPL while infrequent the potential for hazardous waste characteristics does exist. DNAPL waste management and disposal should be evaluated on a site by site basis as discussed in Section 3.

2.5 Troubleshooting Information

If there are any performance problems with the oil/water interface probe which result in inability to achieve the proper measurements presented in Section 5.1, or if there are any problems with the peristaltic pump, consult the appropriate section of the probe instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

Lower temperatures can affect the ability to pump and/or bail NAPL. Weather should be taken into consideration when scheduling gauging and recovery sampling events.

2.6 Data and records management

All information pertaining to maintenance of the oil/water interface probe and the peristaltic pump shall be maintained in the project file. Field measurements (depth to

water, product, *etc.*) and all calculations (product column length, volume of product, *etc.*) shall be recorded on the appropriate field data sheets or in the logbook consistent with GEI SOP Section 5.

2.7 Health and safety considerations

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed job safety analysis (JSA) should be completed prior to the start of work.

3. Limitations

- DNAPL gauging and recovery can be problematic and requires adaptive thinking. A variety of measurement and collection techniques may be necessary to properly execute the work.
- Exposure to DNAPL can accelerate the required maintenance/replacement intervals for tools and equipment.
- A site specific work plan, HASP and JSA needs to be developed prior to commencing work. The documents should address: safety, recovery technologies, waste containment and waste management.

4. References

U.S. EPA. Ground Water Issue: Dense Non-aqueous Phase Liquids, EPA/540/4-91-002, March 1991.

5. Attachments

Attachment A – Example specifications of DNAPL recovery and management tools and equipment.

6. Contact

Jerry Zak

Section 8

Air Sampling and Monitoring (AR)

STANDARD OPERATING PROCEDURES

AR-001 General Guidance on Work Zone Monitoring Methods

1. Objective

Protect human health by measuring air quality at the perimeter of a work area.

2. Execution

Walk-around perimeter and work zone monitoring for Total Volatile Organic Compounds (TVOC), Respirable Particulate matter less than 10 microns (RPM_{10}), and odor will occur along the perimeter of the project site on a regular and as-needed basis. Specific site conditions that will trigger walk-around perimeter or work zone monitoring include:

- visible dust
- odor complaints
- detection of TVOCs and/or RPM_{10} at levels approaching or exceeding action levels
- direction by the site oversight consultant or client

Perimeter air monitoring and work zone monitoring, in the absence of any specific triggering criteria, will be conducted on a regular basis during the normal work day. Particular attention will be given to the direction of any residences or other sensitive receptors.

At the time when a triggering condition is observed, the walk-around perimeter and work zone monitoring will occur continuously until the conditions that triggered the monitoring have subsided. Additional temporary monitoring points may be established due to changing site or meteorological conditions.

TVOC concentrations will be monitored and recorded using a Rae Systems MiniRAE 2000 Portable Ionization Detector (PID) or equivalent. RPM_{10} will be measured and recorded using a MIE personal DataRAM 1200 (PDR-1200) portable real-time aerosol monitor equipped with a PM-10 monitor and Gilian personal air sampling pump. AR-002 Suspended Particulate Matter in Ambient Air using the MIE DataRAM Real-time Aerosol Monitor (Portable) provides guidance on the use of this meter. Odors will be noted based on the n-butanol scale, as adapted from ASTM E544-99.

At each monitoring point, the 15-minute average value of TVOC and RPM_{10}, sample time, and sample location will be collected and recorded. The odor intensity based on the n-butanol scale will be monitored over a 15-minute period and recorded. At each location, air temperature, wind direction, and wind speed may be monitored and recorded using a hand-held wind meter.

Odors as a function of naphthalene concentration will be monitored over a 15-minute period and recorded. To measure naphthalene concentrations, the zNose™ Model 4200 system will be used. The zNose™ is an ultra-fast gas chromatograph (GC) that is capable of analyzing airborne concentrations of VOCs and SVOCs in less than one minute. The zNose™ uses a surface acoustic wave (SAW) detector that changes in vibration frequency as compounds elute from the column and condense onto the surface of the detector.

The zNose™ is a portable instrument and will be positioned downwind of the remedial activities. Up to five samples will be analyzed for naphthalene concentrations over a 15-minute period. The concentrations will be averaged to produce a 15-minute result. The calibration will be checked at the start of the day, at mid-day, and at the end of the day. An air blank will be run every two hours. A blank will also be run if a reading exceeds the calibration range of the instrument.

The zNose™ also has the capability of generating fingerprint images of the chemical constituents in the vapor called VaporPrints™. A VaporPrint™ of an air sample can be collected through a headspace analysis. This VaporPrint™ can be compared to others generated at the perimeter and off-site to see if remedial operations are the source of the odors. VaporPrints™ can allow for identification of odors that may not be affiliated with remedial operations.

To monitor cyanide (as hydrogen cyanide gas), a real-time hand-held meter in conjunction with the Dräger Chip Measuring System (CMS) will be used. Types of continuously monitoring equipment include the V-RAE by Rae Systems and the Mini-Warn by Dräger Safety Systems and are available from rental equipment suppliers. Due to potential interference from sulfur compounds, hydrogen sulfide gas (H_2S) will also be monitored for comparison to the hydrogen cyanide gas levels detected. Hydrogen cyanide gas detections will also be confirmed with CMS Dräger tubes due to this interference. The Dräger CMS can quantify other gases that could potentially provide false positives for hydrogen cyanide gas (including sulfur dioxide, hydrogen sulfide, phosphine gas, chlorine, and nitrogen dioxide) detected by the real-time meter.

At each location, air temperature, wind direction, and wind speed will be monitored and recorded using a hand-held wind meter.

3. References

New York State Department of Environmental Conservation. 2010. DER-10 / Technical Guidance for Site Investigation and Remediation. Division of Environmental Remediation. May 3, 2010. Appendix 1A. pp. 204-206

ASTM E544 - 99(2004) Standard Practices for Referencing Suprathreshold Odor Intensity

4. Attachments

None

5. Contact

Brian Skelly

STANDARD OPERATING PROCEDURE

AR-002 Air Sampling for Dust (Particulate Matter) using the MIE DataRAM™ Real-Time Aerosol Monitor

1. Objective

Describe standard procedures for the real-time monitoring of airborne particulate matter using a MIE DataRAM™ model DR-2000 real-time aerosol monitor.

The MIE DataRAM™ is a real-time, portable monitor that measures airborne particulate matter. It is capable of monitoring total suspended particulate matter, particulate matter less than 10 microns (PM_{10}), and particulate matter less than 2.5 microns ($PM_{2.5}$) by using an appropriate orifice to control the size of the particles being measured. The DataRAM can be programmed to collect continuous real-time data, or to record time averaged data.

2. Materials

- MIE DataRAM™ model DR-2000
- Shelter/Enclosure - a pre-constructed enclosure capable of protecting the instrumentation from severe weather conditions during sample collection
- Omnidirectional inlet
- Inlet heater
- $PM_{2.5}/PM_{10}$ impactor
- IBM compatible computer loaded with MIE DataRAM™ software
- Field notebook

3. Meter Calibration

- Assemble all necessary DataRAM™ attachments.
- Make sure the power selector switch on the rear panel is in the "on" position. Turn on the power by pressing the "on" button on the front display panel of the DataRAM™. "Main Menu I" will appear on the screen.
- Activate the zero mode by pressing the button indicating zero.
- When the screen indicates the zero mode is complete, activate the span check mode by pressing the button indicated, and follow the prompts that appear on the screen.
- Record the time of the zeroing and the calibration difference percent in the field notebook. If the zeroing procedure takes longer than 5 minutes press "exit" and then "off," and then put the power switch on the rear panel of the instrument in the "off" position. Wait several minutes, turn on the power and zero the instrument again. If the calibration difference percent is more than ±5% then follow the "Calibr Diff" Resetting Procedure in the DataRAM™ Instruction Manual.
- Set the DataRAM™ to automatically log data. Refer to the Instruction Manual for details on how to set the data logging function.

- Record the instrument flow rate from the parameters menu in the field notebook.

4. Sample Collection

- Set the DataRAM™ at the predetermined sampling location in a rain or weatherproof containment, with only the inlet tubing exposed to ambient air.
- Start the run.
- When sampling is completed, terminate run and download data using the RS-232 cable connector and the MIE DR-COM software.
- Once the data file has been successfully downloaded and saved in an appropriate location, clear the data from the instrument memory.

5. Limitations

Each instrument must be calibrated using the internal reference standard and zeroed at the start of each sampling event and at a frequency of once per day throughout the duration of the sampling event.

The DataRAM™ can be programmed to collect continuous real-time data, or can collect "averaged" real-time data. These various options should be addressed prior to field operations and must be referenced in an approved work plan. This work plan must be available to all field personnel.

Project objectives will usually dictate the sampling location. In general, for air monitoring, meters are usually placed near breathing height and away from objects that can interfere with air motions. Since the DataRAM™ is measuring particulate matter, placement of the instrument directly on the ground should be avoided to prevent the sampling of dust concentrations that may not be representative of the air that is intended to be sampled (e.g. air at breathing height).

6. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, D.C. EPA-454/B-08-003 December, 2008.

7. Contacts

Brian Skelly
Mark Ensign

STANDARD OPERATING PROCEDURE

AR-003 Air Sampling for PM_{10} Particulate Matter using the High-Volume Sampler Method

1. Objective

Describe standard procedures for the collection of air samples for laboratory analysis of PM_{10} particulate matter using the high volume sampler method.

2. Materials

- General Metal Works (GMW) Model IP 10-8000 or equivalent. The GMW sampler can be rented.
- Calibration kit, as specified for the selected sampler.
- PM_{10} sampling filters, to be supplied by the contract laboratory. A Whatman QM-A quartz filter is currently the only commercially available PM_{10} filter that satisfies all criteria specified in 40 CFR 50, Appendix J. .
- Ice chest for sample storage or shipping.

3. Sampling

This method measures the mass concentration of particulate matter with an aerodynamic diameter equal to or less than 10 micrometers (µm). A high volume (HV) sampler draws a known volume of ambient air at a constant flow rate through a size selective inlet and through one or more filters. Particulates of 10 µm or smaller are collected on the filter(s) during the prescribed time period. Each sample filter is weighed before and after sampling to determine the net weight gain of the collected PM_{10} sample.

A HV sampler consists of two basic components: a specially designed inlet that transmits only particles equal to or less than 10 µm in diameter and a flow control system capable of maintaining a constant flow rate within the design specifications of the inlet.

3.1. Sampler Installation

- On receipt of the sampler, inspect all shipping cartons to ensure that all components have been received and verify that the unit is operational.
- On site, assemble the unit according to the manufacturer's instructions. Check all power cords and tubing for crimps, cracks, and breaks. The HV sampler should be placed on a sturdy platform or table, with the air inlet 4 to 6 feet above ground level.
- The sampler should be strategically placed according to the work plan or objectives of the study and located free of any obstructions to ambient air flow.
- The HV sampler requires 110 V AC power. The electrical outlet should be protected by a ground fault interrupter and water proof electrical connectors should be used.

- Operate the sampler for 30 minutes to ensure that the motor is operating at full performance.
- Calibrate the sampler in accordance with the instructions provided with the appropriate calibration kit. Proper calibration of the sampler is critical.
- Field personnel should be familiar with both the sampling unit and the calibration procedure before attempting to record data.

3.2. Sampling Procedure

- Operate sampler as per manufacturer's instructions.
- Filters are received from the laboratory numbered and pre-weighed in their individual envelope or folder within an envelope. Powder free latex gloves, or equivalent, should be worn during the handling of filters. Only touch the edges of the filter.
- Examine the filter support screen to confirm that it is clean. If it appears to be dirty, wipe it clean using lint free wipes such as laboratory wipes or equivalent. Check the gasket to be sure that it is in good condition. The filter is placed on the support screen with the numbered side facing down. Tighten thumb nuts on alternate corners to properly align and seat the gasket. The nuts should be only hand tightened to avoid damaging the gasket.
- Record the sampler serial number, filter ID number, sampler location, sampling date, and the operator's initials in the field notebook, any field data sheets being used, and on the back of a clean chart and install the chart in the flow recorder.
- Turn the sampler on and allow it to equilibrate to operating temperature, about 3 to 5 minutes. Verify that the recorder is operating and that the pen is inking. Allow the sampler to run for the required sampling interval.
- When sampling interval is completed, turn off the sampler and carefully remove the filter as soon as possible. Sample degredation can occur if the filter is left in the sampler for an extended period of time. The filter should be folded in half with the exposed side inward and the folded filter carefully placed in its respective folder and/or envelope. When removing and folding the filter touch only the outer edges. Powder free latex gloves, or equivalent, should be worn when handling filters.
- Record the following parameters in the field notebook and in any field data sheet being used:
    1. Elapsed time of sampling interval in minutes
    2. Average recorder response in arbitrary units
    3. Starting flow rate and ending flow rate
- The average flow rate for GMW Model IP 10-8000 sampler should be close to 1.13 m^3/min.
- Calculate the total flow rate for the sampling interval by time weighted averaging the flow rate readings. Air monitoring results where the flow rates

varied more than +/- 10%, from beginning to end, should be qualified accordingly and discussed with the project manager.

- The exposed filters, folded in half, are placed back into their shipping envelope and forwarded with completed chain of custody forms to the contracted laboratory for analyses. Follow the contracted laboratory's instructions for handling and returning the exposed filters.

4. General Guidance

The total volume of air sampled is determined from the measured volumetric flow rate and the sampling time. The mass concentration of PM_{10} in the ambient air is calculated as the total mass of collected PM_{10} particles divided by the total volume of air sampled. The PM_{10} measurement is expressed as micrograms (µg) per standard cubic meter (µg/std M^3). The sampled volume must be corrected to EPA standard conditions, 25° C, 760 mm Hg or 101 kPa.

A field blank may be collected, which consists of an unexposed filter removed from its envelope, put in place in the HV sampler, immediately removed, folded, replaced in its envelope and sent to the laboratory. Field blanks, if collected, should be taken at a frequency of one per twenty samples. If fewer than twenty samples will be collected during one week, collect one field blank weekly during sampling.

5. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods (Interim Edition), Addendum to Section 2.11 Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere (High-Volume Sampler Method), US Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA/600/R-94/038b April 1994.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, D.C. EPA-454/B-08-003 December, 2008.

6. Contacts

Brian Skelly
Mark Ensign

STANDARD OPERATING PROCEDURE

AR-004 Air Sampling for Polycyclic Aromatic Hydrocarbons (PAHs) using EPA Method TO-13A

1. Objective

Describe standard procedures for the collection of ambient air samples to be analyzed for polycyclic aromatic hydrocarbons (PAHs) using U.S. EPA Method TO-13A.

2. Materials

- Modified High Volume Sampler
- General Metal Works (GMW) Model PS-1 sampler, or equivalent, sample cartridges and filters
- GMW Model GMW-40 calibrator and associated equipment, or equivalent, for calibration of the GMW PS-1 sampler
- Cooler with ice
- Stopwatch
- Data sheets for recording the sampling location, date, duration, starting and stopping times, and calculated sample volume
- Airtight, labeled, screw-capped container (wide mouth, glass with Teflon seal) to hold filter and adsorbent cartridge during transport to analytical laboratory
- Raised platform for the GMW PS-1 sampler

3. Sampling

This section details the sampling methodology and the media preparation by the analytical laboratory.

3.1. Sampling Equipment Overview

- Filters and adsorbent cartridges (containing XAD-2, Polyurethane Foam (PUF), or combination XAD-2 and PUF) are stored in screw-capped containers wrapped in aluminum foil (for protection from light) prior to installation in a modified high volume sampler. The filters and cartridges are supplied by the laboratory ready for use.
- A GMW Model PS-1 or equivalent sampler must be calibrated to draw approximately 325 cubic meters (m^3) of air through the filter and adsorbent sample cartridge.
- The filter and sample cartridge are placed in an appropriately labeled container and shipped to the analytical laboratory for analysis. Since heat, ozone, nitrogen dioxide (NO_2), and ultra violet (UV) light can cause sample degradation, the exposed sampling media must be immediately removed from the sampler using polyester gloves, wrapped in clean aluminum foil, tightly sealed, and packed in ice or refrigerated.

3.2. Sample Collection

- Calibrate each unit weekly and check the calibration daily, before use and at the end of the run, using the calibration kit and calibration curves supplied by the manufacturer.
- The samplers should be located in an unobstructed area, at least six feet from any obstacle to air flow. The exhaust hose should be stretched out in the downwind direction to prevent recycling of air into the sample head. The sampler should be placed off the ground on a sturdy stand, with the air inlet 4 to 6 feet off the ground.
- Remove the empty sample module from the sampler, rinse all sample contact areas using reagent grade hexane from a Teflon bottle. Allow the hexane to evaporate from the module in a well ventilated area before loading the sample cartridge.
- Detach the lower chamber of the rinsed sampling module. While wearing disposable, clean, lint-free nylon or powder-free latex or nitrile gloves, remove a clean glass sample cartridge from its container (wide-mouthed glass jar) and unwrap its aluminum foil covering. Place the foil back into the jar for rewrapping the sample cartridge after use.
- Insert the sample cartridge into the lower chamber and tightly reattach it to the module.
- Using clean Teflon tipped forceps, carefully place a clean fiber filter atop the filter holder and secure in place by clamping the filter holder ring over the filter using the three screw clamps. Ensure that all module connections are tightly assembled. Failure to do so may cause leaks which could affect sample representativeness. Ideally, sample module loading and unloading should be conducted in a controlled environment within a centralized sample processing area so that the sample handling variables can be minimized.
- With the module removed from the sampler and the flow control valve fully open, turn the pump on and allow it to warm up for approximately five minutes.
- Record the required information for the sampling run on the test data sheet. Record location, sampling date, starting and stopping times. Calculate the volume of air sampled.
- Attach the loaded sample module to the sampler.
- Connect the sampler to a 110 volt AC power source. Turn the power switch on. Activate the lapsed time meter and record the start time.
- Record the Magnehelic reading every six hours during the sampling period. Use the calibration curve to calculate the flow rate. Record the temperature, barometric pressure, and the Magnehelic reading at the beginning and end of the sampling period.
- At the end of the sampling period, turn the power off. Carefully remove the sampling head containing the filter and adsorbent cartridge in a clean area. While wearing lint-free nylon or powder-free latex or nitrile gloves, remove the sorbent cartridge from the lower module chamber and lay it on the

retained aluminum foil in which the sample was originally wrapped. Carefully remove the glass fiber filter from the upper chamber using clean Teflon tipped forceps.

- Fold the filter paper in half twice (sample side inward) and place it in the glass cartridge above the sorbent.
- Wrap the combined samples in aluminum foil and place them in their original glass sample container. Complete and fix a sample label to the sample container. Maintain chain-of-custody records for all samples.
- Store the glass container in a cooler with ice and protect the samples from light to prevent photodecomposition of collected analytes. If the time span between sample collection and lab analysis will exceed 24 hours, samples must be kept refrigerated. The sample holding time is less than 20 days.
- Perform a final calculated sample flow check. If flow rate calibration deviated by more than 10 percent from the initial reading, the flow data for that sample must be marked as estimated.
- Store all samples in the field on ice at approximately 0°C until delivered to the laboratory.

4. General Guidance

- This method may be modified for indoor air sampling.
- Field Blank: If necessary, collect a field blank, which consists of an unexposed filter that is removed from its envelope, put into the sampler, immediately removed, folded, replaced in its envelope and sent to the laboratory for analysis. Collect field blanks at a frequency of one per twenty samples. If fewer than twenty samples will be collected during one week, collect one field blank weekly during the sampling.

5. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, D.C. EPA-454/B-08-003 December, 2008.

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-13A, Determination of PAHs in Ambient Air Using GC/MS, US Environmental Protection Agency, Office of Research and Development, Center for Environmental Research Information, Cincinnati, OH, EPA/625/R-96/010b, January 1999.

6. Contacts

Brian Skelly
Mark Ensign

STANDARD OPERATING PROCEDURE

AR-006 Air Sampling for Volatile Organic Compounds (VOCs) using Summa Canisters

1. Objective

Describe standard procedures for the collection of ambient air samples to be analyzed for volatile organic compounds (VOCs) using Summa canisters. Typically, U.S. EPA Method TO-15 is used for laboratory analysis. The site-specific Work Plan should be consulted for proposed sample locations and sampling duration.

2. Materials

- Sampling canister
- Flow controller
- Vacuum gauge
- Wrench for removing fittings and assembling the sample train
- Data sheets for recording the sampling location, date, duration, starting and stopping times, and calculated sample volume
- Camera and measuring tape
- Weather station data
- PID

3. Sampling

This section details the sampling methodology and the media preparation by the analytical laboratory.

3.1. Sampling Equipment Overview

- The laboratory prepares the canister for sampling by cleaning and then evacuating the contents to a vacuum of approximately 29.9 inches of Mercury (in. Hg). Opening the stainless steel bellows valve allows the air sample to enter the canister. When the target volume of sample is collected, close the valve and return the canister to the laboratory.
- A flow controller is used as part of the sample train to control the amount of air allowed to flow into the container over time. Flow controllers are typically set to a flow rate that collects a sample continuously over a 1-hour (hr), 8-hr, or 24-hr interval. The sampling duration needs to be communicated to the laboratory prior to sampling, so that the laboratory can provide the appropriate flow controller.
- Summa canisters are typically used and named after the “Summa” process which describes the electro polishing of the interior surface of the canister to prepare it for sampling.
- The holding time for a standard VOCs list of EPA Method TO-15 is 30 days after sample collection, although some projects may require a shorter hold time.

3.2. Document Field Conditions

Document pertinent field conditions prior to sample collection:

- Record weather information, if available (such as precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for at least the past 12 hours.
- Sketch the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North).
- Record pertinent observations, such as odors and readings from field instrumentation.

3.3. Sample Collection

- Collect samples in a clean Summa canister (or equivalent) using a flow controller calibrated for the anticipated sample duration (e.g. 8-hour, 24-hour, etc.). The flow controller flow rate should not exceed 0.2 liters per minute.
- Verify the initial vacuum of the canister using the vacuum gauge. If the canister vacuum is less than 25 in. Hg, do not use it. The procedure to verify the initial pressure is simple, and a missed step can compromise the validity of the sample media.
    i. Confirm the canister's bellows valve is closed by turning the knob clockwise to tighten.
    ii. Remove the brass cap from the canister inlet.
    iii. Attach the vacuum gauge.
    iv. Open and close the bellows valve quickly (a few seconds).
    v. Read and record the vacuum on the gauge as 'Initial vacuum' on the chain-of-custody (COC).
    vi. Confirm the bellows valve is closed by turning the knob clockwise to tighten.
    vii. Remove the vacuum gauge and replace the brass cap.
- <u>Begin Sampling</u>
    i. Confirm the bellows valve is open by turning the knob counter-clockwise to loosen.
    ii. Remove the brass cap.
    iii. Attach the flow controller.
    iv. Attach a "J"-shaped sampling cane to prevent precipitation from entering the canister.
    v. Place the canister at the sampling location open the bellows valve. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.

vi. Record the start date and time on the COC.
vii. Record the identification numbers for the canister and flow controller and the vacuum gage.

- Begin Sampling (with a field duplicate)
  i. Confirm the bellows valve is closed by turning the knob clockwise to loosen on both canisters.
  ii. Remove the brass cap from both canisters.
  iii. Attach a flow controller on both canisters.
  iv. Attached a "T"-shaped sample train designed for field duplicates to both canisters.
  v. Attach a "J"-shaped sampling cane to the common end of the sampling "T" to limit precipitation entering the canisters.
  vi. Place the attached primary and duplicate canisters at the sampling location open the bellows valve. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.
  vii. Record the start date and time on the COC.
- Monitoring Sample progress
  i. At regular intervals, record the vacuum on the flow controller to confirm that the vacuum is decreasing in the canister. If the vacuum reads 5 in. Hg or less the bellows valve should be closed and the sample interval ended.
  ii. Some residual vacuum is important to maintaining sample integrity. If there is no vacuum remaining, call the laboratory and discuss the sample viability with them. Evaluate whether another sample will be taken after sharing the laboratory's opinion with your project manager.
- End Sampling
  i. Sampling will end when the time interval (e.g., 8-hr period) is completed, or when the canister vacuum reads 5 in. Hg or less.
  ii. Close the bellow valve by turning the knob clockwise to tighten.
  iii. Remove the "J"-shaped sampling cane.
  iv. Remove the flow controller.
  v. Attach the vacuum gauge.
  vi. Open and close the bellows valve quickly (a few seconds).
  vii. Read and record the vacuum on the gauge as 'Final vacuum' on the chain-of-custody (COC).
  viii. Confirm the bellows valve is closed by turning the knob clockwise to tighten.
  ix. Remove the vacuum gauge and replace the brass cap.
- Sample Transport
  i. Return the canister, flow controller, and sampling cane to the laboratory in the boxes provided.
  ii. Fill out the COC and relinquish samples properly with flow controller and canister numbers on the COC.

iii. Place the COC in the box and retain a copy of the COC for your records.
iv. Tape the box shut.
v. Deliver or ship the samples to the laboratory as soon as practical to adequately meet the holding time of the sample.

4. General Guidance

- This method may be modified for indoor air sampling.
- Field Blank: Do not collect a field blank.
- Trip Blank: Do not collect a trip blank. The canister is prepared for sampling by evacuating the contents to a vacuum of, so no air exists for a trip blank to provide meaningful information.

5. References

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/ Mass Spectrometry (GC/MS), US Environmental Protection Agency, Office of Research and Development, Center for Environmental Research Information, Cincinnati, OH, EPA/625/R-96/010b, January 1999.

Guide To Air Sampling & Analysis, Air Toxics, Ltd., Folsom, CA.

6. Contacts

Brian Skelly
Mark C. Ensign

Section 9

Soil Gas Sampling (SG)

STANDARD OPERATING PROCEDURE

SG-001 General Guidance on Soil Vapor Intrusion Evaluations

1. Objective

The goal of a soil vapor intrusion evaluation is to assess whether complete exposure pathways of soil vapor to indoor air exist. A complete exposure pathway exists if vapors from constituents are migrating through various pathways into residential or commercial buildings at concentrations that may result in an unacceptable human health risk. If a complete exposure pathway does not exist, then further assessment of soil vapor intrusion is not required.

Depending on the status of investigation performed at the site it may be appropriate to approach an evaluation of soil vapor intrusion at different tiers. If little work has been performed relative to the potential for contaminants to affect soil vapor near a structure, then a screening level assessment is an appropriate first step. However, if a plume is well delineated and the potential for groundwater impacts, or nearby source material, to affect soil vapor near a potential receptor structure is well understood, then it may be more appropriate to directly develop and implement a soil vapor and/or indoor air sampling plan. To accommodate the potential varied states of knowledge when a vapor intrusion evaluation is required, a flexible approach is needed that incorporates the following elements.

- SOP SG-002 Soil Vapor Sample Collection
- SOP SG-003 Sub-Slab Soil Vapor Collection
- Indoor Air Sampling
- SOP SG-004 Ambient Air Sample Collection

Soil vapor intrusion evaluations should be approached on a site-specific basis and depending on the site-specific setting and proximity to impacted groundwater or source material, it may be appropriate to proceed in a hierarchical fashion through each tier of evaluation or a variety of tiers may be combined and implemented simultaneously. The SOPs presented in this SOP address each of these sampling procedures.

2. Execution

2.1. Implementation Triggers

Soil vapor intrusion evaluations may be implemented at various times based on event triggers throughout the Site Characterization (SC), Remedial Investigation (RI), and site remedial action plan. The following event triggers would require the implementation of this soil vapor intrusion investigation.

- Identification of a potential complete exposure pathway
- Private property owner request for sampling

- State or Federal administrative order

2.2. Factors Affecting Soil Vapor Intrusion

Prior to conducting a soil vapor intrusion assessment at a private property, an analysis of the factors contributing to the migration of soil vapor to indoor air should be conducted. The completion of this analysis should take into account the two types of factors: environmental and building factors.

2.2.1. Environmental Factors

Environmental factors include site specific conditions in the subsurface and above the ground surface that may affect the rate and direction at which soil vapor may migrate.

The soil and groundwater conditions between the contamination and the residential/commercial building should be evaluated and recorded in any soil vapor intrusion investigation. If the SC/RI has been completed, then the data are available for this review. If the SC/RI has not been completed, then at a minimum the nature and extent of impacted soil and/or groundwater between the site and the residential/commercial building should be defined.

After compiling the necessary site-specific data, that information should be reviewed to determine groundwater conditions at the site. The potential for man-made or natural preferential pathways for vapor migration in the vadose zone and/or for groundwater migration in the saturated zone should also be determined at this time.

- The depth to groundwater below the residential or commercial building will be determined. For example, in cases where groundwater intersects the foundation there is no vadose zone to collect a sub-slab sample. In cases where the groundwater is close to the foundation, there is a risk of causing/exacerbating groundwater intrusion through the foundation during periods of high groundwater.

Additional Site Observations

- Direction of groundwater flow from the contaminant source to the residential or commercial building;
- The location, depth, extent, and concentration of potential constituents in unsaturated soil and groundwater on the property; and,
- Presence of an overlying water bearing zone that does not have impacts beneath the residential or commercial building. An un-impacted shallow water zone will significantly retard or completely prohibit the potential for deeper impacted groundwater to affect soil vapor.
- Potential "smear zones" (residual non-aqueous phase liquid (NAPL) present at depths over which the water table fluctuates) should also be identified as they may also affect the rate of soil vapor migration.
- Location, depth, extent of NAPL, if present.

Soils which are highly organic, wet, and/or of low permeability should be identified. If these soils are present beneath a structure and above impacted groundwater or soil, they may effectively shield the building from potential vapor intrusion. Conversely, dry and porous soils underlying a building may provide a less inhibited soil vapor intrusion pathway. The limits of backfill surrounding residential or commercial building should be also noted.

2.2.2. Building Factors

Building Factors include the physical characteristics, such as structure, floor layout, air flow, and physical conditions. These conditions will be documented during the evaluation. The New York State Department of Health (NYSDOH) Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory form is presented in Attachment A. At a minimum, the following information should be recorded.

- Building foundation construction characteristics (basement, footers, crawl spaces, etc), including potential preferential vapor intrusion pathways such as foundations cracks and utility penetrations.
- Basement wall materials (hollow block, stone, or poured concrete, etc.)
- Presence of an attached garage.
- Recent renovations to the building such as new paint or new carpet.
- Mechanical heating/cooling equipment that may affect air flow.
- Use and storage of petroleum products such as home heating oil storage tanks, underground storage tanks (USTs), or kerosene heaters.
- Recent use of petroleum-based finish or other products containing volatile organic compounds (VOCs).
- Areas of pavement on the property should also be identified in the event sub slab vapor sampling is not feasible or appropriate due to a high groundwater table. Paved areas could serve as surrogate locations in lieu of sub slab soil vapor sampling if high water table conditions exist.

The construction materials and integrity of the floor of the structure closest to the potential point of entry for soil vapor (basement level or first floor for slab-on-grade constructions) should be identified. In addition to the foundation type and integrity, this survey should note any preferential pathways (utility lines/pipes, sumps, etc.) that may exist within the bottom-most level of the structure.

The operation and presence of heating systems, including fireplaces and clothes dryers, may create a pressure differential between the structure and the outside environment, causing an increase of migration of soil vapor into the building. The NYSDOH guidance document suggests limiting indoor air sampling to the heating season (with the exception of immediate inhalation hazard situations), which is roughly defined as November 15th to March 31st. However, sampling may be completed at any time during the year for any sampling completed in response to a request by a community member. In situations where non-heating season sampling

has taken place, consideration should be given to re-sampling the property within the heating season. The operation of HVAC systems should be noted on the building inventory form (Attachment A).

During the initial building assessment and visit, and again when sub-slab soil vapor and/or indoor air sampling are performed, differential pressure measurements between indoor air, ambient air, and soil vapor should be collected and recorded to document the potential effect building conditions have on soil vapor migration.

2.2.3. Property Visit

A property visit will be conducted prior to sampling. During the site visit, technical representatives will complete site visit observations, inventories and occupant questionnaire forms (Appendix A). During the course of the interview, observations will be made to identify any potential areas or issues of concern or the presence of any odors, and if sampling appears necessary, identify potential sampling points and general building characteristics. The questionnaire is also used to identify potential sources and activities that may interfere with sampling results. The questionnaire will specifically address the activities of the occupant's (e.g., smoking, work place activities) that may contribute to indoor air concentrations of volatile chemicals.

The responses to the questionnaire will be evaluated and a determination will be made as to whether additional investigation is required.

2.2.4. Chemical Inventory

The chemical inventory complements the identification of the building factors affecting soil vapor intrusion. The chemical inventory will identify the occurrence and use of chemicals and products throughout the building. These products can be used to develop an indoor environmental profile. A separate inventory should be prepared for each room on the floor being tested as well as any other indoor areas physically connected to the areas being tested. Inventories will include product names, chemical ingredients, or both. If possible, photographs of the products should be taken of the location and condition of the inventoried products and the photographic records should be indexed with the inventory records. The products inventory can also be used to document odors and if possible portable vapor monitoring equipment measurements should be taken and recorded. A product inventory will be repeated prior to each round of testing at the building. If available, the volatile ingredients should be recorded for each product. If the ingredients are not listed on the label, record the manufacturer's name and address or phone number if available. The product inventory form is presented in Attachment A.

2.2.5. Water Table Conditions and Vapor Intrusion Assessment Approach

Sub-slab soil vapor sampling is intended to evaluate the potential for vapor intrusion. However, there are circumstances where collection of sub-slab soil vapor samples may not be feasible if the water table is near, at, or above the elevation of a buildings foundation slab. An evaluation of the water table elevation relative to the

building slab should be made before attempting to install a sub-slab vapor sampling point.

If the water table is found to be sufficiently below the building slab and sub-slab vapor sampling can be performed, then the following Low Water Table Scenario should be followed.

2.2.5.1. Low Water Table Scenario

If the water table elevation is lower than the basement slab, then the following samples should be collected.

- Sub-slab soil vapor samples
- Indoor air samples from basement level
- Indoor air samples from main living space (First floor)
- Outdoor ambient air sample

If the water table is deemed to be at too high of an elevation to allow sub-slab vapor sampling, then alternate means of evaluating the potential for vapor intrusion must be employed. If a building has a groundwater sump, the sump should be evaluated to determine if there is water present in the sump and if that water is representative of groundwater or if the water is stagnant. If water in the sump represents groundwater, then a sample from the sump should be collected. The High Water Scenario below summarizes the methods to evaluate potential vapor intrusion if sub-slab vapor sampling cannot be conducted due to high groundwater conditions.

2.2.5.2. High Water Table Scenario

If the water table elevation is higher than the basement slab, then the following tasks should be performed.

- Determine if a sump pump is present and actively pumping water.
- If sump is actively pumping, collect a sample of groundwater from the sump.
- Collect an indoor air sample from basement level.
- Collect an indoor air sample from main living space (first floor).
- Identify exterior soil vapor sample location near foundation (outside of foundation backfill) and preferably beneath a surrogate vapor cap (e.g. paved driveway, patio).
- Collect soil vapor samples from exterior soil vapor location
- Collect an outdoor ambient air sample.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, *dated October 2006.*

4. Attachments

Attachment A - NYSDOH Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory Form

5. Contact

Chris Berotti

ATTACHMENT A

Off-Site Property Sampling Documentation Form

Property Location/Address: _____

Property: _____

Sampling Date: _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

Preparer's Name: _____ Date/Time Prepared: _____

Preparer's Affiliation: _____ Phone No.: _____

Purpose of Investigation:_____

1. OCCUPANT Interviewed: Yes ☐ No ☐

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

Number of Occupants/persons at this location _____ Age of Occupants_____

2. OWNER OR LANDLORD (Check if same as occupant __) Interviewed: Yes ☐ No ☐

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

3. CONTACT NAME (Check if same as Occupant ____, Owner ____)

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

4. PROPERTY LOCATION: _____

Relative to Site:

Direction _____ Direction to Nearest Cross Street: _____

Distance _____ Distance to Nearest Cross Street: _____

Surrounding Land Use:

North: _____ East: _____

South: _____ West: _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

5. PROPERTY BOUNDARIES

Delineate the boundaries of the property (on a separate project map, outline property location, private well location, septic/leachfield location, groundwater flow, compass direction, windrose.)

6. BUILDING CONSTRUCTION

Type of Building (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _____

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_____

If multiple units, how many? _____

If the property is commercial, type?

Business Type(s) _____

Does it include residences (i.e., multi-use)? Yes □ No □

If yes, how many? _____

Other characteristics:

Number of floors_____ Building age_____

Is the building insulated? Yes □ No □ How air tight? Tight / Average / Not Tight

Construction Material _____

7. BASEMENT AND CONSTRUCTION CHARACTERISTICS

Does the building have a basement and/or crawl space, or is it slab-on-grade construction?

_____

Describe the construction of the basement/crawl space (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

c. Basement floor:	concrete	dirt	stone	other _____
d. Basement floor surface:	uncovered	covered	covered with _____	
e. Concrete floor:	unsealed	sealed	sealed with _____	
	unpainted	painted	painted with _____	
f. Foundation walls:	poured	block	stone	other _____
g. Foundation walls:	unsealed	sealed	sealed with _____	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	

Does your basement have a sump? Yes ☐ No ☐

Is, is there water in the sump? Yes ☐ No ☐

Describe sump conditions:_____

_____

Have you observed standing water in your basement? Yes ☐ No ☐

If so, what is the frequency of this observation? _____During rain events? ☐

Have you observed sheen atop the standing water? Yes ☐ No ☐

Basement/Lowest level depth below grade: _____(feet)

Are there any cracks in the floor of your basement? Yes ☐ No ☐

Description: _____

_____

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

Description: _____

_____

What activities occur in the finished basement?

Description: _____

_____

Approximately how many hours per day (or week) do you spend in your basement? _____

8. HEATING, VENTING AND AIR CONDITIONING

Type of heating system(s) used in building: (Circle all that apply – note primary)

Property Location/Address: _____
Property: _____
Sampling Date: _____

Hot Air Circulation	Hot Water Baseboard	Steam Radiation
Electric Baseboard	Heat Pump	Wood Stove
Space Heaters	Radiant Floor	Outdoor wood boiler
Unvented Kerosene Heater	Other _____	

The primary type of fuel used is:

Fuel Oil	Natural Gas	Electric
Kerosene	Propane	Solar
Wood	Coal	Other? _____

Time of use of each type of heating? _____

Domestic hot water tank fueled by: _____

Boiler/furnace located in: Basement Outdoors Main Floor Other_____

Air conditioning: Central Air Window units Open Windows None

Are there air distribution ducts present? Yes ☐ No ☐

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

_____

_____

_____

_____

Type of insulation (e.g. blown, fiber, etc.)? _____

Does building have energy efficient windows (e.g. double paned) Yes ☐ No ☐

Was weather-stripping recently added/upgraded? Yes ☐ No ☐

Particleboard used in construction? Yes ☐ No ☐

9. OCCUPANCY

Property Location/Address: _____
Property: _____
Sampling Date: _____

Level	General Use of Each Floor (e.g., family room, bedroom, laundry, workshop, storage)
Basement	_____
1st Floor	_____
2nd Floor	_____
3rd Floor	_____
4th Floor	_____

10. BULK PETROLEUM STORAGE

Aboveground storage tank on the property Yes ☐ No ☐

If yes, how old is tank? _____ Condition? _____

Last inspected? _____ Location: _____

Describe conduits to building (type, location, and entry portal condition): _____

_____

Underground storage tank on the property. Yes ☐ No ☐

If yes, how old is tank? _____ Condition? _____

Last inspected? _____ Location: _____

Describe conduits to building (type, location, and entry portal condition): _____

_____

11. WATER AND SEWAGE

Water Supply:

Public Water Drilled Well Driven Well Dug Well Other _____

Is there use of groundwater water for irrigation purposes? Yes ☐ No ☐

Sewage Disposal:

Public Sewer Septic Tank Leach Field Dry Well Other _____

12. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Yes ☐ No ☐

If not, is there a separate garage or carport? Yes ☐ No ☐

b. Does the garage have a separate heating unit? Yes ☐ No ☐ NA ☐

Property Location/Address: _____
Property: _____
Sampling Date: _____

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, ATV, car)
Yes ☐ No ☐ NA ☐ Please specify_____

Is gasoline stored in the garage? Yes ☐ No ☐

Quantity? _____

d. Has the building ever had a fire? Yes ☐ No ☐

When?_____

e. Is a kerosene or unvented gas space heater present? Yes ☐ No ☐

Where? _____

f. Is there a workshop or hobby/craft area? Yes ☐ No ☐

Where & Type? _____

g. Is there smoking in the building? Yes ☐ No ☐

How frequently? _____

h. Have cleaning products been used recently? Yes ☐ No ☐

When & Type? _____

i. Have cosmetic products been used recently? Yes ☐ No ☐

When & Type? _____

j. Has painting/staining been done in the last 6 months? Yes ☐ No ☐

Where & When? _____

Is house paint stored inside? Yes ☐ No ☐

Where? _____

k. Is there new carpet, drapes or other textiles? Yes ☐ No ☐

Where & When? _____

l. Have air fresheners been used recently? Yes ☐ No ☐

When & Type? _____

m. Is there a kitchen exhaust fan? Yes ☐ No ☐

If yes, where vented?_____

n. Is there a bathroom exhaust fan? Yes ☐ No ☐

If yes, where vented?_____

o. Is there a clothes dryer? Yes ☐ No ☐

If yes, is it vented outside? Yes ☐ No ☐

p. Has there been a pesticide/chemical fertilizer application? Yes ☐ No ☐

Property Location/Address: _____
Property: _____
Sampling Date: _____

When & Type?_____

Conducted by Owner or Private Yard Service _____

Is yard waste/trash burned on-site? Yes ☐ No ☐

Do any of the building occupants use solvents at work? Yes ☐ No ☐

(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? _____

If yes, are their clothes washed at work? Yes ☐ No ☐

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, Use dry-cleaning regularly (weekly) No

Use dry-cleaning infrequently (monthly or less) Unknown

Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Yes ☐ No ☐

Date of Installation: _____

Is the system active or passive? Active ☐ Passive ☐

Are there any recent/past improvements to building? Yes ☐ No ☐

Interior painting? _____

Any landscaping improvements that involved bringing fill on site? Yes ☐ No ☐

Other _____

Approximately when (how long ago) did these improvements occur? _____

Does anyone living here engage in any of the following activities or hobbies?

a. Art projects (e.g. oil painting, ceramics, pottery, stained glass, metal sculpture)

Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

b. Furniture refinishing Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

c. Model building(e.g. planes,boats,cars) Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

d. Gardening Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

e. Automotive work Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

f. Ammunition reloading Yes ☐ No ☐

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

Is there a wood burning stove? Yes ☐ No ☐

If so, how frequently is it used?

_____

_____

Is there a barbeque grill? Yes ☐ No ☐

If so, how frequently is it used? What is the type of fuel?

_____

_____

Has the building ever had fumigation? Yes ☐ No ☐

Property Location/Address: _____
Property: _____
Sampling Date: _____

If so, when and how frequently? Type?

_____

_____

13. ODOR SUMMARY

Have the occupants observed any unusual odors? _____

_____

_____

_____

_____

History of odor observation – date of onset, duration, severity, etc.

_____

_____

_____

_____

_____

_____

_____

14. PRODUCT INVENTORY

Record the specific products found in building that have the potential to affect indoor air quality on the attached product inventory form.

15. INDOOR SKETCH

Draw a plan view sketch (on grid paper) of the basement, first floor, and any other floor where sampling was conducted in the building as well as any outdoor sample locations. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Property Location/Address: _____
Property: _____
Sampling Date: _____

Product Inventory
Off-Site Property Sampling Documentation
Soil Vapor Intrusion Investigation

Property Address:	**Performed by:**
Date of Inventory:	**Field Instrument Make & Model:**

Location	Product Description	Size (units)	Condition *	Chemical Ingredients	Field Instrument Reading (units)	Photo ** Y/N

Notes

* 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.

STANDARD OPERATING PROCEDURE

SG-002 Soil Vapor Sample Collection

1. Objective

This procedure outlines the general steps to collect soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary soil vapor probes should be installed using the procedures outlined below. All soil vapor probes should be installed using a direct-push drill rig (e.g., Geoprobe® or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe points.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North);
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Soil Vapor Point Installation Specifications

Each soil vapor point should be constructed as follows:

- Six-inch stainless steel Geoprobe® AT86 series Permanent Implants (soil vapor screens) or equivalent and threaded to an (expendable) stainless steel anchor point.
- The implants should be fitted with inert Teflon or stainless steel tubing of laboratory or food grade quality.
- The annular space surrounding the vapor screen interval and a minimum of 6-inches above the top of the screen should be filled with a porous backfill

material (e.g., glass beads or coarse silica sand) to create a sampling zone 1 foot in length.

For temporary points, a hydrated bentonite surface seal should be created at the surface to minimize infiltration. For permanent points, the additional measures described below should be included.

- The soil vapor points should be sealed above the sampling zone with a bentonite slurry for a minimum distance of 3 feet (or to grade, whichever is smaller) to prevent ambient air infiltration.
- If needed, the remainder of the borehole should be backfilled with clean material.
- A protective casing should be set around the top of the point tubing and grouted in place to the top of the bentonite to minimize infiltration of water or ambient air, as well as to prevent accidental damage to the soil vapor point.
- The tubing top should be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

2.3. Soil Vapor Sample Collection

Soil vapor samples should be collected as indicated in the work plan and in accordance with applicable state or federal guidance documents. Specifically, samples from the points should be collected as follows:

- Permanent soil vapor points should not be sampled or purged for a minimum of 24 hours after installation. Temporary points may be purged and sampled immediately following installation.
- Document pertinent field conditions prior to sampling as described above.
- A suction pump should be used to remove a minimum of three implant volumes from the soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples should be collected for volatile organic compounds (VOCs) in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate should not exceed 0.2 liters per minute.
- A helium tracer gas should be used to identify any potential migration or short circuiting of ambient air during sampling as described below.
- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing

laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.

- Connect the tubing from the soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample should be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data should be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the soil vapor probe seal and assess the potential for introduction of ambient air into the soil vapor sample.

A tracer gas evaluation should be conducted on the each temporary soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on

the each permanent soil vapor probe during the initial sampling event and a minimum of 10% of the soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

Retain the tracer gas around the sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.

- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber should have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber should have a gas-tight fitting or sealable penetration to allow the soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that should be pre-calibrated to extract soil vapor at a rate of no more than 0.2 liters per minute. Purge the tubing using the pump. Calculate the volume of air in the tubing and probe and purge one to three tubing/probe volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary.

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred, however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil

vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006*.

4. Contact

Chris Berotti

STANDARD OPERATING PROCEDURE

SG-003 Sub-slab Soil Vapor Collection

1. Objective

This procedure outlines the general steps to collect sub-slab soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary sub-slab soil vapor probes will be installed using the procedures outlined below. All sub-slab soil vapor probes will be installed using a direct-push drill rig (e.g., Geoprobe® or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe locations.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours. Record the indoor conditions (temperature, heating/cooling system active, windows open/closed, etc.).
- Measure the differential pressure at the building. Measure the indoor and outdoor barometric pressure using a high resolution device. Where possible, measure the sub-slab barometric pressure at the sampling point.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Indoor floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, heating, ventilating and air conditioning (HVAC) system air supply and return registers, compass orientation (North), footings that create separate foundation sections, and any other pertinent information should be completed;
- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas.
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sub-Slab Soil Vapor Point Installation Specifications

Each sub-slab soil vapor point will be constructed as follows:

- Drill an approximately 3/8-inch hole through the slab. If necessary, advance the drill bit 2-3 inches into the sub-slab material to create an open cavity.
- Using dedicated inert Teflon or stainless steel tubing of laboratory or food grade quality, insert the inlet of the tubing to the specified depth below the slab. For permanent installation, only stainless steel tubing and fittings will be used.
- For permanent point installations, the annular space surrounding the vapor probe tip will be filled with a porous backfill material (e.g., glass beads or coarse silica sand) to cover 1-inch of the above the tip of the probe.
- Seal the annular space between the hole and the tubing using an inert non-shrinking sealant such as melted 100% beeswax, permagum grout, putty, etc. For permanent installations, cement may be used.
- For permanent points, a protective casing will be set around the top of the point tubing and grouted in place minimize infiltration of water or ambient air, as well as to prevent accidental damage to he permanent point.
- The tubing top will be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

In cases where sub-slab sampling is impractical or infeasible, a surrogate location (attached garage, concrete patio, asphalt driveway, etc.) may be used if it is representative of sub-slab conditions. In surrogate locations, the vapor sampling point may be installed in accordance with SOP SG-002 Soil Vapor Collection.

2.3. Sub-Slab Soil Vapor Sample Collection

Sub-slab soil vapor samples will be collected as indicated in the site-specific Sampling and Analysis Work Plan and in accordance with state or Federal guidance documents. Specifically, sub-slab samples from the points will be collected as follows:

- Document pertinent field conditions prior to sampling as described above.
- A suction pump will be used to remove one to three implant volumes from the sub-slab soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples will be collected in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate will not exceed 0.2 liters per minute.
- A helium tracer gas will be used to identify any potential migration or short circuiting of ambient air during sampling as described below.

- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.
- Connect the tubing from the sub-slab soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples will be analyzed for volatile organic compounds (VOCs) and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the sub-slab soil vapor probe seal and assess the potential for introduction of indoor air into the sub-slab soil vapor sample. A tracer gas evaluation should be conducted on the each temporary sub-slab soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on the each permanent sub-slab soil vapor probe during the initial sampling event and a minimum of 10% of the sub-slab soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

- Retain the tracer gas around the sub-slab sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.
- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber will have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber will have a gas-tight fitting or sealable penetration to allow the sub-slab soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that will be pre-calibrated to extract sub-slab soil vapor at a rate of no more than 0.2 lpm. Purge the tubing using the pump. Calculate the volume of air in the tubing and purge one to three tubing volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation will be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary:

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the

surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred; however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006.

4. Contact

Chris Berotti

STANDARD OPERATING PROCEDURE

SG-004 Ambient Air Sample Collection

1. Objective

Describe procedures to collect ambient air samples. The site-specific Work Plan should be consulted for proposed sample locations and sampling duration.

2. Execution

2.1. Document Field Conditions

Document pertinent field conditions prior to sample collection:

- Record weather information, if available (such as precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for at least the past 12 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North).
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sample Collection

- Samples should be collected in laboratory-certified clean SUMMA® canister (or equivalent) using a flow controller calibrated for the anticipated sample duration (1-hour, 8-hour, etc.). The regulator flow rate should not exceed 0.2 liters per minute.
- Place the canister at the sampling location. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.
- Remove the protective brass plug from canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of custody form for each sample.

- Connect the tubing to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- If possible, monitor the vacuum pressure in the canister routinely during sampling. During monitoring, note the vacuum pressure on the gauge.
- Stop sample collection after the scheduled duration of sample collection but make sure that the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, call the laboratory and discuss the sample viability with them. Determine whether another sample will be taken after sharing the laboratory's opinion with your project manager.
- Record the final vacuum pressure and close the canister valves. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006*.

4. Contacts

Chris Berotti
Bill Simons

Section 10

Quality Control – Quality Assurance (QA)

STANDARD OPERATING PROCEDURE

QA-001 Equipment Decontamination

1. Objective

This SOP describes methods used to decontaminate reusable sampling equipment for projects that require collection of organic and inorganic analytical samples. The goal is to minimize cross-contamination between samples. This maximizes confidence that field samples will be representative of specific locations and conditions.

Refer to the work plan or project manager to determine if different decontamination methods are acceptable.

2. Execution

- All contractor-provided equipment (augers, rods, spoons, backhoe buckets) should be decontaminated by steam cleaning or pressure washing prior to coming on site. If there is doubt about cleanliness of drilling tools, they should be decontaminated before use at the site.
- Sampling equipment decontamination is a sequential procedure consisting of the following steps:

    - Alconox-solution wash (or equivalent non-phosphate detergent)
    - Potable water rinse
    - A ten percent reagent grade nitric acid wash should be used to strip potential inorganic contaminants from sampling devices.
    - Laboratory grade 100 percent methanol, should be used to strip potential organic contaminants from sampling devices.
    - Three distilled/deionized water rinses.

- Alconox solution is a mixture of approximately 1 cup of Alconox per 1 gallon of potable water. Alconox solution wash requires scrubbing the equipment with a brush soaked in Alconox solution to remove visible contamination or dirt from sampling devices.
- Split-spoon samplers must be decontaminated prior to collecting each sample. The procedure follows:

    - Overall wash and scrub in a bucket of Alconox solution
    - Potable water rinse.
    - 10% nitric rinse
    - 100% laboratory grade methanol rinse
    - Three distilled-water rinses.

The same procedure is applied to all devices that may contact soil or groundwater slated for analytical samples - spoons and knifes used to inspect or sample soils; water level indicators; oil/water interface probes.

Equipment used for well development of multiple wells must be decontaminated between wells.

Pumps and tubing should be flushed using a minimum of one gallon of Alconox-solution followed by a gallon of potable water. Some projects may require methanol (in much lower quantities) and distilled water instead of or in addition to the Alconox-solution and potable water.

For pumps and tubing, a final rinse of the sampling equipment may be performed with the water being sampled.

Equipment blanks measure the effectiveness of the decontamination procedures. Blanks should be collected per guidance provided in QA-002, Field Quality Control Samples.

3. Limitations

- Do not store the deionized/distilled water in polyethylene bottles, use Nalgene, glass, or Teflon. Polyethylene may leach phthalates.
- Do not attempt to decontaminate string or rope - replace it.
- Due to eye and skin absorption hazards, safety glasses and gloves must be worn when handling decontamination solvents.
- Decontamination procedures may also require modification based on state or federal requirements.
- Steam cleaning or pressure washing with potable water is generally an acceptable decontamination method for drilling equipment (i.e., augers). Check with the work plan.
- Dedicated equipment need not be decontaminated beyond initial decontamination prior to field use.

4. References

Environmental Response Team (ERT), US EPA. Sampling Equipment Decontamination, SOP No. 2006, Revision 0.0. August 11, 1994.

US EPA Region 9. Sampling Equipment Decontamination, SOP No. 1230, Revision 1.September 1999.

5. Contacts

Brian Conte
Bill Simons

STANDARD OPERATING PROCEDURE

QA-002 Field Quality Control Samples

1. Objective

Field Quality Control (QC) samples are used to monitor the reproducibility and representativeness of field sampling. The QC samples are handled, transported, and analyzed in the same manner as the associated field samples. QC samples may include trip blanks, equipment blanks, and field duplicates.

2. Execution

2.1. Trip blanks

- Used to monitor possible sources of contamination from transport, storage, inadequate bottle cleaning, or laboratory methodologies.
- Sample containers filled at the laboratory with analyte-free water are transported to and from the site, and are not opened until time of analysis.
- Trip blanks are stored with the sample containers prior to and after field activities and remain with the collected samples until analyzed.
- Generally, one trip blank per volatiles analysis (e.g. volatile organic compounds) shipment.
- Consider submitting a trip blank when sample shipment is by Fed Ex or other large carrier, or laboratory courier.
- Trip blanks should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

2.2. Equipment blanks

- Equipment blanks (also known as equipment rinsate blanks) are used to monitor possible sources of contamination associated with sample collection. Monitors on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions
- Equipment blanks are collected by pouring laboratory supplied or distilled or deionized water over sampling tools that have been decontaminated per the work plan, into sample containers.
- Equipment blanks are stored with the associated field samples until submitted for analysis.
- Generally collected when site conditions indicate site related contamination is a concern. Check project-specific work plan and/or quality assurance project plan for required frequency.
- Prepare equipment blanks immediately after the equipment is cleaned in the field and before leaving the sampling site.
- Prepare equipment blanks by rinsing the decontaminated sampling equipment set with the appropriate type of analyte-free water and collecting the rinse water in appropriate sample containers.

- If a potable water rinse is the typical final step, collect the equipment blank with analyte-free water after the potable water rinse.
- Equipment blanks should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

2.3. Field Duplicates

- Used to evaluate the precision and representativeness of the sampling procedures.
- Field duplicates are two samples collected from the same location using the same procedures. Both samples are submitted to the laboratory as individual samples with different sample identification.
- Field duplicates from groundwater sampling for all analyses except volatiles analysis are collected by alternating filling sample containers from the same sampling device. Field duplicates for volatiles analysis are filled sequentially.
- Soil or sediment field duplicates are collected by homogenizing the sample for all analyses except volatiles. The homogenized sample is then divided into two equal portions and placed in separate sample containers. Field duplicates for volatile analysis are collected at two adjacent sampling locations.
- Each sample is assigned different sample identifications.
- Field duplicates are generally collected at frequency of 1/20 samples. Check project-specific work plan and/or quality assurance project plan for required frequency.
- All field QC samples should be labeled in the field and submitted “blind” to the laboratory – as if they are separate, primary samples.
- Field duplicates should be recorded in the field notebook and on the chain-of-custody that same as all other samples.
-

2.4. Matrix-Spike samples (MS/MSD)

- Matrix spike and matrix spike duplicate samples (MS/MSDs) are environmental samples that are spiked in the laboratory or in the field with a known concentration of a target analyte(s) to verify percent recoveries.
- Matrix spike and matrix spike duplicate samples are primarily used to check sample matrix interferences. They can also be used to monitor error due to laboratory bias and poor precision. However, a data set of at least three or more results is necessary to statistically distinguish between laboratory performance and matrix interference.
- Generally, the laboratory is required to extract and analyze MS or MS / MSDs at a minimum frequency of 5% of samples being analyzed for the target analyte(s). If the project or client criteria require an MS or MS/MSD, collect sufficient volume in the appropriate containers, and designate the sample to be used as the MS or MS/MSD on the chain of custody.
- Calculate the percent recovery for all spiked analytes for both the MS and MSD. For MS/MSDs also calculate the relative percent difference (RPD). The

RPD for each spiked analyte is calculated using the amount detected not percent recovery. If your data will be subjected to validation, the % recovery and the RPD will generally be determined by the validator.

2.5. Typical QA/QC Frequency

- QA/QC frequency is determined by project, client or regulatory criteria and should be verified prior to sample collection. Generally, QA/QC samples are collected according to the frequency described below:

Duplicate Samples	One per sampling event, one per 10 samples collected, or one every two weeks, whichever comes first.
Equipment Blanks	For each equipment type that is not dedicated or disposable - one per sampling event, one per 20 samples collected, or one every two weeks, whichever comes first.
Trip Blanks	One per sample delivery group, or in each cooler containing VOC soil or aqueous samples, depending on project.
MS or MS / MSDs	One MS or MS/MSD per sampling event, one per 20 samples collected, or one every two weeks, whichever comes first.

3. Limitations

- Trip blanks must never be opened in the field.
- Trip blanks are usually for VOCs only because less volatile compounds are not likely to cross-contaminate other samples by simply being in close proximity.
- Laboratory-grade water must be used during the collection of equipment blanks.
- Field duplicates must have different sample identifications.

4. References

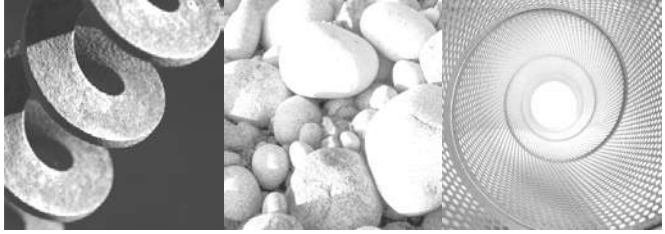
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (November 1986), U.S. Environmental Protection Agency Department of Solid Waste, Washington, D.C.

U.S. Environmental Protection Agency Office of Emergency and Remedial Response, 1990, Quality assurance/quality control guidance for removal activities: EPA/540/G-90/004, Sampling QA/QC Plan and Data Validation Procedures Interim Final, April, 1990.

5. Contact

Brian Conte
Pat King

APPENDIX C – QUALITY ASSURANCE PROJECT PLAN



GEI Consultants

Consulting
Engineers and
Scientists

Quality Assurance Project Plan
Woodworth Avenue Works Former MGP Site

Yonkers, New York
AOC Index No. CO0-20180516-519
Site #: 360164

Prepared For:
Consolidated Edison Company of New York, Inc.
31-01 20th Avenue
Astoria, NY 11105

Submitted by:
GEI Consultants, Inc., P.C.
455 Winding Brook Drive
Glastonbury, CT 06480
860.368.5300

September 2020
Project 1900674-4.1

Matthew O'Neil, P.E.
Senior Engineer

Melissa Felter, P.G., LEP
Environmental Scientist



Table of Contents

Abbreviations and Acronyms iii

Quality Assurance Glossary v

1. Purpose 1

2. Project Goals and Objectives 2

3. Project Organization and Responsibility 3

4. Quality Assurance Objectives 6
4.1 Required Quantification Limit 7
4.2 Accuracy 7
4.3 Precision 8
4.4 Completeness 8
4.5 Representativeness 9
4.6 Comparability 9

5. Sampling Plan 10
5.1 Sample Type, Location, and Frequency 10
5.1.1 Subsurface Soil and Sediment Samples 10
5.1.2 Investigation-Derived Waste Sample Collection 10
5.1.3 Field QC Sample Collection 10
5.2 Sample Preservation and Containerization 11
5.3 Equipment Decontamination 12

6. Documentation and COC 13
6.1 Sample Collection Documentation 13
6.1.1 Field Notes 13
6.1.2 COC Records 13
6.1.3 Sample Labeling 14
6.1.4 Sample Handling 14
6.2 Sample Custody 14
6.2.1 Field Custody Procedures 15
6.2.2 Laboratory Custody Procedures 16

7. Calibration Procedure 17
7.1 Field Instruments 17
7.2 Laboratory Instruments 17

8. Sample Preparation and Procedures 18

9. Data Reduction, Validation, and Reporting 19
9.1 Field Data Evaluation 19
9.2 Analytical Data Validation 19
9.3 Analytical Data Deliverable 20

10. Internal Quality Control 22

11. Performance and System Audits 23

12. Preventative Maintenance 24

13. Specific Procedures to Assess Data Quality Indicators 25
13.1 Detection Limits 25
13.1.1 Method Detection Limit 25
13.1.2 Reporting Limit 25
13.2 Precision 26
13.3 Accuracy 27
13.4 Completeness 27
13.5 Representativeness 28
13.6 Comparability 28

14. Corrective Action 29
14.1 Immediate Corrective Action 29

Tables

1. Soil and Sediment Field Sampling Matrix
2. Analytical Methods/Quality Assurance Summary Table
3. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil and Sediment Samples
4. Quality Control Limits Precision and Accuracy for Soil and Sediment Samples

Attachment

A Test America Laboratory Quality Manual (electronic only)

Abbreviations and Acronyms

%R	Percent Recovery
ASP	Analytical Service Protocol
ASTM	American Society for Testing and Materials
CAS	Chemical Abstract Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	Chip Measurement System
CLP	Contract Laboratory Protocol
COC	Chain Of Custody
DQO	Data Quality Objective
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
EPA	United States Environmental Protection Agency
eV	Electron Volt
FSP	Field Sampling Plan
FWRIA	Fish and Wildlife Resource Impact Analysis
GC/MS	Gas Chromatography/Mass Spectroscopy
GEI	GEI Consultants, Inc., P.C.
LCS	Laboratory Control Sample
LEL	Lower Explosive Limit
MDL	Method Detection Limit
MGP	Manufactured Gas Plant
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NTU	Nephelometric Turbidity Unit
NYSDEC	New York State Department of Environmental Conservation
PAH	Polycyclic Aromatic Hydrocarbon
PID	Photoionization Detector
PM	Project Manager
PQL	Practical Quantification Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QHHEA	Qualitative Human Health Exposure Assessment
RCRA	Resource Conservation Recovery Act
RI	Remedial Investigation
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SD	Standard Deviation
SOP	Standard Operating Procedures
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compounds
TOX	Total Organic Halides

USDOT	United States Department of Transportation
VOC	Volatile Organic Compound
MEASUREMENTS	
mg/kg	milligrams per kilogram
µg /L	micrograms per liter
µg /m^3	micrograms per cubic meter

Quality Assurance Glossary

"Alteration" means altering a sample collected for analysis in any way other than by adding a preservative, such as nitric acid to lower pH. Examples of alteration include, but are not limited to: filtering, settling and decanting, centrifuging and decanting and acid extracting.

"Analytical Services Protocol" or "ASP" means the New York State Department of Environmental Conservation (NYSDEC's) compendium of approved United States Environmental Protection Agency (EPA) and NYSDEC laboratory methods for sample preparation and analysis and data handling procedures.

"Correlation Sample" means a sample taken, when using a field-testing technology, to be analyzed by an Environmental Laboratory Approval Program (ELAP)-certified laboratory to determine the correlation between the laboratory and field analytical results.

"Confirmatory Sample" means a sample taken after remedial action is expected to be complete to verify that the cleanup requirements have been met. This term has the same meaning as "post remediation sample."

"Contract laboratory program" or "CLP" means a program of chemical analytical services developed by the EPA to support Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

"Data Usability Summary Report, (DUSR)" is a document that provides a thorough evaluation of the analytical data to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and use.

"Effective solubility" means the theoretical aqueous solubility of an organic constituent in groundwater that is in chemical equilibrium with a separate phase mixed product (product containing several organic chemicals). The effective solubility of a particular organic chemical can be estimated by multiplying its mole fraction in the product mixture by its pure phase solubility.

"Environmental Laboratory Accreditation Program" or "ELAP" means a program conducted by the New York State Department of Health, which certifies environmental laboratories through on-site inspections and evaluation of principles of credentials and proficiency testing.

"Filtration" means the filtering of a groundwater or surface water sample, collected for metals analysis, at the time of collection and prior to preservation. Filtering includes, but is not limited to, the use of any membrane, fabric, paper or other filter medium, irrespective of pore size, to remove particulates from suspension.

"**Final delineation sample**" means a sample taken as an endpoint sample, used to make a decision regarding the extent of contamination at a site, which is to be analyzed by an ELAP-certified laboratory.

"Intermediate Sample" means a sample taken during the investigation process that will be followed by another sampling event to confirm that remediation was successful or to confirm that the extent of contamination has been defined to below a level of concern.

"Method detection limit" or "MDL" means the minimum concentration of a substance that can be measured and reported with a 99-percent confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the analyte.

"Minimum reporting limit" means the lowest concentration at which an analyte can be detected and which can be reported with a reasonable degree of accuracy. It is the lowest concentration that can be measured, a lab-specific number, developed from minimum detection limits, and is also referred to as the practical quantitation limit (PQL).

"Non-targeted compound" means a compound detected in a sample using a specific analytical method that is not a targeted compound, a surrogate compound, a system monitoring compound or an internal standard compound.

"Nephelometric Turbidity Unit" or "NTU" is the unit by which turbidity in a sample is measured.

"Practical quantitation level" or "PQL" means the lowest quantitation level of a given analyte that can be reliably achieved among laboratories within the specified limits of precision and accuracy of a given analytical method during routine laboratory operating conditions.

"Preservation" means preventing the degradation of a sample due to precipitation, biological action, or other physical/chemical processes between the time of sample collection and analysis. The most common examples involve refrigeration at 4 degrees Celsius and lowering sample pH by the addition of acid to keep dissolved metals in solution or to reduce the biodegradation of dissolved organic analytes.

"PAH" means polycyclic aromatic hydrocarbon as defined by EPA Method 8270.

"Quality assurance" or "QA" means the total integrated program for assuring the reliability of monitoring and measurement data, which includes a system for integrating the quality planning, quality assessment and quality improvement efforts to meet data end-use requirements.

"Quality assurance project plan" or "QAPP" means a document, which presents in specific terms the policies, organization, objectives, functional activities, and specific quality assurance/quality control activities designed to achieve the data quality goals or objectives of a specific project or operation.

"Quality control" or "QC" means the routine application of procedures for attaining prescribed standards of performance in the monitoring and measurement process.

"Semivolatile organic compound" or "SVOC" means compounds amenable to analysis by extraction of the sample with an organic solvent. For the purposes of this section, semivolatiles are those target compound list compounds identified in the statement of work in the current version of the 2005 ASP.

"Target analyte list" or "TAL" means the list of inorganic compounds/elements designated for analysis as contained in the version of the EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration in effect as of the date on which the laboratory is performing the analysis. For the purpose of this chapter, a Target Analyte List scan means the analysis of a sample for Target Analyte List compounds/ elements.

"Targeted compound" means a hazardous substance, hazardous waste, or pollutant for which a specific analytical method is designed to detect that potential contaminant both qualitatively and quantitatively.

"Target compound list plus 30" or "TCL+30" means the list of organic compounds designated for analysis (TCL) as contained in the version of the EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis, and up to 30 non-targeted organic compounds (plus 30) as detected by gas chromatography/mass spectroscopy (GC/MS) analysis. For the purposes of this chapter, a TCL+30 scan means the analysis of a sample for TCL compounds and up to 10 non-targeted volatile organic compounds and up to 20 non-targeted SVOCs using GC/MS analytical methods. Non-targeted compound criteria should be pursuant to the version of the EPA "Contract

Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis.
"Tentatively identified compound or TIC" means a chemical compound that is not on the target compound list but is detected in a sample analyzed by a GC/MS analytical method. TICs are only possible with methods using mass spectrometry as the detection technique. The compound is tentatively identified using a mass spectral instrumental electronic library search and the concentration of the compound estimated.

"Unknown compound" means a non-targeted compound which cannot be tentatively identified. Based on the analytical method used, the estimated concentration of the unknown compound may or may not be determined.

"Volatile organics" or "VOC" means organic compounds amenable to analysis by the purge and trap technique. For the purposes of this chapter, analysis of VOCs means the analysis of a sample for either those priority pollutants listed as amenable for analysis using EPA method 8260B or those target compounds identified as volatiles in the version of the EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis.

"**Waste oil"** means used and/or reprocessed engine lubricating oil and/or any other used oil, including but not limited to: fuel oil, engine oil, gear oil, cutting oil, transmission fluid, oil storage tank residue, animal oil, and vegetable oil, which has not subsequently been refined.

"Well development" means the application of energy to a newly installed well to establish a good hydraulic connection between the well and the surrounding formation. During development, fine-grained formation material that may have infiltrated the sand pack and/or well during installation is removed, allowing water from the formation to enter the well without becoming turbid and unrepresentative of groundwater in the formation.

1. Purpose

GEI Consultants, Inc., P.C. (GEI) has prepared this Quality Assurance Project Plan (QAPP) to address analytical sampling during Remedial Investigation (RI) activities at the Woodworth Avenue Works Former Manufactured Gas Plant (MGP) Site (Site) located in Yonkers, New York. The QAPP is a companion document to the *Remedial Investigation Work Plan*. The QAPP presents the project scope and goals, organization, objectives, sample handling procedures and quality assurance/quality control (QA/QC) procedures associated with the Site.

Furthermore, this QAPP identifies project responsibilities, prescribes guidance and specifications to make certain that:

- Samples are identified and controlled through sample tracking systems and chain-of-custody (COC) protocols
- Field and laboratory analytical results are valid and usable by adherence to established protocols and procedures
- Laboratory data are validated, as necessary, so they can be applied to developing a conceptual understanding of the nature and extent of contamination at the Site
- All aspects of investigation, from field to laboratory, are documented to provide data that are technically sound and legally defensible

The requirements of this QAPP apply to all contractor activities as appropriate for their respective tasks.

This QAPP was prepared based upon guidance provided by the EPA and New York State Department of Environmental Conservation (NYSDEC) including:

- *DER-10, Technical Guidance for Site Investigation and Remediation.* NYSDEC. *May 3, 2010;*
- *Analytical Service Protocol,* NYSDEC. *July 2005;*
- *US EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5, March 2001); and*
- *Guidance for Quality Assurance Project Plans (EPA QA/G-5, December 2002).*

2. Project Goals and Objectives

Con Edison has completed a Site Characterization at the site. A RI is required to determine the nature and extent of impacts. The scope of the RI is presented in the RI Work Plan dated June 2020. The RI will include the following tasks:

- Field Investigation Sampling and Analysis
- Qualitative Human Health Exposure Assessment (QHHEA)
- Step 1 Fish and Wildlife Resource Impact Analysis (FWRIA)
- Quality Assurance / Quality Control (QA/QC) and Data Validation
- RI Report Preparation

The RI scope of work described in this work plan is intended to collect sufficient data to evaluate the nature and extent of impacts that may be associated with the Woodworth Avenue Works former MGP site. The RI will assess whether potential pathways exist through which people, flora, or fauna could be exposed to the contaminants.

3. Project Organization and Responsibility

GEI is responsible for the implementation of the scope of work associated with the RI, and associated performance monitoring tasks including the supervision of contractors, field activities, and the evaluation and interpretation of data. GEI will perform the sampling activities and coordinate submittal of samples to testing laboratories. The project organization and key personnel for GEI are listed below:

In House Consultant: Matt O'Neil
Project Manager: Melissa Felter
Field Team Leader: Matt Sandefur
GEI Corporate Health & Safety Officer: Steven Hawkins
Data Validators: Lorie Mackinnon
Quality Assurance Officer/Data Manager: Jaimie Wargo

The primary responsibilities of each of these personnel are described in the following table.

Key Project Personnel and Responsibilities		
Position	**GEI Personnel**	**Areas of Responsibilities**
In-House Consultant	Matt O'Neil	• Provide strategic guidance of project activities • Client contact regarding strategic issues • Review of project deliverables
Program Manager	Matt O'Neil	• Overall program oversight • Project management • Project schedule • Client contact regarding project-related issues • Personnel and resource management • Review of project submittals • Budgeting
Project Manager	Melissa Felter	• Client contact regarding project related issues • Coordination of contractors • Technical development and implementation of RI, Work Plan, and Field Sampling Plan • Personnel and resource management • Preparation and review of project submittals • Preparation of project submittals • Budgeting
Field Team Leader	Matt Sandefur	• Client contact regarding project related issues on day to day basis as part of field operations • Coordination of contractors • Implementation of RI Work Plan and Field Sampling Plan

Key Project Personnel and Responsibilities		
Position	**GEI Personnel**	**Areas of Responsibilities**
		• Plan Personnel and resource management • Preparation of project submittals
Data Validators	Lorie MacKinnon	• Perform data validation activities • Prepare data usability summary reports • Evaluate data with regards to quality objectives
Quality Assurance Officer/Data Manager	Jaimie Wargo	• Manage raw data from the laboratory • Maintain copies of COCs in the project file • QA/QC for sampling, validation and laboratory performance

Test America Laboratory of Edison, New Jersey, has been selected to perform the following standard analytical chemistry parameters for subsurface soil and sediment samples which may include:

- Volatile Organic Compounds (VOCs) according to EPA Method 8260B
- Semi-Volatile Organic Compounds (SVOCs) according to EPA Method 8270C
- Target Analyte List (TAL) Metals according to EPA Method 6010B/7470A/7471B series
- Total Cyanide by EPA Method 9012
- Disposal Parameters including:
    - Toxicity Characteristic Leaching Procedure (TCLP) constituents including VOCs by EPA 8260B, SVOCs by EPA 8270, Resource Conservation and Recovery Act (RCRA)-8 Metals by EPA 6000/7000 series, pesticides by EPA Method 8081, and herbicides by EPA Method 8151A
    - pH by EPA Method 150.1
    - Reactive cyanide by EPA method 7.3.3.2 (2)
    - Reactive sulfide by EPA Method 7.3.4.1 (2)
    - Total Organic Halides (TOX) by EPA Method 9020B
    - Total Petroleum Hydrocarbons by EPA 8100/418.1
    - Total cyanide EPA 9010
    - Percent sulfur by EPA D129-64
    - BTU content by American Society for Testing and Materials (ASTM) D240-87
    - Flash point by EPA Method 1010
    - Percent moisture and density

Test America's relevant certifications are summarized in the following table.

Test America's Certifications		
Location	**Responsible Agency**	**Certification**
New York	New York State Department of Health	ELAP for potable water/non-potable water, solid and hazardous waste Contract Laboratory Protocol (CLP) CLP-Lab: 10023
United States	United States Environmental Protection Agency	EPA Lab Code: NY00044 [VOCs/SVOCs/Inorganics]

Table 1 provides a summary of soil and sediment analyses. **Table 2** provides a summary of quality assurance samples, holding times and analysis for each media.

4. Quality Assurance Objectives

This section establishes the QA objectives for measurements that are critical to the project. The QA objectives are developed for relevant data quality indicators. These indicators include the method detection limit (MDL), reporting limit (RL), precision, accuracy, completeness, representativeness, and comparability. The data quality objectives (DQOs) are based on project requirements and ensure: (1) that the data generated during the project are of known quality, and (2) that the quality is acceptable to achieve the project's technical objectives.

Quantitation Limits are laboratory-specific and reflect those values achievable by the laboratory performing the analyses. However, in order to ensure that the analytical methodologies are capable of achieving the DQOs, measurement performance criteria have been set for the analytical measurements in terms of accuracy, precision, and completeness. The analytical methods to be used at this site will provide a level of data quality and can be used to evaluate potential impacts to soil from the former MGP operations, compared to New York State Standards, Criteria and Guidance values, and for purposes of risk assessment.

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting, which will provide results that are scientifically valid and the levels of which are sufficient to meet DQOs. Specific procedures for sampling, chain of custody, laboratory instruments calibration, laboratory analysis, reporting of data, internal quality control, and corrective action are described in other sections of the QAPP and the Field Sampling Plan (FSP) included in Appendix B of the RI Work Plan.

The data quality indicators are presented in subsections 4.1 through 4.6. Procedures to assess the data quality indicators are given below in Section 13.

Table 3 provides the RLs, MDLs and the DQOs for soil and sediment samples. The DQOs for soil samples for this project include minimum RLs specified within the 2005 NYSDEC Analytical Services Protocol (ASP) as well as unrestricted use criteria listed in Title 6 of the Compilation of the Rules and Regulations of the State of New York Part 375 (6 NYCRR Part 375).

Table 4 provides the precision and accuracy DQOs for soil and water samples.

4.1 Required Quantification Limit

The required quantification limit is the quantitative analytical level for individual analytes needed to make decisions relative to the objectives of the project. Quantitative limits may be expressed as the MDL or some quantitative level defined in terms relative to the program. It should be noted that there is some ambiguity in the definitions and use of terms that define quantification limits. The MDL presented herein is a well-defined and accepted entity, although attainable only under ideal laboratory conditions.

Method Detection Limit: The MDL is the minimum concentration of a substance that can be measured and reported with 99-percent confidence that the analyte concentration is greater than zero. The MDL is determined from analysis of a sample in a given matrix-type containing the analyte.

Practical Quantitation Limit: The practical quantitation limit (PQL) [also referred to as the reporting limit (RL)] is the concentration in the sample that corresponds to the lowest concentration standard of the calibration curve.

Tables 3 and **4** provide the reporting limits and the DQOs for soil and sediment samples.

4.2 Accuracy

Accuracy is the closeness of agreement between an observed value and an accepted reference value. The difference between the observed value and the reference value includes components of both systematic error (bias) and random error.

Accuracy in the field is assessed through the adherence to all field instrument calibration procedures, sample handling, preservation, and holding time requirements, and through the collection of equipment blanks prior to the collection of samples for each type of equipment being used (e.g., sample liners, drilling shoe, or stainless–steel sampling implements).

The laboratory will assess the overall accuracy of their instruments and analytical methods (independent of sample or matrix effects) through the measurement of "standards," materials of accepted reference value. Accuracy will vary from analysis to analysis because of individual sample and matrix effects. In an individual analysis, accuracy will be measured in terms of blank results, the percent recovery (%R) of surrogate compounds in organic analyses, or %R of spiked compounds in matrix spikes (MSs), matrix spike duplicates (MSDs) and/or laboratory control samples (LCSs). This gives an indication of expected recovery for analytes tending to behave chemically like the spiked or surrogate compounds. The laboratory accuracy will be evaluated in accordance with laboratory quality assurance plan and standard operating procedures located in **Attachment A**.

4.3 Precision

Precision is the agreement among a set of replicate measurements without consideration of the "true" or accurate value: i.e., variability between measurements of the same material for the same analyte. In environmental sampling, precision is the result of field sampling and analytical factors. Precision in the laboratory is easier to measure and control than precision in the field. Replicate laboratory analyses of the same sample provide information on analytical precision; replicate field samples provide data on overall measurement precision. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision. Precision is measured in a variety of ways including statistically, such as calculating variance or standard deviation. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision.

Precision in the field is assessed through the collection and measurement of field duplicates. Field duplicates will be collected at a frequency of one per twenty samples per matrix per analytical parameter, with the exception of the waste characterization parameters. Precision will be measured through the calculation of relative percent differences (RPDs) as described below in subsection 13.2. The resulting information will be used to assess sampling and analytical variability. Duplicate samples are described below in subsection 5.1.3. **Table 2** summarizes the number of duplicates per media sampled.

Precision in the laboratory is assessed through the calculation of RPD for duplicate samples. For organic analyses, laboratory precision will be assessed through the analysis of MS/MSD samples and field duplicates. For the inorganic analyses, laboratory precision will be assessed through the analysis of matrix duplicate pairs and field duplicate pairs. MS/MSD samples or matrix duplicate pairs will be performed at a frequency of one per twenty primary samples per matrix. Duplicate samples are described below in subsection 5.1.3. **Table 2** summarizes the number of duplicates per media sampled.

4.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. "Normal conditions" are defined as the conditions expected if the sampling plan was implemented as planned. The objective for completeness is a sufficient amount of valid data to achieve a predetermined statistical level of confidence. Critical samples must be identified and plans must be formulated to secure requisite valid data for these samples.

Field completeness is a measure of the amount of (1) valid measurements obtained from all the measurements taken in the project, and (2) valid samples collected. The field completeness objective is greater than 90-percent.

Laboratory completeness is a measure of the amount of valid measurements obtained from all valid samples submitted to the laboratory. The laboratory completeness objective is greater than 95-percent.

4.5 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which data accurately and precisely represents either a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. To ensure representativeness, the sampling locations have been selected to provide coverage over a wide area and to highlight potential trends in the data.

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that work plan is followed and that proper sampling, sample handling, and sample preservation techniques are used.

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, and meeting sample-holding times.

4.6 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the work plan is followed and that proper sampling techniques are used. Maximization of comparability with previous data sets is expected because the sampling design and field protocols are consistent with those previously used.

Comparability is dependent on the use of recognized EPA or equivalent analytical methods and the reporting of data in standardized units. To facilitate data comparison, the data-reporting format as presented below will be used:

- Conventions (units reported as): for solids (weight/unit weight [i.e., milligrams per kilogram (mg/kg)]); for liquids (weight/unit volume [i.e., micrograms per liter (µg/L)]); for air (weight/unit volume [i.e., micrograms per cubic meter ($\mu g/m^3$)]);
- Use common chemical name with corresponding chemical abstract system (Chemical Abstracts Service [CAS]) code; and
- Report all data for soils on a dry-weight basis.

5. Sampling Plan

Environmental sampling will include soil, sediment, and waste characterization sampling. Sonic drilling will be the preferred method for obtaining subsurface soil samples. A hand auger is the preferred method for collecting sediment samples. Performing grab or composite sampling by appropriate hand-held sampling equipment will be the preferred method for waste characterization sampling. Analytical samples and analysis methods will be described in future work plans. Sampling methods and procedures are presented in the FSP.

5.1 Sample Type, Location, and Frequency

5.1.1 Subsurface Soil and Sediment Samples

Subsurface soil samples will be collected using Geoprobe®, sonic, or other appropriate drilling methods. Sediment samples will be collected using a hand auger. The depth, location and number of soil borings are described in the RI Work Plan. Soil and sediment samples will be collected and submitted for laboratory analysis in general accordance with the job-specific Work Plan and FSP. A summary of typical subsurface soil and sediment sample naming analysis is provided in **Table 1**.

5.1.2 Investigation-Derived Waste Sample Collection

Waste classification sampling will be conducted for any future soil and liquid wastes. The purpose of characterizing a waste is for its proper off-site disposal. Composite samples will be collected from the on-site waste storage vessels (i.e. drums) for parameters required by the approved disposal facility. Soil samples will be collected utilizing stainless steel sampling tools, shovel, or auger that had been decontaminated. Liquid samples will be collected utilizing disposable bailer, peristaltic pump, a pump with tubing, or other similar methods. These samples will be handled in general accordance with sample handling procedures presented in the FSP. Investigation-derived waste samples will be analyzed at a rate and for parameters that are required by the Con Edison-approved disposal facility.

5.1.3 Field QC Sample Collection

Field QC samples are used to monitor the reproducibility and representativeness of field sampling activities. The field QC samples are handled, transported and analyzed in the same manner as the associated field samples. Field QC samples will include equipment blanks, trip blanks, field duplicates, and MS/MSDs. The quantity, field QC sample type, and analysis is detailed in **Table 2**.

Equipment Blank Samples are used to monitor the adequacy of decontamination procedures and possible sources of contamination such as potential laboratory methodologies. Equipment blanks will consist of laboratory-supplied, distilled or de-ionized water and will be used to check for potential contamination of the equipment which may cause sample contamination. Equipment blanks will be collected by routing the distilled water through a decontaminated piece of sampling equipment or disposable sampling equipment into laboratory supplied bottles. Non-dedicated field equipment will be decontaminated as specified below in subsection 4.3. Equipment blanks will be submitted to the laboratory at a frequency of one per 20 samples per matrix per type of equipment being used per parameter. Equipment blanks will not be completed for waste characterization sampling activities.

Trip Blank Samples will consist of analyte-free water and will be prepared by the laboratory. (Trip blanks are used to assess the potential for VOC contamination of samples due to contaminant migration during sample shipment and storage). Trip blanks will be transported to the project location unopened, stored with the site characterization samples, and kept closed until analyzed by the laboratory. Trip blanks will be submitted to the laboratory at a frequency of one-per-cooler containing samples submitted for VOC analysis.

Field Duplicate Samples, also referred to as blind duplicate samples, are two samples that are submitted from the same interval using the same sample procedures. Field duplicates will be used to assess the sampling and analytical reproducibility. Both samples are collected utilizing the same methods and are submitted for the same laboratory analysis; however, different sample identification numbers are used. Field duplicates will be submitted at a frequency of one-per-20 samples for all matrices and all parameters. Field duplicates will not be completed for waste characterization sampling activities.

MS/MSD Samples are two additional aliquots of the same sample submitted for the same parameters as the original sample. However, the additional aliquots are spiked with the compounds of concern. Matrix spikes provide information about the effect of the sample matrix on the measurement methodology. MS/MSDs will be submitted at a frequency of one-per-20 investigative samples per matrix for organic and inorganic parameters. MS/MSDs will not be completed for waste characterization sampling activities.

Refer to **Table 2** for a summary of QC sample preservation and container requirements.

5.2 Sample Preservation and Containerization

The analytical laboratory will supply the sample containers for the chemical samples. These containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest EPA's Specifications and Guidance for Contaminant-Free Sample Containers. Certificates of analysis are provided with each bottle lot and maintained on file

to document conformance to EPA specifications. The containers will be pre-preserved, where appropriate. Sample preservation and containerization details are outlined in **Table 2**.

5.3 Equipment Decontamination

All non-dedicated sampling equipment shall be cleaned between each use in the following manner:

- Wash/scrub with a biodegradable degreaser ("Simple Green") if there is oily residue on equipment surface
- Tap water rinse
- Wash and scrub with Alconox (or non-phosphate soap) and water mixture
- Tap water rinse
- All equipment used to collect samples for VOCs and SVOC analysis will then receive a methanol rinse followed by a de-ionized water rinse
- All equipment used to collect samples for metals analysis will then receive a 10% nitric acid solution rinse followed by a de-ionized water rinse
- The drilling equipment will be decontaminated in general accordance with methods described in the FSP
- Decontamination fluids will be containerized into United States Department of Transportation (USDOT)/UN-approved 55-gallon drums or containment vessels and will be characterized and disposed of by Con Edison at an approved disposal facility

6. Documentation and COC

6.1 Sample Collection Documentation

6.1.1 Field Notes

Field notes documenting field activities will be maintained in a field notebook in general accordance with the FSP. Field logbooks will provide the means of recording the chronology of data collection activities performed during the investigation. The logbook will be a bound notebook with water-resistant pages. Logbook entries will be dated, legible, and contain accurate and inclusive documentation of the activity. No erasures or obliterations of field notes will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, which is signed and dated by the sampler. The correction shall be written adjacent to the error.

Field logbooks will be reviewed at regular intervals by the field team leader, site manager and project manager for completeness and representativeness. When necessary, logbooks will be supported by daily activity reports.

6.1.2 COC Records

Sample custody is discussed in detail below in subsection 6.2. COC records are initiated by the samplers in the field. The field portion of the custody documentation should include:

- The project name
- The project number
- Signature(s) of sampler (s) responsible for sample custody
- Sample Name/ID number
- Date and time of collection
- Whether the sample is grab or composite
- Names of individuals involved in sampling
- Required analytical methods
- Air bill or other shipping number (if applicable)

On a regular basis (daily or on such a basis that all holding times will be met), samples will be transferred to the custody of the respective laboratories, via third-party commercial carriers or via laboratory courier service. Sample packaging and shipping procedures, and field COC procedures are described below in subsection 6.2.1 of this Plan. Sample receipt and log-in procedures at the laboratory are described below in subsection 6.2.2 of this Plan.

6.1.3 Sample Labeling

Each sample will be labeled with an adhesive label using indelible ink. The label should include the date and time of collection, sampler's initials, tests to be performed, preservative (if applicable), and a unique identification. The following identification scheme will be used:

PRIMARY SAMPLE TYPES	QA/QC SAMPLE TYPES
SOIL SAMPLES Boring-ID (SAMPLE DEPTH-FEET) SB-01 (10-15) **SEDIMENT SAMPLES** Sediment-ID (SAMPLE DEPTH-FEET) SED-01 (0-0.5)	**FIELD BLANKS** SAMPLE-ID – [DATE] SB-FB-020120 SED-FB-020120 **MATRIX SPIKE/DUP** SAMPLE [ID] [DEPTH] [EITHER MS OR MSD] SB-01 (10-15) MS/MSD SED-01 (0-0.5) MS/MSD **TRIP BLANKS** SAMPLE- ID [DATE] TB-020120 **BLIND DUPLICATES** SAMPLE-ID[XX][DATE] SB-XX-020120 SED-XX-020120

This sample label contains the authoritative information for the sample. Inconsistencies with other documents will be settled in favor of the vial or container label unless otherwise corrected in writing from the field personnel collecting samples or the Data Manager and/or the Project QA Officer.

6.1.4 Sample Handling

Samples will be handled in general accordance with the FSP.

6.2 Sample Custody

The COC provides a record of the custody of any environmental field sample from the time of collection to the delivery to the laboratory. Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

A sample is considered to be under a person's custody if:

- The item is in the actual possession of a person
- The item is in the view of the person after being in actual possession of the person
- The item was in the actual physical possession of the person but is locked up to prevent tampering

- The item is in a designated and identified secure area

6.2.1 Field Custody Procedures

Samples will be collected following the sampling procedures indicated in the FSP. A summary of samples and collection methods are provided above in Section 5 of this QAPP. Documentation of sample collection is described above in subsection 6.1. Sample COC and packaging procedures are summarized below. These procedures will ensure that the samples will arrive at the laboratory with the COC intact.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.
- All bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample naming system is presented above in subsection 6.1.3.
- Sample labels will be completed for each sample using waterproof ink.
- Samples will be accompanied by a completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, and to the laboratory facility.
- All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and provided to the data manager and placed in the project files.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the cooler and covered with clear plastic tape after being signed by field personnel.
- If the samples are sent by common carrier, the air bill will be used. Air bills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.
- Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample custodian, and signature of the laboratory sample custodian on COC document as receiving the samples and signature of sampler as relinquishing samples.

6.2.2 Laboratory Custody Procedures

After accepting custody of the shipping containers, the laboratory will document the receipt of the shipping containers by signing the COC record. The laboratory will:

- Examine the shipping containers to verify that the custody tape is intact
- Examine all sample containers for damage
- Determine if the temperature required for the requested testing program has been maintained during shipment and document the temperature on the COC records
- Compare samples received against those listed on the COC
- Verify that sample holding times have not been exceeded
- Examine all shipping records for accuracy and completeness
- Determine sample pH (if applicable) and record on COC forms
- Sign and date the COC immediately (if shipment is accepted) and attach the air bill
- Note any problems associated with the coolers and/or samples on the cooler receipt form and notify the laboratory project manager, who will be responsible for contacting the GEI data manager
- Attach laboratory sample container labels with unique laboratory identification and test
- Place the samples in the proper laboratory storage

Following receipt, samples will be logged in according to the following procedure:

- The samples will be entered into the laboratory tracking system. At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory), type of sample, required tests, date and time of laboratory receipt of samples, and field ID provided by field personnel
- The completed COC, air bills, and any additional documentation will be placed in the project file

7. Calibration Procedure

7.1 Field Instruments

Field instruments will be calibrated according to the manufacturer's specifications. Air monitoring instruments will be calibrated to a known reference gas standard and ambient air outside the work zone. Calibration will be completed daily, at a minimum. If concentrations of VOCs are encountered above the reference gas standard, the soil screening photoionization detector (PIDs) may be calibrated or re-checked against the reference gas standard. Water quality meters will be calibrated with known reference solutions. All calibration procedures performed will be documented in the field logbook and will include the date/time of calibration, name of person performing the calibration, reference standard used, and the readings. The following equipment may be used during sampling activities.

Subsurface Soil Sampling Activities:

- RAE Systems MultiRAE Plus equipped with VOC (10.6 electron volt [eV] lamp); lower explosive limit (LEL), percent oxygen, hydrogen sulfide, and hydrogen cyanide, or equivalent
- RAE Systems MiniRAE 2000 (PID) with 10.6 eV lamp or equivalent
- Drager Chip Measurement System (CMS) and compound specific chips (including benzene, naphthalene, hydrogen cyanide, etc.) or equivalent
- TSI DustTrak DRX 8533 (particulate monitor) or equivalent

7.2 Laboratory Instruments

Calibration procedures for a specific laboratory instrument will consist of initial calibrations, initial calibration verifications, and/or continuing calibration verification. Detailed descriptions of the calibration procedures for a specific laboratory instrument are included in the laboratory's quality assurance plan, which describe the calibration procedures, their frequency, acceptance criteria, and the conditions that will require recalibration.

The laboratory quality plan for Test America is located in **Attachment A**.

8. Sample Preparation and Procedures

Analytical samples will be collected in general accordance with the FSP and as specified in a job specific Work Plan. **Table 1** provide samples collection matrices for soil and sediment. Analytical samples will be collected into laboratory-preserved sample containers and will be preserved as indicated in **Table 2**.

9. Data Reduction, Validation, and Reporting

Appropriate QC measures will be used to ensure the generation of reliable data from sampling and analysis activities. Proper collection and organization of accurate information followed by clear and concise reporting of the data is a primary goal in this project. Complete data packages suitable for data validation to support the generation of a Data Usability Summary Report (DUSR) according to NYSDEC requirements will be provided by the analytical laboratory. Complete data packages suitable for data validation to support the generation of a DUSR according to NYSDEC requirements will be provided by the project data validator Ms. Lorie Mackinnon. Data Management will be performed under the direction of Jaimie Wargo Senior Technician.

9.1 Field Data Evaluation

Measurements and sample collection information will be transcribed directly into the field logbook or onto standardized forms. If errors are made, results will be legibly crossed out, initialed and dated by the person recording the data, and corrected in a space adjacent to the original (erroneous) entry. Reviews of the field records by the field team leader, site manager, and project manager will ensure that:

- Logbooks and standardized forms have been filled out completely and that the information recorded accurately reflects the activities that were performed.
- Records are legible and in accordance with good record keeping procedures, i.e., entries are signed and dated, data are not obliterated, changes are initialed, dated, and explained.
- Sample collection, handling, preservation, and storage procedures were conducted in accordance with the protocols described in the FSP and Work Plan, and that any deviations were documented and approved by the appropriate personnel.

9.2 Analytical Data Validation

GEI will be responsible for performing an independent validation of the analytical data. Project-specific procedures will be used to validate analytical laboratory data. The basis for the validation will be the USEPA CLP National Functional Guidelines for Organic Data Review (January 2005) and the USEPA CLP National Functional Guidelines for Inorganic Data Review (October 2004), modified to accommodate the criteria in the analytical methods used in this program, and Region II Standard Operating Procedures (SOPs) for CLP Organic Data review (Revision 11, June 1996) and Evaluation of Metals for the CLP Program (Revision 11, January 1992). Critical functions for determining the validity of generated data are: (1) strict adherence to the analytical methods, (2) assurance that the instrumentation

employed was operated in accordance with defined operating procedures, (3) assurance that quality parameters built into the analytical procedures have been adhered to, and (4) confirmation that the DQOs have been met.

Table 2 highlights the QC criteria and holding time requirements for all analyses conducted under this program. These criteria will be used to evaluate and qualify the data during validation.

Laboratory deliverables will consist of an original hard copy data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements for data packages that require validation. Data validation is required for 20-percent of soil and sediment samples.

The laboratory will provide a data package that is in general accordance with NYSDEC ASP Category A data deliverable requirements for data packages that do not require validation.

Data validation will be completed by the consultants' data validators or qualified contracted personnel. Samples collected for waste classification will not be validated. Validation will include all technical holding times, as well as QC sample results (blanks, surrogate spikes, laboratory duplicates, MS/MSDs, and LCSs), tunes, internal standards, calibrations, target compound identification, and results calculations.

For all analyses, the laboratory will report results which are between the laboratory's RL and the MDL; these results will be qualified as estimated (J) by the laboratory. The laboratory may be required to report tentatively identified compounds (TICs) for the VOC and SVOC analyses; this will be requested by GEI on an as-needed basis.

The overall completeness of the data package will also be evaluated by the data validator. Completeness checks will be administered on all data to determine whether full data deliverables were provided. The reviewer will determine whether all required items are present and request copies of missing deliverables.

Upon completion of the validation, a report will be prepared. This report will summarize the samples reviewed, elements reviewed, any nonconformance with the established criteria, and validation actions. Data qualifiers will be consistent with EPA National Functional Guidelines. This report will be in a format consistent with NYSDEC's DUSR.

9.3 Analytical Data Deliverable

Laboratory deliverables will consist of an original hard copy data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements when validation is

requested. The laboratory will provide a deliverable in accordance with NYSDEC ASP Category A data deliverable when validation is not required.

10. Internal Quality Control

Laboratory and field quality internal control checks will be used to ensure the data quality objectives are achieved. At a minimum, this will include:

- MS and/or MS/MSDs samples
- Matrix duplicate analyses
- Laboratory control spike samples
- Instrument calibrations
- Instrument tunes for VOC 8260B and SVOC 8270C analyses
- Method and/or instrument blanks
- Surrogate spikes for organic analyses
- Internal standard spikes for VOC 8260B and SVOC 8270C analyses
- Detection limit determination and confirmation by analysis of low-level calibration standard

Field quality control samples will include:

- Equipment blanks as outlined in **Table 2**
- Field duplicate samples as outlined in **Table 2**
- Trip blanks as outlined in **Table 2**
- MS/MSDs as outlined in **Table 2**

11. Performance and System Audits

Audits are an independent means of: 1) evaluating the operation or capability of a measurement system, and 2) documenting the use of QC procedures designed to generate data of know and acceptable quality.

Field audits may be completed to assess sample collection protocols, determine the integrity of COC procedures, and evaluate sample documentation and data handling procedures. Field audits may be scheduled by the QA officer, PM, site manager or in-house consultant, at their discretion. Written records of audits and any recommendations for corrective action will be submitted to the PM.

The QA officer is the interface between management and project activities in matters of project quality. The QA officer will review the implementation of the QAPP. Reviews will be conducted at the completion of field activities and will include the results of any audits and an evaluation of the data quality.

12. Preventative Maintenance

Preventative maintenance will be performed on field equipment in accordance with the manufacturer's recommendations. Preventative maintenance to field equipment will be provided by equipment vendors U.S Environmental Rental Corporation, Pine Environmental Services, or other selected vendors.

Laboratory equipment calibration and maintenance procedures are specified in Test America's laboratory quality manual located in **Attachment A**.

13. Specific Procedures to Assess Data Quality Indicators

QC analyses conducted as a part of the testing program will provide a quantitative quality assessment of the data generated and their adherence to the data quality indicators. The data quality indicators ensure that the quality assurance objectives for the project are met.

13.1 Detection Limits

13.1.1 Method Detection Limit

The MDL is defined as follows for all measurements:

$$MDL = (t[n-1,1-a=0.99]) \times (s)$$

where: s = standard deviation of the replicate analysis,
t(n-1, 1-a=0.99) = student's t-value for a one-sided, 99-percent confidence level and a standard deviation estimate with n-1 degrees of freedom

The MDLs calculated by the laboratory are determined under ideal conditions. MDLs for environmental samples are dependent on the sample aliquot, the matrix, the concentration of analyte, and interference present in the matrix, the percent of moisture, dilution factor, etc. The MDL for each sample analysis will be adjusted accordingly.

13.1.2 *Reporting Limit*

The RL is the concentration of an analyte in the sample that corresponds to the lowest concentration standard of the calibration curve. As with the MDLs, the RLs are dependent on the sample aliquot, the final sample volume, the percent of moisture, dilution factor, etc.

The RL is determined as follows:

$$PQL = \frac{Lowest\ conc.\ std\ (ng)}{Volume\ injected\ (uL)}\ x\ \frac{Sample\ aliquot\ (mL\ or\ g)}{Final\ volume\ (mL)}\ x\ DF\ x\ \frac{100}{(100 - PM)}$$

where: DF = dilution factor, including all dilutions or lost samples not accounted for in a sample aliquot/final volume ratio
%M = percent moisture for solid samples

13.2 Precision

Variability will be expressed in terms of the RPD when only two data points exist. The RPD is calculated as:

$$RPD = \frac{(Larger\ Value - Smaller\ Value)}{[(Larger\ Value + Smaller\ Value)/2]}\ x\ 100\%$$

For data sets greater than two points, the percent relative standard deviation (percent RSD) is used as the precision measurement. It is defined by the equation:

$$Percent\ RSD = \frac{Standard\ Deviation}{Mean}\ x\ 100\%$$

Standard deviation (SD) is calculated as follows:

$$SD = \sqrt{\sum_{i=1}^{n} \frac{(y_i - y)^2}{n - 1}}$$

where: SD = standard deviation
yi = measured value of the ith replicate
y = mean of replicate measurements
n = number of replicates

For measurements such as pH, where the absolute variation is more appropriate, precision is usually reported as the absolute range (D) of duplicate measurements:

D = | first measurement - second measurement |

or as the absolute standard deviation previously given. RPD, %RSD, and D are independent of the error of the analyses and reflect only the degree to which the measurements agree with each other, not the degree to which they agree with the true value for the parameter measured.

13.3 Accuracy

Accuracy is related to the bias in a measurement system. Accuracy describes the degree of agreement of a measurement with a true value. Accuracy will be expressed as percent recovery for each matrix spike analyte by using the following equation:

$$\%\ Recovery = \frac{Css - Cus}{Csa}\ X\ 100\%$$

where: Css = measured concentration in spiked sample
Cus = measured concentration in unspiked sample
Csa = known concentration added to the sample

Accuracy for a measurement such as pH is expressed as bias in the analysis of a standard reference sample according to the equation:

$$Bias = pH_m - pH_t$$

where: pH_m = measured pH
pH_t = the true pH of the standard reference sample

13.4 Completeness

Data completeness is a measure of the amount of usable data resulting from a measurement effort. For this program, completeness will be defined as the percentage of valid data obtained compared to the total number of measurements necessary to achieve our required statistical level of confidence for each test. The confidence level is based on the total number of samples.

Data completeness is calculated as:

$$Completeness = \frac{Number\ of\ valid\ data\ points}{Number\ of\ data\ points\ necessary\ for\ confidence\ level}\ x\ 100\%$$

The completeness goal is to generate a sufficient amount of valid data. It is anticipated that 95-percent of the data will be complete. Data validation criteria discussed in Section 10 of this QAPP will be used to determine data completeness. Any data deficiencies and their effect on project goals will be evaluated in the DUSR.

13.5 Representativeness

Representativeness is a qualitative statement that expresses the extent to which the sample accurately and precisely represents the characteristics of interest of the study. Representativeness is primarily concerned with the proper design of the sampling program and is best ensured by proper selection of sampling locations and the taking of a sufficient number of samples. It is addressed by describing the sampling techniques, the matrices sampled, and the rationale for the selection of sampling locations, which are discussed in the FSP and job-specific Work Plan.

13.6 Comparability

Comparability is a qualitative parameter expressing the confidence that one set of data can be compared to another. Comparability is possible only when standardized sampling and analytical procedures are used.

14. Corrective Action

If unacceptable conditions are identified as a result of audits or are observed during field sampling and analysis, the PM, Field Team Leader, and QA officer will document the condition and initiate corrective procedures. The specific condition or problem will be identified, its cause will be determined, and appropriate action will be implemented.

The entire sampling program will be under the direction of the PM and QA officer. The emphasis in this program is on preventing problems by identifying potential errors, discrepancies, and gaps in the data collection and the laboratory analysis and interpretation process. Any problems identified will be promptly resolved. Likewise, follow-up corrective action is always an option in the event that preventative corrective actions are not effective.

The acceptance limits for the sampling and analyses to be conducted in this program will be those stated in the method or defined by other means in the Work Plan and FSP. Corrective actions are likely to be immediate in nature and most often will be implemented by the contracted laboratory analyst or the PM. The corrective action will usually involve recalculation, reanalysis, or repeating a sample run.

14.1 Immediate Corrective Action

Corrective action in the field may be needed when the sample requirements are changed (i.e., more/less samples, sampling locations other than those specified in the Work Plan), or when sampling procedures and/or field analytical procedures require modification, etc. due to unexpected conditions. The field team may identify the need for corrective action. The Field Team Leader, Site Manager, and PM will approve the corrective action and notify the QA officer. The PM and QA officer will approve the corrective measure. The Field Team Leader and Project Manager will ensure that the corrective measure is implemented by the field team.

Corrective actions will be implemented and documented in the field record book. Documentation will include:

- A description of the circumstances that initiated the corrective action
- The action taken in response
- The final resolution
- Any necessary approvals

Corrective action in the laboratory will be completed in accordance with the quality assurance procedures located in **Attachment A**. Any corrective actions completed by the laboratory will be documented in both the laboratory's corrective action files, and the narrative data report sent from the laboratory to the PM. If the corrective action does not rectify the situation, the laboratory will contact the PM, who will determine the action to be taken and inform the appropriate personnel.

If potential problems are not solved as an immediate corrective action, the contractor will apply formalized long-term corrective action if necessary.

Tables

Table 1. Soil and Sediment Field Sampling Matrix
Woodworth Avenue Works Former MGP Site
Yonkers, New York

Sample I.D.	TYPICAL SOIL & SEDIMENT BORING SAMPLE SELECTION RATIONALE: 1. Sediment within observed impacts (0 to 2'). 2. Subsurface soil within heaviest observed impacts (if present). 3. Subsurface soil below deepest observed visual impacts. IF NO IMPACTS ARE OBSERVED IN BORING: 1. Water table interface.							Analysis				
	Sample Number											
	Number Samples Proposed	Number Samples Collected	Date Collected	0 to 2'	Heaviest Impacted Zone (if Present)	Water Table Interface	Completion depth of boring	VOCs (EPA Method	SVOCs (EPA Method	TAL Metals (EPA Method	Total CN (EPA Method	Forensic Analysis
Subsurface Soil												
SB-XX	1 - 2				X		X	X	X	X	X	
Sediment												
SED-XX	1			X				X	X	X	X	X

Notes:

VOCs - Volatile Organic Compounds
TAL - Target Analyte List
TBD - To Be Determined
BGS - Below Ground Surface

Table 2. Analytical Methods/Quality Assurance Summary Table
Woodworth Avenue Works Former MGP Site
Yonkers, New York

Media	Number of Primary Samples	QA/QC Samples				Total Number of Samples	Analytical Parameters	Method	Preservative	Holding Time	Container
		TB	FB[1]	DUP	MS/MSD						
Subsurface Soil and Sediment	20	1/Cooler	1/20	1/20	1/20	TBD	VOCs	8260C	Cool to 4°C	5 days unpreserved, 12 days preserved	Terra Core or En Core
	20	1/Cooler	1/20	1/20	1/20	TBD	SVOCs	8270D	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	Wide mouth 8-oz. clear glass jar
	20	1/Cooler	1/20	1/20	1/20	TBD	TAL Metals	6010B/7471B	Cool to 4°C	28 days to analysis for mercury; 6 months to analysis for other metals	Wide mouth 8-oz. clear glass jar
	20	1/Cooler	1/20	1/20	1/20	TBD	TCN	9012B	Cool to 4°C	14 days	Wide mouth 8-oz. clear glass jar

Notes:

[1]: Soil field blanks will include bottles listed in groundwater section of the table.

Waste Characterization disposal sample analysis will meet the requirements of the selected disposal facility.

TBD - To Be Determined

VOCs - volatile organic compounds

SVOCs - semivolatile organic compounds

TAL - Target Analyte List

TCN - total cyanide

°C- Degrees Celsius

oz. - ounce

Table 3. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Samples
Woodworth Avenue Works Former MGP Site
Yonkers, New York

CAS Number	Analyte	DQO's		Test America Labs[2]	
		ASP 2005	Unrestricted Use[1]		
		CRQL (ug/mg)	SCO (mg/kg)	RL (mg/kg)	MDL (mg/kg)
Volatile Organic Compounds Method 8260C (mg/kg)					
67-64-1	Acetone	10	0.05	0.025	0.00421
107-13-1	Acrylonitrile	100	NE	0.025	0.00448
71-43-2	Benzene	10	0.06	0.005	0.000245
74-97-5	Bromochloromethane	10	NE	0.005	0.000361
75-27-4	Bromodichloromethane	10	NE	0.005	0.00067
75-25-2	Bromoform	10	NE	0.005	0.0025
74-83-9	Bromomethane	10	NE	0.005	0.00045
78-93-3	2-Butanone (MEK)	10	0.12	0.025	0.00183
75-15-0	Carbon disulfide	10	100*	0.005	0.0025
56-23-5	Carbon tetrachloride	10	0.76	0.005	0.000484
108-90-7	Chlorobenzene	10	1.1	0.005	0.00066
75-00-3	Chloroethane	10	NE	0.005	0.00113
110-75-8	2-Chloroethylvinylether	10	NE	0.01	0.0025
67-66-3	Chloroform	10	0.37	0.005	0.000309
74-87-3	Chloromethane	10	NE	0.005	0.000302
124-48-1	Dibromochloromethane	10	NE	0.005	0.00064
96-12-8	1,2-Dibromo-3-chloropropane	100	NE	0.005	0.0025
106-93-4	1,2-Dibromoethane (EDB)	10	NE	0.005	0.000642
95-50-1	1,2-Dichlorobenzene	10	1.1	0.005	0.000391
541-73-1	1,3-Dichlorobenzene	10	2.4	0.005	0.000257
106-46-7	1,4-Dichlorobenzene	10	1.8	0.005	0.0007
110-57-6	trans-1,4-dichloro-2-butene	100	NE	0.005	0.00113
75-34-3	1,1-Dichloroethane	10	0.27	0.005	0.00061
107-06-2	1,2-Dichloroethane	10	0.02	0.005	0.000251
75-35-4	1,1-Dichloroethene	10	0.33	0.005	0.000612
156-59-2	cis-1,2-Dichloroethene	10	0.25	0.005	0.00064
156-60-5	trans-1,2-Dichloroethene	10	0.19	0.005	0.000516
75-09-2	Methylene chloride	10	0.05	0.005	0.0023
78-87-5	1,2-Dichloropropane	10	NE	0.005	0.0025
10061-01-5	cis-1,3-Dichloropropene	10	NE	0.005	0.00072
10061-02-6	trans-1,3-Dichloropropene	10	NE	0.005	0.0022
100-41-4	Ethylbenzene	10	1	0.005	0.000345
591-78-6	Methyl Butyl Ketone (2-Hexanone)	10	NE	0.025	0.0025
74-88-4	Iodomethane	10	NE	0.005	0.000243
108-10-1	4-Methyl-2-pentanone (MIBK)	10	NE	0.025	0.00164
100-42-5	Styrene	10	NE	0.005	0.00025
79-34-5	1,1,2,2-Tetrachloroethane	10	35*	0.005	0.000811
630-20-6	1,1,1,2-Tetrachloroethane	10	NE	0.005	0.0005
127-18-4	Tetrachloroethene	10	1.3	0.005	0.000671
108-88-3	Toluene	10	0.7	0.005	0.000378
71-55-6	1,1,1-Trichloroethane	10	0.68	0.005	0.000363
79-00-5	1,1,2-Trichloroethane	10	NE	0.005	0.00065
79-01-6	Trichloroethene	10	0.47	0.005	0.0011
75-69-4	Trichlorofluoromethane (FREON 11)	10	NE	0.005	0.000473
96-18-4	1,2,3-Trichloropropane	10	80*	0.005	0.000509
108-05-4	Vinyl acetate	10	NE	0.01	0.00251
75-01-4	Vinyl chloride	10	0.02	0.005	0.00061
108383/106423	m,p-Xylene	NA	NE	0.01	0.00084
95-47-6	o-Xylene	NA	NE	0.005	0.000653
1330-20-7	Total Xylene	10	0.26	0.01	0.00084
107-05-1	Allyl chloride (3-Chloropropene)	10	NE	0.005	0.0024
75-71-8	Dichlorodifluoromethane (FREON 12)	10	NE	0.005	0.000413
98-82-8	Isopropyl benzene (Cumene)	10	NE	0.005	0.000754
91-20-3	Naphthalene	10	12	0.005	0.00067
103-65-1	n-Propylbenzene (Propylbenzene)	10	3.9	0.005	0.0004
120-82-1	1,2,4-Trichlorobenzene	10	NE	0.005	0.000304
95-63-6	1,2,4-Trimethylbenzene	10	3.6	0.005	0.00096
108678/622968	1,3,5-Trimethylbenzene/P-ethyltoluene	10	8.4	0.005	0.000322
106-99-0	1,3-Butadiene	NE	NE	0.005	0.000492
123-91-1	1,4-Dioxane	NE	0.1	0.1	0.0218
540-84-1	2,2,4-Trimethylpentane (iso-Octane)	NE	NE	0.005	0.0006
67-63-0	2-Propanol (Isopropyl alcohol)	NE	NE	NA	NA
75-07-0	Acetaldehyde	NE	NE	NA	NA
25168-05-2	Chlorotoluene	NE	NE	NA	NA
110-82-7	Cyclohexane	NE	NE	0.005	0.0007
64-17-5	Ethanol (Ethyl Alcohol)	NE	NE	0.1	0.0836

Table 3. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Samples
Woodworth Avenue Works Former MGP Site
Yonkers, New York

CAS Number	Analyte	DQO's		Test America Labs[2]	
		ASP 2005	Unrestricted Use[1]		
		CRQL (ug/mg)	SCO (mg/kg)	RL (mg/kg)	MDL (mg/kg)
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	NE	100*	0.005	0.00114
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane	NE	NE	NA	NA
142-82-5	n-Heptane (Heptane)	NE	NE	0.1	0.0027
110-54-3	n-Hexane (Hexane)	NE	NE	0.05	0.0029
1634-04-4	Methyl tert-butyl ether (MTBE)	NE	0.93	0.005	0.000491
109-99-9	Tetrahydrofuran	NE	NE	0.01	0.0029
Semivolatile Organic Compounds (mg/kg) via Method 8270 C					
83-32-9	Acenaphthene	330	20	0.17	0.025
208-96-8	Acenaphthylene	330	100	0.17	0.022
120-12-7	Anthracene	330	100	0.17	0.042
56-55-3	Benz[a]anthracene	330	1	0.17	0.017
205-99-2	Benzo[b]fluoranthene	330	1	0.17	0.027
207-08-9	Benzo[k]fluoranthene	330	0.8	0.17	0.022
191-24-2	Benzo[g,h,i]perylene	330	100	0.17	0.018
50-32-8	Benzo[a]pyrene	330	1	0.17	0.025
100-51-6	Benzyl alcohol	330	NE	0.33	0.023
85-68-7	Butyl benzyl phthalate	330	100*	0.17	0.028
111-91-1	Bis(2-chloroethoxy)methane	330	NE	0.17	0.036
111-44-4	Bis(2-chloroethyl)ether	330	NE	0.17	0.022
117-81-7	Bis(2-ethylhexyl)phthalate	330	50*	0.17	0.058
101-55-3	4-Bromophenyl phenyl ether	330	NE	0.17	0.024
106-47-8	4-Chloroaniline	330	200*	0.17	0.42
59-50-7	4-Chloro-3-methylphenol	330	NE	0.17	0.042
91-58-7	2-Chloronaphthalene	330	NE	0.17	0.028
95-57-8	2-Chlorophenol	330	400*	0.17	0.031
7005-72-3	4-Chlorophenyl phenyl ether	330	NE	0.17	0.021
218-01-9	Chrysene	330	1	0.17	0.038
53-70-3	Dibenz[a,h]anthracene	330	0.33	0.17	0.03
132-64-9	Dibenzofuran	330	7	0.17	0.02
84-74-2	Di-n-butyl phthalate	330	100*	0.17	0.029
95-50-1	1,2-Dichlorobenzene	330	1.1	0.33	0.023
541-73-1	1,3-Dichlorobenzene	330	2.4	0.33	0.2
106-46-7	1,4-Dichlorobenzene	330	1.8	0.33	0.026
91-94-1	3,3-Dichlorobenzidine	660	NE	0.33	0.2
120-83-2	2,4-Dichlorophenol	330	2*	0.17	0.018
84-66-2	Diethyl phthalate	330	100*	0.17	0.022
51-28-5	2,4-Dinitrophenol	800	200*	1.66	0.784
131-11-3	Dimethyl phthalate	330	100*	0.17	0.02
534-52-1	4,6-Dinitro-2-methylphenol	800	NE	0.33	0.17
105-67-9	2,4-Dimethylphenol	330	NE	0.17	0.041
121-14-2	2,4-Dinitrotoluene	330	NE	0.17	0.035
606-20-2	2,6-Dinitrotoluene	330	NE	0.17	0.02
117-84-0	Di-n-octyl phthalate	330	100*	0.17	0.02
206-44-0	Fluoranthene	330	100	0.17	0.018
86-73-7	Fluorene	330	30	0.17	0.02
118-74-1	Hexachlorobenzene	330	0.33	0.17	0.023
87-68-3	Hexachlorobutadiene	330	NE	0.17	0.025
77-47-4	Hexachlorocyclopentadiene	330	NE	0.17	0.023
67-72-1	Hexachloroethane	330	NE	0.17	0.022
193-39-5	Indeno[1,2,3-cd]pyrene	330	0.5	0.17	0.021
78-59-1	Isophorone	330	100*	0.17	0.036
91-57-6	2-Methylnaphthalene	330	NE	0.17	0.034
95-48-7	2-Methylphenol (o-Cresol)	330	0.33	0.17	0.02
106-44-5	4-Methylphenol (p-Cresol)	330	0.33	0.33	0.02
91-20-3	Naphthalene	330	12	0.17	0.022
88-74-4	2-Nitroaniline	800	NE	0.33	0.025
99-09-2	3-Nitroaniline	800	NE	0.33	0.047
100-01-6	4-Nitroaniline	800	NE	0.33	0.089
98-95-3	Nitrobenzene	330	3.7*	0.17	0.019
88-75-5	2-Nitrophenol	330	NE	0.17	0.048
100-02-7	4-Nitrophenol	800	NE	0.33	0.119
62-75-9	N-Nitrosodimethylamine	330	NE	0.33	0.072
86-30-6	N-Nitrosodiphenylamine	330	NE	0.17	0.138
621-64-7	N-Nitrosodi-n-propylamine	330	NE	0.17	0.029
52438-91-2	2,2-oxybis[1-Chloropropane]	330	NE	0.17	0.034
87-86-5	Pentachlorophenol	800	0.8	0.33	0.17
85-01-8	Phenanthrene	330	100	0.17	0.025

Table 3. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Samples
Woodworth Avenue Works Former MGP Site
Yonkers, New York

CAS Number	Analyte	DQO's		Test America Labs[2]	
		ASP 2005	Unrestricted Use[1]		
		CRQL (ug/mg)	SCO (mg/kg)	RL (mg/kg)	MDL (mg/kg)
108-95-2	Phenol	330	0.33	0.17	0.026
129-00-0	Pyrene	330	100	0.17	0.02
120-82-1	1,2,4-Trichlorobenzene	330	NE	0.33	0.024
95-95-4	2,4,5-Trichlorophenol	330	NE	0.17	0.046
88-06-2	2,4,6-Trichlorophenol	330	NE	0.17	0.034
86-74-8	Carbazole	330	NE	0.17	0.02

Notes:

ug/mg - micrograms per milligram
mg/kg - milligrams per kilogram
RL - Reporting Limits
MDL - Method Detection Limit
DQO - Data Quality Objectives
ASP - Analytical Service Protocol
CRQL - Contract Required Quantitation Limit
SCO - Site Clean-up Objective
1 - DQOs are based on 6 NYCRR Part 375 Unrestricted Use Soil Clean-up Objectives
2 - RLs and MDLs are based on Test America's Reporting Limits and Method Detection limits as of February 2017. They are subject to change.
* - Guidance came from SSCO's listed in the NYSDEC DRAFT Soil Cleanup Guidance (November 4, 2009)
Bolding - Does not meet the DQO
NA - Not Applicable. Analysis not per+A1formed by the lab for a soil matrix.

Table 4. Quality Control Limits Precision and Accuracy for Soil and Sediment Samples
Woodworth Avenue Works Former MGP Site
Yonkers, New York

Analytical	Analytical Method	MS/MSD Compound	MS/MSD % Recovery			LCS % Recovery		Surrogate	Surrogate % Recovery	
			Low	High	RPD	Low	High		Low	High
VOCs	8260C	1,1-Dichloroethene	61	145	14	61	145	1,2-Dichloroethane-d4	33	145
		Benzene	76	127	11	76	127	4-Bromofluorobenzene	60	148
		Chlorobenzene	75	130	13	75	130	Toluene-d8	60	132
		Toluene	76	125	13	76	125			
		Trichloroethene	71	120	14	71	120			
SVOCs	8270D	Phenol	26	90	35	NA	NA	Nitrobenzene-d5	23	120
		2-Chlorophenol	25	102	50	NA	NA	2-Fluorobiphenyl	30	115
		1,4-Dichlorobenzene	28	104	27	NA	NA	Terphenyl-d14	18	137
		N-Nitroso-di-n-propylamine	41	126	38	NA	NA	Phenol-d5	24	113
		1,2,4-Trichlorobenzene	38	107	23	NA	NA	2-Fluorophenol	25	121
		4-Chloro-3-methylphenol	26	103	33	NA	NA	2,4,6-Tribromophenol	19	122
		Acenaphthene	31	137	19	NA	NA	2-Chlorophenol-d4	20	130
		4-Nitrophenol	11	114	50	NA	NA	1,2-Dichlorobenzene-d4	20	130
		2,4-Dinitrotoluene	28	89	47	NA	NA			
		Pentachlorophenol	17	109	47	NA	NA			
		Pyrene	35	142	36	NA	NA			
Inorganics	6010B	Metals excluding Hg	75[(a)]	125	20[(b)]	Varies	Varies	NA		
	7470A	Mercury	75[(a)]	125	20[(b)]	NA		NA		
	9012B	Total Cyanide	75[(a)]	125	20[(b)]	NA		NA		

Notes:

MS - Matrix Spike
MSD - Matrix Spike Duplicate
LCS - Laboratory Control Sample
(a) - Matrix spike only
(b) - Laboratory duplicate RPD
NA - Not Applicable
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds
RPD - Relative Percent Difference

Attachment A

Test America Quality Assurance Manual (electronic only)

Cover Page:

Quality Assurance Manual

TestAmerica Buffalo
10 Hazelwood Drive
Amherst, New York 14228
716.504.9800
716.691.7991

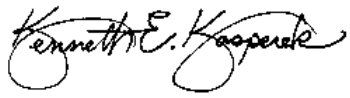
www.testamericainc.com

Copyright Information:
This documentation has been prepared by TestAmerica Laboratories, Inc. and its affiliates ("TestAmerica"), solely for their own use and the use of their customers in evaluating their qualifications and capabilities in connection with a particular project. The user of this document agrees by its acceptance to return it to TestAmerica upon request and not to reproduce, copy, lend, or otherwise disclose its contents, directly or indirectly, and not to use if for any other purpose other than that for which it was specifically provided. The user also agrees that where consultants or other outside parties are involved in the evaluation process, access to these documents shall not be given to said parties unless those parties also specifically agree to these conditions.

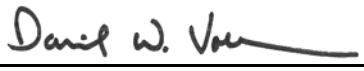
THIS DOCUMENT CONTAINS VALUABLE CONFIDENTIAL AND PROPRIETARY INFORMATION. DISCLOSURE, USE OR REPRODUCTION OF THESE MATERIALS WITHOUT THE WRITTEN AUTHORIZATION OF TESTAMERICA IS STRICTLY PROHIBITED. THIS UNPUBLISHED WORK BY TESTAMERICA IS PROTECTED BY STATE AND FEDERAL LAW OF THE UNITED STATES. IF PUBLICATION OF THIS WORK SHOULD OCCUR THE FOLLOWING NOTICE SHALL APPLY:

©COPYRIGHT 2016 TESTAMERICA LABORATORIES, INC. ALL RIGHTS RESERVED

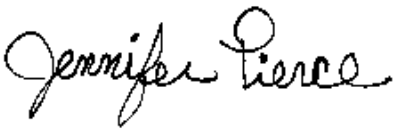
Title Page:
Quality Assurance Manual
Approval Signatures



Laboratory Director – Kene' Kasperek — 10/05/2016 Date



Quality Assurance Manager - Daniel Vollmer — 10/12/2016 Date



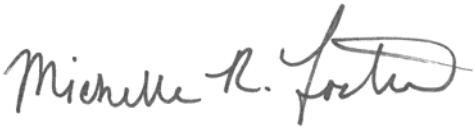
Inorganics Operations Manager – Jennifer Pierce — 10/04/2016 Date



Organic Operations Manager – Gary Rudz — 10/04/2016 Date



Organic Preparation Manager – Vikrambhai Patel — 10/07/2016 Date



Wet Chemistry Manager – Michelle Foster — 10/04/2016 Date

Uncontrolled Copy



Metals Manager – Todd Brandt

10/04/2016
Date



GC/MS Semivolatiles – Michelle Page

10/07/2016
Date



GC/MS Volatiles – Leah Hill

10/11/2016
Date



Facilities Manager – Ken Kinecki

10/05/2016
Date

SECTION 2

TABLE OF CONTENTS

Section No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page No.
-	COVER PAGE	V1M1 Sec.4.2.8.3		1
1.0	TITLE PAGE			2
2.0	TABLE OF CONTENTS	V1M1 Sec.4.2.8.3-4.2.8.4		4
3.0	INTRODUCTION	V1M2 Sec.4.2.8.4		15
3.1	Introduction And Compliance References	V1M2 Secs. 1.1; 1.2; 2.0; 3.2; 4.1.2; 4.2.4	4.1.2; 4.2.4	15
3.2	Terms And Definitions	V1M2 Secs. 3.0; 4.2.4	4.2.4	16
3.3	Scope / Fields Of Testing	V1M2 Secs. 1.2; 4.2.4	4.1.2; 4.2.4	16
3.4	Management Of The Manual	V1M2 Secs. 4.2.1; 4.2.7; 4.3.3.2; 4.3.3.3	4.2.1; 4.2.7; 4.3.3.2; 4.3.3.3	16
4.0	MANAGEMENT REQUIREMENTS	V1M2 Sec. 4		18
4.1	Overview	V1M2 Secs. 4.1.1, 4.1.3; 4.1.5	4.1.1; 4.1.3; 4.1.5; 4.2.Z2	18
4.2	Roles And Responsibilities	V1M2 Secs. 4.1.4; 4.1.5; 4.1.6; 4.2.1; 4.2.6; 5.2.4	4.1.3; 4.1.5; 4.1.Z1; 4.1.6; 4.2.1; 4.2.Z2; 4.2.6; 5.2.4	18
4.3	Deputies	V1M2 Secs. 4.1.5; 4.1.7.2; 4.2.7	4.1.5; 4.2.Z2	25
5.0	QUALITY SYSTEM			29
5.1	Quality Policy Statement	V1M2 Secs. 4.1.5; 4.2.2; 4.2.3; 4.2.8.3	4.1.5; 4.2.2; 4.2.3	29
5.2	Ethics And Data Integrity	V1M2 Secs. 4.1.5; 4.16; 4.2.2; 4.2.8.1; 5.2.7	4.1.5; 4.2.2	29
5.3	Quality System Documentation	V1M2 Secs. 4.1.5; 4.2.2; 4.2.5	4.2.2; 4.2.5	30
5.4	Qa/Qc Objectives For The Measurement Of Data	V1M2 Sec. 4.2.2	4.1.5; 4.2.2	31
5.5	Criteria For Quality Indicators			33
5.6	Statistical Quality Control			33

Section No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page No.
5.7	Quality System Metrics			34
6.0	DOCUMENT CONTROL	V1M2 Secs. 4.2.7; 4.3.1; 4.3.2.2 ; 4.3.3.3; 4.3.3.4	4.2.7; 4.3.1; 4.3.2.2; 4.3.3.3; 4.3.3.4	35
6.1	Overview			35
6.2	Document Approval And Issue	V1M2 Secs. 4.3.2; 4.3.2.1-4.3.2.3; 4.3.3.1	4.3.2.1; 4.3.2.2; 4.3.2.3; 4.3.3.1	35
6.3	Procedures For Document Control Policy	V1M2 Secs. 4.3.2.1–4.3.2.2; 4.3.3.1	4.3.2.1; 4.3.2.2; 4.3.3.1	36
6.4	Obsolete Documents	V1M2 Secs. 4.3.2.1–4.3.2.2	4.3.2.1; 4.3.2.2	36
7.0	SERVICE TO THE CLIENT	V1M2 Secs. 4.4.1 - 4.4.4	4.4.1; 4.4.2; 4.4.3; 4.4.4	37
7.1	Overview	V1M2 Secs. 4.4.5; 4.5.5; 5.7.1	4.4.5; 5.7.1	37
7.2	Review Sequence And Key Personnel	V1M2 Sec. 4.4.5	4.4.5	38
7.3	Documentation	V1M2 Sec. 5.7.1	5.7.1	39
7.4	Special Services	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	40
7.5	Client Communication	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	40
7.6	Reporting	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	40
7.7	Client Surveys	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	41
8.0	SUBCONTRACTING OF TESTS	V1M2 Secs. 4.4.3; 4.5.4	4.4.3; 4.5.4	42
8.1	Overview	V1M2 Secs. 4.5.1 - 4.5.3; 4.5.5; 5.3.1	4.5.1; 4.5.2; 4.5.3; 5.3.1	42
8.2	Qualifying And Monitoring Subcontractors	V1M2 Secs. 4.5.1; 4.5.2; 4.5.3; 4.5.5	4.5.1; 4.5.2; 4.5.3	43
8.3	Oversight And Reporting	V1M2 Sec. 4.5.5		44
8.4	Contingency Planning			45
9.0	PURCHASING SERVICES AND SUPPLIES	V1M2 Sec. 4.6.1	4.6.1	46
9.1	Overview	V1M2 Secs. 4.6.2; 4.6.3; 4.6.4	4.6.2; 4.6.3; 4.6.4	46
9.2	Glassware	V1M2 Sec. 5.5.13.1		46
9.3	Reagents, Standards & Supplies	V1M2 Secs. 4.6.2; 4.6.3; 4.6.4	4.6.2; 4.6.3; 4.6.4	46
9.4	Purchase Of Equipment/Instruments/Software			49
9.5	Services			49

Section No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page No.
9.6	Suppliers			50
10.0	COMPLAINTS	V1M2 Sec. 4.8	4.8	52
10.1	Overview			52
10.2	External Complaints			52
10.3	Internal Complaints			53
10.4	Management Review			53
11.0	CONTROL OF NON-CONFORMING WORK	V1M2 Secs. 4.9.1; 5.10.5	4.9.1; 5.10.Z.10	54
11.1	Overview	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5	4.9.1; 4.11.3; 4.11.5	54
11.2	Responsibilities And Authorities	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5; 5.2.7	4.9.1; 4.11.3; 4.11.5	54
11.3	Evaluation Of Significance And Actions Taken	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5	4.9.1; 4.11.3; 4.11.5	55
11.4	Prevention Of Nonconforming Work	V1M2 Secs. 4.9.4; 4.11.2	4.9.2; 4.11.2	55
11.5	Method Suspension/Restriction (Stop Work Procedures)	V1M2 Secs. 4.9.1; 4.9.2; 4.11.5	4.9.1; 4.9.2; 4.11.5	56
12.0	CORRECTIVE ACTION	V1M2 Sec. 4.11		57
12.1	Overview	V1M2 Secs. 4.9.2; 4.11.1; 4.11.2	4.9.2; 4.11.1; 4.11.2	57
12.2	General	V1M2 Sec. 4.11.2; 4.11.3	4.11.2; 4.11.3	57
12.3	Closed Loop Corrective Action Process	V1M2 Sec. 4.11.2; 4.11.3; 4.11.4; 4.11.6; 4.11.7; 4.12.2	4.11.2; 4.11.3; 4.11.4; 4.12.2	58
12.4	Technical Corrective Actions	V1M2 Sec. 4.11.6		60
12.5	Basic Corrections	V1M2 Secs. 4.11.1; 4.13.2.3	4.11.1; 4.13.2.3	61
13.0	PREVENTIVE ACTION	V1M2 Secs. 4.10; 4.12.1; 4.12.2	4.10; 4.12.1; 4.12.2	67
13.1	Overview	V1M2 Secs. 4.15.1; 4.15.2	4.15.1; 4.15.2	67
13.2	Management Of Change			68
14.0	CONTROL OF RECORDS	V1M2 Secs. 4.2.7; 4.13.1.1; 4.13.3	4.2.7; 4.13.1.1	69
14.1	Overview	V1M2 Secs. 4.13.1.1; 4.13.1.2; 4.13.1.3; 4.13.1.4; 4.13.2.1; 4.13.2.2; 4.13.2.3; 4.13.3	4.13.1.1; 4.13.1.2; 4.13.1.3; 4.13.1.4; 4.13.2.1; 4.13.2.2; 4.13.2.3	69

Section No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page No.
14.2	Technical And Analytical Records	V1M2 Sec. 4.13.2.2 - 4.13.2.3	4.13.2.2; 4.13.2.3	72
14.3	Laboratory Support Activities			74
14.4	Administrative Records			74
14.5	Records Management, Storage And Disposal	V1M2 Sec. 4.13.3		74
15.0	AUDITS			76
15.1	Internal Audits	V1M2 Sec. 4.2.8.1; 4.14; 4.14.1; 4.14.2 ; 4.14.3; 4.14.5; 5.9.1; 5.9.2	4.14.1; 4.14.2; 4.14.3; 5.9.1; 5.9.A.15	76
15.2	External Audits	V1M2 Secs.4.14.2; 4.14.3	4.14.2; 4.14.3; 4.14.4	78
15.3	Audit Findings	V1M2 Secs. 4.14.2; 4.14.3; 4.14.5		78
16.0	MANAGEMENT REVIEWS	V1M2 Sec. 4.1.6; 4.15; 4.15.1; 4.15.2	4.1.6; 4.15.1; 4.15.2	80
16.1	Quality Assurance Report			80
16.2	Annual Management Review	V1M2 Sec. 4.2.2; 4.15.3	4.2.2	80
16.3	Potential Integrity Related Managerial Reviews			81
17.0	PERSONNEL	V1M2 Secs. 5.2; 5.2.1	5.2.1	82
17.1	Overview	V1M2 Secs. 5.2.2; 5.2.3; 5.2.5	5.2.2; 5.2.3; 5.2.5	82
17.2	Education And Experience Requirements For Technical Personnel	V1M2 Secs. 5.2.1; 5.2.3; 5.2.4	5.2.1; 5.2.3; 5.2.4	82
17.3	Training	V1M2 Sec. 5.2.5	5.2.5	83
17.4	Data Integrity And Ethics Training Program	V1M2 Sec. 4.2.8.1; 5.2.7		84
18.0	ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS	V1M2 Sec. 5.3		86
18.1	Overview	V1M2 Secs. 5.3.1; 5.3.3; 5.3.4; 5.3.5	5.3.1; 5.3.3; 5.3.4; 5.3.5	86
18.2	Environment	V1M2 Secs. 5.3.1; 5.3.2; 5.3.3; 5.3.4; 5.3.5	5.3.1; 5.3.2; 5.3.3; 5.3.4; 5.3.5	86
18.3	Work Areas	V1M2 Secs. 5.3.3; 5.3.4; 5.3.5	5.3.3; 5.3.4; 5.3.5	87
18.4	Floor Plan			87
18.5	Building Security	V1M2 Sec. 5.3.4	5.3.4	87
19.0	TEST METHODS AND METHOD	V1M2 Sec. 5.4.1	5.4.1	89

Section No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page No.
	VALIDATION			
19.1	Overview	V1M2 Sec. 5.4.1	5.4.1; 5.4.5.1	89
19.2	Standard Operating Procedures	V1M2 Secs. 4.2.8.5; 4.3.3.1; 5.4.2	4.3.3.1; 5.4.2	89
19.3	Laboratory Methods Manual	V1M2 Sec. 4.2.8.5		89
19.4	Selection Of Methods	V1M2 Secs. 4.13.3; 5.4.1; 5.4.2; 5.4.3. V1M4 Secs. 1.4; 1.5.1; 1.6.1; 1.6.2; 1.6.2.1; 1.6.2.2	5.4.1; 5.4.2; 5.4.3; 5.4.4; 5.4.5.1; 5.4.5.2; 5.4.5.3	90
19.5	Laboratory Developed Methods And Non-Standard Methods	V1M2 Sec. 5.4.2. V1M4 Sec. 1.5.1	5.4.2; 5.4.4; 5.4.5.2; 5.4.5.3; 5.4.Z.3	94
19.6	Validation Of Methods	V1M2 Sec. 5.4.2. V1M4 Secs. 1.5.1; 1.5.2; 1.5.2.1; 1.5.2.2; 1.5.3	5.4.2; 5.4.4; 5.4.5.2; 5.4.5.3; 5.4.Z.3	94
19.7	Method Detection Limits (Mdl)/ Limits Of Detection (Lod)	V1M2 Sec. 5.9.3. V1M4 Secs. 1.5.2; 1.5.2.1; 1.5.2.2	5.4.Z.3	95
19.8	Instrument Detection Limits (Idl)	V1M2 Sec. 5.9.3		96
19.9	Verification Of Detection And Reporting Limits	V1M2 Sec. 5.9.3. V1M4 Sec. 1.5.2.1		96
19.10	Retention Time Windows	V1M2 Sec. 5.9.3		96
19.11	Evaluation Of Selectivity	V1M2 Sec. 5.9.3. V1M4 Sec. 1.5.4; 1.7.3.6		97
19.12	Estimation Of Uncertainty Of Measurement	V1M2 Sec. 5.1.1; 5.1.2; 5.4.6	5.1.1; 5.1.2; 5.4.6.1; 5.4.6.2; 5.4.6.3; 5.4.Z.4	97
19.13	Sample Reanalysis Guidelines	V1M2 Sec 5.9.1	5.9.1	98
19.14	Control Of Data	V1M2 Secs. 5.4.7.1; 5.4.7.2; 5.9.1	5.4.7.1; 5.4.7.2; 5.9.1;	98
20.0	Equipment and Calibrations	V1M2 Secs. 5.5.4; 5.5.5; 5.5.6	5.5.4; 5.5.5; 5.5.Z.5; 5.5.6; 5.5.Z.6	105
20.1	Overview	V1M2 Secs. 5.5.1; 5.5.2; 5.5.3; 5.5.5; 5.5.10	5.5.1; 5.5.2; 5.5.3; 5.5.5; 5.5.10; 5.6.1; 5.6.Z.8	105
20.2	Preventive Maintenance	V1M2 Secs. 5.5.1; 5.5.3; 5.5.7; 5.5.9	5.5.1; 5.5.3; 5.5.7; 5.5.9; 5.6.1; 5.6.Z.8	105

Section No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page No.
20.3	Support Equipment	V1M2 Secs. 5.5.10; 5.5.11; 5.5.13.1	5.5.10; 5.5.11; 5.6.2.1.2; 5.6.2.2.1; 5.6.2.2.2	106
20.4	Instrument Calibrations	V1M2 Secs. 5.5.8; 5.5.10; 5.6.3.1. V1M4 Sec. 1.7.1.1; 1.7.2	5.5.8; 5.5.Z.6; 5.5.10; 5.6.1; 5.6.Z.8; 5.6.3.1	109
20.5	Tentatively Identified Compounds (Tics) – Gc/Ms Analysis			112
20.6	Gc/Ms Tuning			113
21.0	MEASUREMENT TRACEABILITY			124
21.1	Overview	V1M2 Sec. 5.6.3.1	5.6.2.1.2; 5.6.2.2.2; 5.6.3.1	124
21.2	Nist-Traceable Weights And Thermometers	V1M2 Secs. 5.5.13.1; 5.6.3.1; 5.6.3.2	5.6.3.1; 5.6.3.2	124
21.3	Reference Standards / Materials	V1M2 Secs. 5.6.3.1; 5.6.3.2; 5.6.3.3; 5.6.3.4; 5.6.4.1; 5.6.4.2; 5.9.1; 5.9.3	5.6.3.1; 5.6.3.2; 5.6.3.3; 5.6.3.4; 5.9.1	125
21.4	Documentation And Labeling Of Standards, Reagents, And Reference Materials	V1M2 Secs. 5.6.4.2; 5.9.3		126
22.0	SAMPLING			129
22.1	22.1 Overview	V1M2 Secs. 5.7.1; 5.7.3	5.7.1; 5.7.3	129
22.2	Sampling Containers			129
22.3	Definition Of Holding Time			129
22.4	Sampling Containers, Preservation Requirements, Holding Times			130
22.5	Sample Aliquots / Subsampling	V1M2 Sec. 5.7.1	5.7.1	130
23.0	HANDLING OF SAMPLES	V1M2 Sec. 5.8.1	5.8.1	131
23.1	Chain Of Custody (Coc)	V1M2 Secs. 5.7.2; 5.7.4; 5.8.4; 5.8.7.5; 5.8.8; 5.9.1	5.7.2; 5.8.4; 5.9.1	131
23.2	Sample Receipt	V1M2 Secs. 5.8.1; 5.8.2; 5.8.3; 5.8.5; 5.8.7.3; 5.8.7.4; 5.8.7.5	5.8.2; 5.8.3	132
23.3	Sample Acceptance Policy	V1M2 Secs. 5.8.6; 5.8.7.2		133
23.4	Sample Storage	V1M2 Secs. 5.7.4; 5.8.4	5.8.4	134
23.5	23.5 Hazardous Samples And			135

Uncontrolled Copy

Section No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page No.
	Foreign Soils			
23.6	23.6 **Sample Shipping**	V1M2 Sec. 5.8.2	5.8.2	135
23.7	23.7 **Sample Disposal**			136
24.0	ASSURING THE QUALITY OF TEST RESULTS			142
24.1	Overview	V1M2 Secs. 5.9.2; 5.9.3	5.9.2	142
24.2	Controls	V1M2 Secs. 5.9.2; 5.9.3	5.9.2	142
24.3	Negative Controls	V1M2 Secs. 5.9.2; 5.9.3 V1M4 Secs. 1.7.3; 1.7.3.1; 1.7.4.1	5.9.2	142
24.4	Positive Controls	V1M2 Secs 5.9.2; 5.9.3. V1M4 Secs. 1.7.3; 1.7.3.2; 1.7.3.2.1; 1.7.3.2.2; 1.7.3.2.3	5.9.2	143
24.5	Sample Matrix Controls	V1M2 Secs. 5.9.2; 5.9.3. V1M4 Secs. 1.7.3 ; 1.7.3.3; 1.7.3.3.1; 1.7.3.3.2; 1.7.3.3.3	5.9.2	145
24.6	Acceptance Criteria (Control Limits)	V1M2 Sec. 5.9.3. V1M4 Secs. 1.7.4.2; 1.7.4.3		146
24.7	Additional Procedures To Assure Quality Control	V1M2 Sec. 5.9.3. V1M4 Sec. 1.7.3.4		147
25.0	REPORTING RESULTS			149
25.1	Overview	-V1M2 Secs. 5.10.1; 5.10.2; 5.10.8	5.10.1; 5.10.2; 5.10.8	149
25.2	Test Reports	V1M2 Secs. 5.10.1; 5.10.2; 5.10.3.1; 5.10.3.2; 5.10.5; 5.10.6; 5.10.7; 5.10.8; 5.10.10; 5.10.11	5.10.1; 5.10.2; 5.10.3.1; 5.10.3.2; 5.10.5; 5.10.6; 5.10.7; 5.10.8	149
25.3	Reporting Level Or Report Type	V1M2 Secs. 5.10.1; 5.10.7; 5.10.8	5.10.1; 5.10.7; 5.10.8	151
25.4	Supplemental Information For Test	V1M2 Secs. 5.10.1; 5.10.3.1; 5.10.5	5.10.1; 5.10.3.1; 5.10.5	152
25.5	Environmental Testing Obtained From	V1M2 Secs. 4.5.5; 5.10.1;	5.10.1; 5.10.6	153

Section No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page No.
	Subcontractors	5.10.6		
25.6	Client Confidentiality	V1M2 Secs. 4.1.5; 5.10.7	4.1.5; 5.10.7	153
25.7	Format Of Reports	V1M2 Sec. 5.10.8	5.10.8	154
25.8	Amendments To Test Reports	V1M2 Sec. 5.10.9	5.10.9; 5.10.Z.10	154
25.9	Policies On Client Requests For Amendments	V1M2 Secs. 5.9.1; 5.10.9	5.9.1; 5.10.Z.10	154

LIST OF TABLES

Table No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page
12-1	Example- General Corrective Action Procedures	V1M2 Sec. 4.11.6. V1M4 Sec. 1.7.4.1	4.11.2; 4.13.2.3	63
14-1	Example- Record Index		4.13.1.1	69
14-2	Example- Special Record Retention Requirements			71
15-1	Types of Internal Audits and Frequency		4.14.1	76
20-1	Example - Laboratory Equipment & Instrumentation		5.5.4; 5.5.5	114
20-2	Example – Schedule of Routine Maintenance			118
20-3	Example – Periodic Calibration			121
24-1	Example – Negative Controls			142
24-2	Sample Matrix Control			145

Uncontrolled Copy

LIST OF FIGURES

Figure No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page
4-1	Corporate and Laboratory Organizational Charts	V1M2 Sec. 4.1.5	4.1.3; 4.1.5; 4.2.Z2	26
12-1	Example – iCAT Corrective Action Report			62
19-1	Example - Demonstration of Capability Documentation			104
23-1	Example – Chain of Custody			137
23-2	Example – Sample Acceptance Policy	V1M2 Sec. 5.8.6; 5.8.7.1. V1M4 Sec. 1.7.5		138
23-3	Example – Cooler Receipt Form (optional)		5.8.3	141

LIST OF APPENDICES

Appendix No.	Title	Page
1	Laboratory Floor Plan	156
2	Glossary / Acronyms	161
3	Laboratory Certifications, Accreditations, Validations	171

REFERENCED CORPORATE SOPs AND POLICIES

Uncontrolled Copy

SOP / Policy Reference	Title
CA-I-P-002	Electronic Reporting and Signature Policy
CA-L-P-002	Contract Compliance Policy
CW-L-S-004	Subcontracting Procedures
CA-Q-M-002	Corporate Quality Management Plan
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-006	Detection Limits
CA-Q-S-009	Root Cause Analysis
CA-T-P-001	Qualified Products List
CW-E-M-001	Corporate Environmental Health & Safety Manual
CW-F-P-002	Company-Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization
CW-L-P-004	Ethics Policy
CW-L-S-002	Internal Investigation
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CW-Q-S-005	Data Recall Process
CA-C-S-001	Work Sharing Process

REFERENCED LABORATORY SOPs

SOP Reference	Title
BF-GP-001	Calibration of Autopipettes and Repipetters
BF-GP-002	Support Equipment: Maintenance, Record Keeping and Corrective Actions
BF-GP-005	Sample Homogenization and Subsampling
BF-GP-012	Technical Data Review
BF-GP-013	Manual Integration
BF-GP-015	Record Storage and Retention
BF-GP-018	Strict Internal Chain or Custody
`BF-GP-019	Standard Traceability and Preparation

BF-GP-020	Thermometer Calibration
BF-PM-001	Project Information Requirements
BF-PM-003	Bottle Order Set-up
BF-PM-005	Correctness of Analysis
BF-PM-008	Massachusetts DEP Notification Procedures
BF-QA-001	Determination of Method Detection Limits
BF-QA-002	Quality Control Limits
BF-QA-003	Procedure for Writing, Reviewing and Revising Controlled Documents
BF-QA-004	Laboratory Personnel Training
BF-QA-005	Preventative and Corrective Action
BF-QA-006	Data Quality Review
BF-SR-001	Cooler Shipping - Bottle Kits and Samples
BF-SR-002	Receipt of Analytical Samples

- The full list of Laboratory SOPs is maintained in the Quality Assurance Department
- The full list of analytical methods performed in the Laboratory is can be exported from the Laboratory Information Management System's Total Access Database

Uncontrolled Copy

SECTION 3

INTRODUCTION, SCOPE AND APPLICABILITY

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Buffalo's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with 2003 National Environmental Laboratory Accreditation Conference (NELAC) standards, The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025(E) In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- ANSI/ASQC, E4-1994, "Specifications and Guidelines for Quality Management Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995, or most recent version)
- "EPA Requirements for Quality Management Programs" (QA/R-2) (EPA/240/B-01/002, May 31, 2006).
- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition September 1986, Final Update I, July 1992, Final Update II A, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261. New York State Analytical Services Protocol, July 2005
- Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005).
- Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th, and on-line Editions. 21st.

- *U.S. Department of Energy* Order 414.1B, *Quality Assurance*, Approved April 29, 2004.
- *U.S. Department of Energy* Order 414.1C, *Quality Assurance*, June 17, 2005.
- *U.S. Department of Energy Order 414.1D, Quality Assurance, Aril, 25, 2011.*
- Toxic Substances Control Act (TSCA).

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air, drinking water, effluent water, groundwater, hazardous waste, sludge and soils. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in Section 19.0. The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director/Manager and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director/Manager and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. The manual itself is reviewed every two years by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & updating procedures (refer to BF-QA-003)

SECTION 4

MANAGEMENT REQUIREMENTS

4.1 OVERVIEW

TestAmerica Buffalo is a local operating unit of TestAmerica Laboratories, Inc. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President and Chief Executive Officer (CEO), Chief Operating Officer (COO), Executive VP Operations, Corporate Quality, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Buffalo is presented in Figure 4-1.

4.2 ROLES AND RESPONSIBILITIES

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this manual and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Buffalo laboratory.

4.2.2 Laboratory Director

TestAmerica Buffalo's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to their respective GM. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

The Laboratory Director has the authority to affect those policies and procedures to ensure that only data of the highest level of excellence are produced. As such, the Laboratory Director is responsible for maintaining a working environment which encourages open, constructive problem solving and continuous improvement.

Specific responsibilities include, but are not limited to:

- Provides one or more department managers for the appropriate fields of testing. If the Department Manager is absent for a period of time exceeding 15 consecutive calendar

days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Department Manager to temporarily perform this function. If the absence exceeds 65 consecutive calendar days, the primary NELAP accrediting authority must be notified in writing.

- Ensures that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented.
- Ensures that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensures TestAmerica's human resource policies are adhered to and maintained.
- Ensures that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory.
- Ensures that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Reviews and approves all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.
- Pursues and maintains appropriate laboratory certification and contract approvals. Supports ISO 17025 requirements.
- Ensures client specific reporting and quality control requirements are met.
- Leads the management team, consisting of the QA Manager, the Technical Manager, and the Operations Manager as direct reports.

4.2.3 Quality Assurance (QA) Manager or Designee

The QA manager has responsibility and authority to ensure the continuous implementation of the quality system.

The QA Manager reports directly to the Laboratory Director and their Corporate Quality Director. This position is able to evaluate data objectively and perform assessments without outside (i.e., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA department to accomplish specific responsibilities, which include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.

- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems, data authenticity and the technical operation.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.
- Maintain, improve, and evaluate the corrective action and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Review a subset of all final data reports for internal consistency. Review of Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, evaluate manual calculations, format, holding time, sensibility and completeness of the project file contents.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Leads the QA team to enable communication and to distribute duties and responsibilities.
- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.

- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.

- Evaluation of the thoroughness and effectiveness of training.

- Compliance with ISO 17025.

4.2.4 Technical Manager or Designee

The Technical Manager(s) report(s) directly to the Laboratory Director. He/she is accountable for all analyses and analysts under their experienced supervision and for compliance with the ISO 17025 Standard. The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercises day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.

- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc..
- Captains department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinates audit responses with the QA Manager.

4.2.5 Operations Manager

The Operations Manager manages and directs the analytical production sections of the laboratory. He/She reports directly to the Laboratory Director. He/She assists the Technical Manager in determining the most efficient instrument utilization. More specifically, he/she:

- Evaluates the level of internal/external non-conformances for all departments.
- Continuously evaluates production capacity and improves capacity utilization.
- Continuously evaluates turnaround time and addresses any problems that may hinder meeting the required and committed turnaround time from the various departments.
- Develops and improves the training of all analysts in cooperation with the Technical Manager and QA Manager and in compliance with regulatory requirements.
- Is responsible for efficient utilization of supplies.
- Constantly monitors and modifies the processing of samples through the departments.
- Fully supports the quality system and, if called upon in the absence of the QA Manager, serves as his substitute in the interim.

4.2.6 Department Managers

Department Managers report to the Operations Manager. The Department Managers serve as the technical experts on assigned projects, provide technical liaison, assist in resolving any technical issues within the area of their expertise; and implement established policies and procedures to assist the Operations Manager in achieving section goals. Each one is responsible to:

- Ensure that analysts in their department adhere to applicable SOPs and the QA Manual. They perform frequent SOP and QA Manual review to determine if analysts are in compliance and if new, modified, and optimized measures are feasible and should be added to these documents.
- With regard to analysts, participates in the selection, training, and development of performance objectives and standards of performance, appraisal (measurement of objectives), scheduling, counseling, discipline, and motivation of analysts and documents these activities in accordance with systems developed by the QA and Human Resources

Departments. They evaluate staffing sufficiency and overtime needs. Training consists of familiarization with SOP, QC, Safety, and computer systems.

- Encourage the development of analysts to become cross-trained in various methods and/or operate multiple instruments efficiently while performing maintenance and documentation, self-supervise, and function as a department team.
- Provide guidance to analysts in resolving problems encountered daily during sample prep/analysis in conjunction with the Technical Manager, Operations Manager, and/or QA Manager. Each is responsible for 100% of the data review and documentation, non-conformance and CPAR issues, the timely and accurate completion of performance evaluation samples and MDLs, for his department.
- Ensure all logbooks are maintained, current, and properly labeled or archived.
- Report all non-conformance conditions to the QA Manager, Technical Manager, Operations Manager, and/or Laboratory Director.
- Ensure that preventive maintenance is performed on instrumentation as detailed in the QA Manual or SOPs. He is responsible for developing and implementing a system for preventive maintenance, troubleshooting, and repairing or arranging for repair of instruments.
- Maintain adequate and valid inventory of reagents, standards, spare parts, and other relevant resources required to perform daily analysis.
- Achieve optimum turnaround time on analyses and compliance with holding times.
- Conduct efficiency and cost control evaluations on an ongoing basis to determine optimization of labor, supplies, overtime, first-run yield, capacity (designed vs. demonstrated), second- and third-generation production techniques/instruments, and long-term needs for budgetary planning.
- Develop, implement, and enhance calibration programs.
- Provide written responses to external and internal audit issues.

4.2.7 Hazardous Waste Coordinator

The Hazardous Waste Coordinator reports directly to the Laboratory Director. The duties consist of:

- Staying current with the hazardous waste regulations.
- Continuing training on hazardous waste issues.
- Reviewing and updating annually the Hazardous Waste Contingency Plan in the Environmental Health & Safety Manual.
- Auditing the staff with regard to compliance with the Hazardous Waste Contingency Plan.
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste.

4.2.8 Environmental Health & Safety Coordinator

The Environmental Health and Safety Coordinator reports to the Laboratory Director and ensures that systems are maintained for the safe operation of the laboratory. The Safety Officer is responsible to:

- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administer dispersal of all Safety Data Sheet (SDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is “reasonable” and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by TestAmerica’s medical consultants.

4.2.9 Laboratory Analysts

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the group leader or supervisor. The responsibilities of the analysts are listed below:

- Perform analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Document standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on worklists, benchsheets, lab notebooks and/or the Non-Conformance Database.
- Report all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, the Technical Manager, and/or the QA Manager or member of QA staff.
- Perform 100% review of the data generated prior to entering and submitting for secondary level review.

Uncontrolled Copy

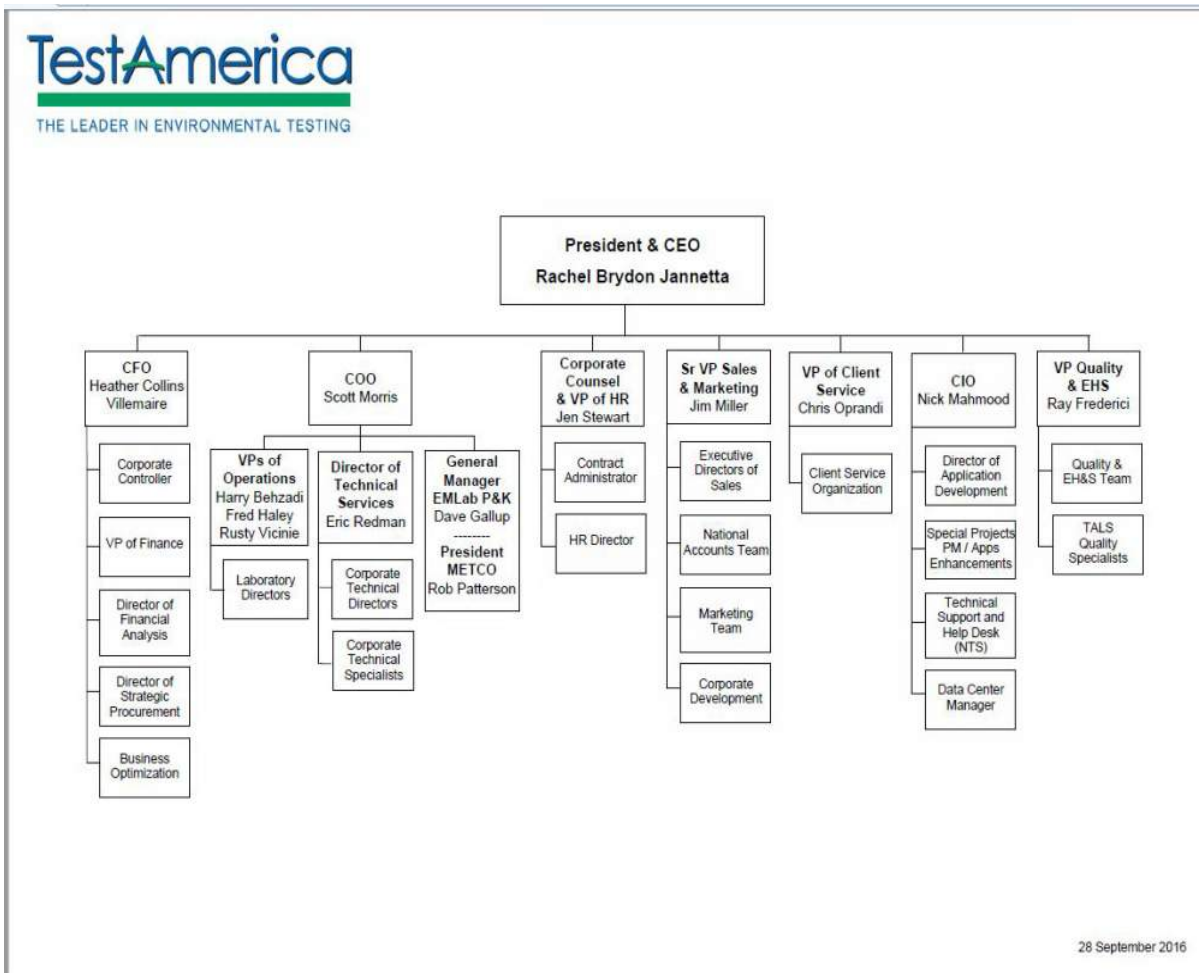
- Suggest method improvements to their supervisor, the Technical Manager, and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Work cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.

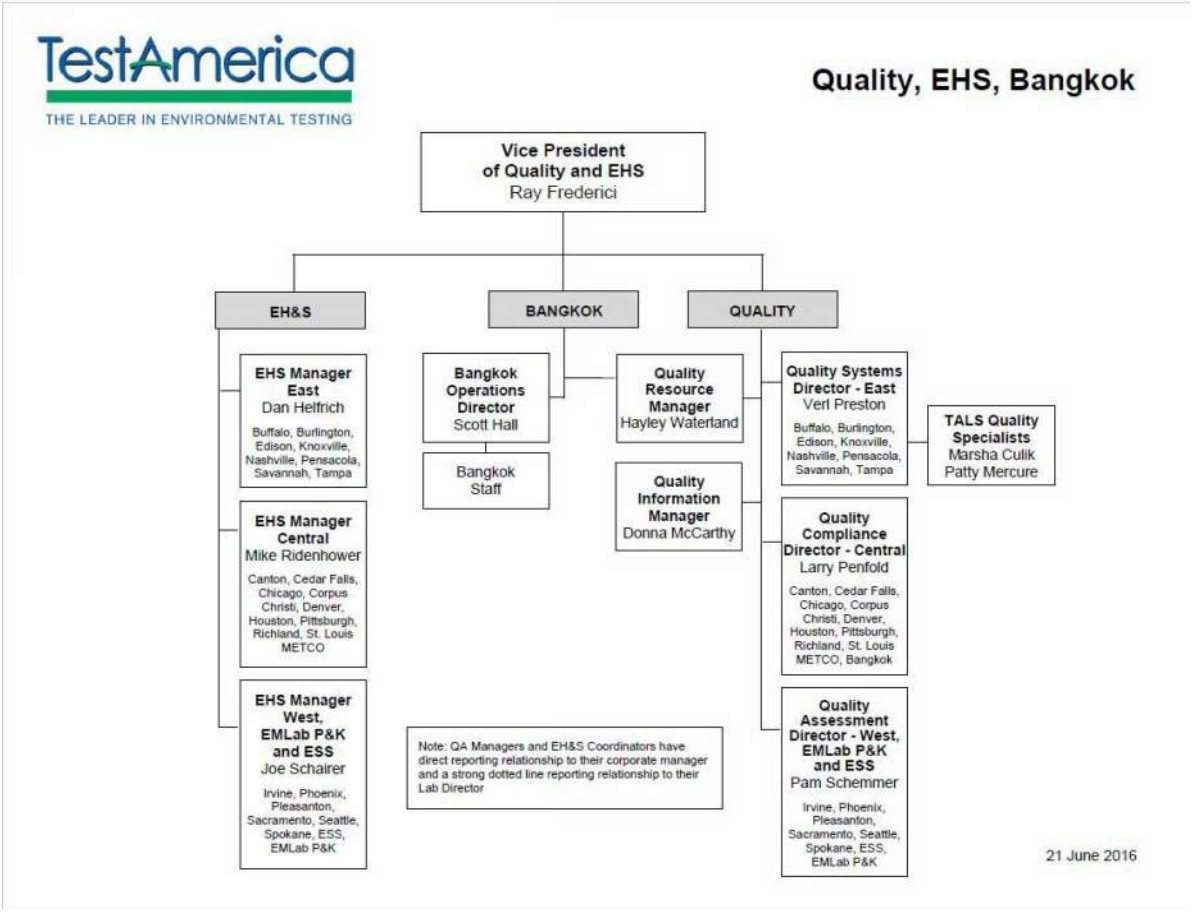
4.3 DEPUTIES

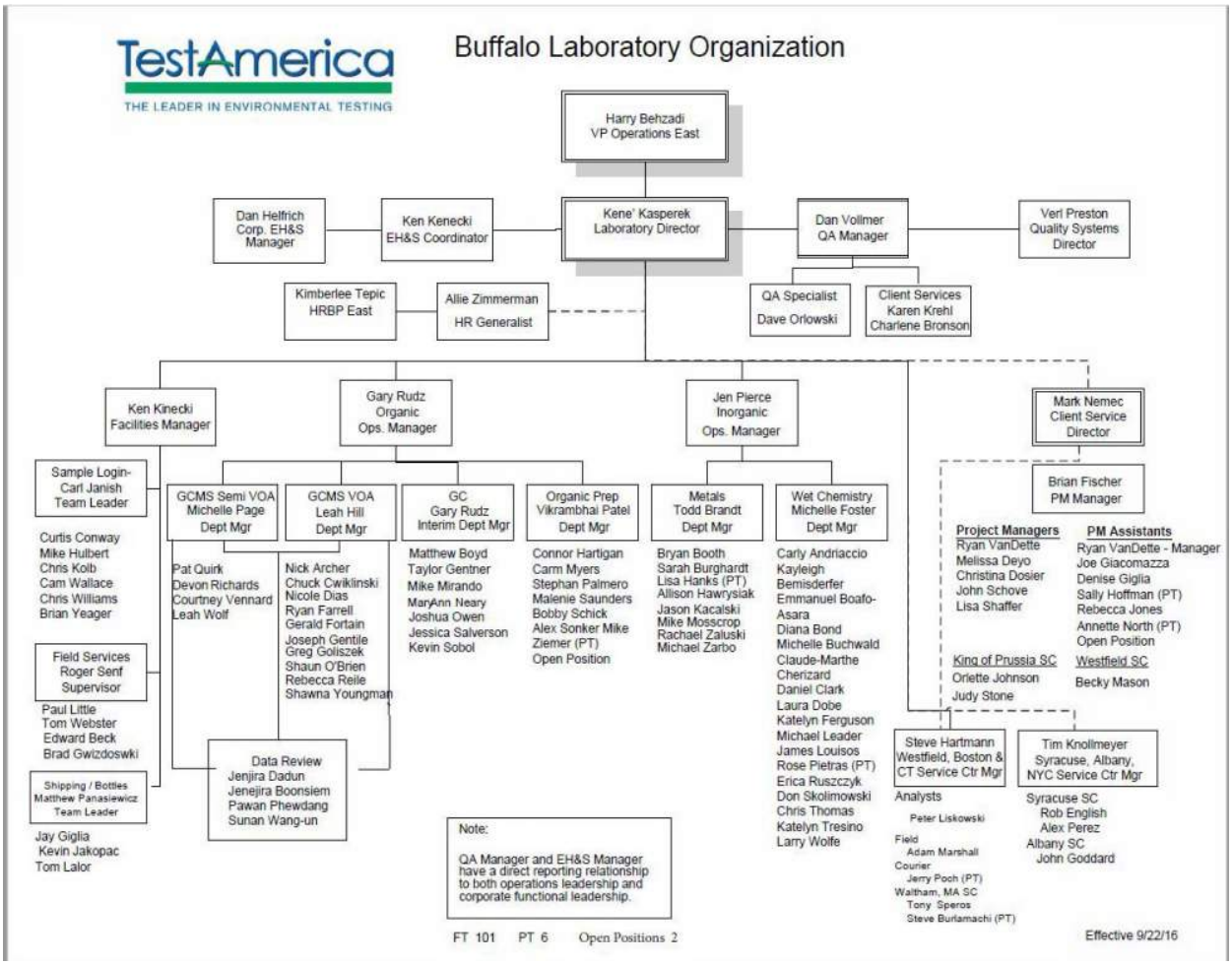
The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy	Comment
Laboratory Director	Operations Manager (1) Technical Manager (2)	
QA Manager	QA Specialist (1) Operations Manager (2)	
Technical Manager	Laboratory Director (1) Operations Manager (2)	
Operations Manager	Department Manager (1) Department Manager (2)	Selected based on availability
Manager of Project Management	Project Manager (1) Client Services Director (2)	Selected based on availability
Project Manager	Project Manager (1) Project Management Asst. (2)	(1) 2° team PM (2) Team PMA
Organic Department Manager	Analyst (1) Analyst (2)	Selected based on department, experience and availability
Inorganic Department Manager	Analyst (1) Analyst (2)	Selected based on department, experience and availability
Data Validation / Data Packaging Manager	Data Validation Specialist Data Packaging Specialist	Selected based on department and availability
EHS Coordinator	Laboratory Director (1) EHS Manager (2)	
Sample Management Manager	Sample Custodian (1) EHS Coordinator (2)	
Bottle Preparation / Shipping Manager	Bottle Prep Technician (1) Sample Mng't Manager (2)	

Figure 4-1.
Corporate and Laboratory Organization Charts




TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
Quality, EHS, Bangkok
Vice President of Quality and EHS
Ray Frederici
EH&S
BANGKOK
QUALITY
EHS Manager East
Dan Helfrich
Buffalo, Burlington, Edison, Knoxville, Nashville, Pensacola, Savannah, Tampa
EHS Manager Central
Mike Ridenhower
Canton, Cedar Falls, Chicago, Corpus Christi, Denver, Houston, Pittsburgh, Richland, St. Louis METCO
EHS Manager West, EMLab P&K and ESS
Joe Schairer
Irvine, Phoenix, Pleasanton, Sacramento, Seattle, Spokane, ESS, EMLab P&K
Bangkok Operations Director
Scott Hall
Bangkok Staff
Quality Resource Manager
Hayley Waterland
Quality Information Manager
Donna McCarthy
Note: QA Managers and EH&S Coordinators have direct reporting relationship to their corporate manager and a strong dotted line reporting relationship to their Lab Director
Quality Systems Director - East
Verl Preston
Buffalo, Burlington, Edison, Knoxville, Nashville, Pensacola, Savannah, Tampa
TALS Quality Specialists
Marsha Culik
Patty Mercure
Quality Compliance Director - Central
Larry Penfold
Canton, Cedar Falls, Chicago, Corpus Christi, Denver, Houston, Pittsburgh, Richland, St. Louis METCO, Bangkok
Quality Assessment Director - West, EMLab P&K and ESS
Pam Schemmer
Irvine, Phoenix, Pleasanton, Sacramento, Seattle, Spokane, ESS, EMLab P&K
21 June 2016



Note: Organizational Charts are current at the date of publication of this manual. Updated charts may be obtained by contacting the TestAmerica Buffalo Quality Department.

SECTION 5

QUALITY SYSTEM

5.1 QUALITY POLICY STATEMENT

It is TestAmerica's Policy to:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- Provide clients with the highest level of professionalism and the best service practices in the industry.
- To comply with the NELAC Standards (2003), ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 ETHICS AND DATA INTEGRITY

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The 7 elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A training program.
- Self-governance through disciplinary action for violations.
- A confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CW-Q-S-005).

Uncontrolled Copy

- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 QUALITY SYSTEM DOCUMENTATION

The laboratory's Quality System is communicated through a variety of documents:

- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratories normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Laboratory QA/QC Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC OBJECTIVES FOR THE MEASUREMENT OF DATA

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

Uncontrolled Copy

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

Uncontrolled Copy

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory maintains Quality Control Limit Data in their LIMS system. A summary report is generated from LIMS to check the precision and accuracy acceptability limits for performed analyses on request. The summary report is generated and is managed by the laboratory's QA department. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits are contained in Section 24.

5.6 STATISTICAL QUALITY CONTROL

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs [such as the Ohio Voluntary Action Plan (VAP)]. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The procedure for determining the statistical limits may be found in SOP BF-QA-002, Quality Control Limits. The analysts are instructed to use the current limits in the laboratory (dated and approved the QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance department maintains an archive of all limits used within the laboratory through date sensitive tables within the LIMs System. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Surrogate recoveries are determined for a specific time period as defined above. The resulting ranges are entered in LIMS.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The QA Manager periodically evaluates these to determine if adjustments need to be made or for corrective actions to methods (SOP No. BF-QA-002). All findings are documented and kept on file.

Uncontrolled Copy

5.7 QUALITY SYSTEM METRICS

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

Uncontrolled Copy

SECTION 6

DOCUMENT CONTROL

6.1 OVERVIEW

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP No. BF-QA-003.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action notices. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 DOCUMENT APPROVAL AND ISSUE

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item, or an 'end of document' page, the effective date, revision number and the laboratory's name. The Quality personnel are responsible for the maintenance of the system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a Department Manager submits an electronic draft to the QA Department for

suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retain that document as the official document on file. That document is then provided to all applicable operational units. Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every two years for the majority of procedures. Exceptions include review every 1 year for Drinking Water programs and the Kentucky CWA program. Changes to documents occur when a procedural change warrants.

6.3 PROCEDURES FOR DOCUMENT CONTROL POLICY

For changes to the QA Manual, refer to SOP No. BF-QA-003, “Writing, Reviewing and Revising Controlled Documents”. Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA department. A controlled electronic copy of the current version is maintained on the laboratory Intranet site and is available to all personnel.

For changes to SOPs, refer to SOP No. BF-QA-003, “Writing, Reviewing and Revising Controlled Documents”.

Forms, worksheets, work instructions and information are organized by department and are maintained electronically by QA. There is a table of contents. As revisions are required, a new version number and revision date is assigned. Controlled electronic copies are made available on a public server for laboratory staff to access.

6.4 OBSOLETE DOCUMENTS

When revisions are implemented for an SOP, form or work instruction, the previous document becomes obsolete and is archived. All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are destroyed. At least one copy of the obsolete document is archived according to SOPs No. BF-GP-015 and BF-QA-003. All archived SOPs, manuals, forms or work instructions are considered obsolete.

SECTION 7

SERVICE TO THE CLIENT

7.1 OVERVIEW

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client and the participating personnel are informed of the changes.

7.2 REVIEW SEQUENCE AND KEY PERSONNEL

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Client Relations Manager or Proposal Team, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002**,** Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below):

- Contact Administrator
- VP of Operations
- Laboratory Project Manager
- Laboratory and/or Corporate Technical Managers
- Corporate Information Technology Managers/Directors
- Regional and/or National Account representatives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

The Sales Director, Contract Administrator, Account Executive or Proposal Coordinator then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The Contracts Department maintains copies of all signed contracts. The Project Managers at the TestAmerica Buffalo facility also maintains copies of these documents.

7.3 DOCUMENTATION

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes.

The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Executive. A copy of the contract and formal quote will be filed with the laboratory PM and the Laboratory Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal a PM is assigned to each client. The PM is the first point of contact for the client. It is the PM's responsibility to ensure that project specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements. Specific information related to project planning may be found in SOP BF-PM-001, Project Information Requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the management staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory during production meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Department Manager.

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 SPECIAL SERVICES

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 CLIENT COMMUNICATION

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical Managers/Designees are available to discuss any technical questions or concerns that the client may have.

7.6 REPORTING

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 CLIENT SURVEYS

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service.

TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

Uncontrolled Copy

SECTION 8

SUBCONTRACTING OF TESTS

8.1 OVERVIEW

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase “work sharing” refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica’s Corporate SOP’s on Subcontracting Procedures (CW-L-S-004) and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client’s Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client’s analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

Project Managers (PMs), Client Service Managers (CSM), or Account Executives (AE) for the Export Lab (TestAmerica laboratory that transfers samples to another laboratory) are responsible for obtaining client approval prior to subcontracting any samples. The laboratory will advise the client of a subcontract or work sharing arrangement in writing and when possible approval from the client shall be retained in the project folder. Standard TestAmerica Terms & Conditions include the flexibility to subcontract samples within the TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies, such as the Department of Energy and the USDA, may require notification prior to placing such work**.**

Approval may be documented through reference in a quote / contract or e-mail correspondence.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM, Account Executive (AE) or Client Service Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;
- Firms specified by the client for the task (Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be
- as simple as placing a copy of an e-mail from the client in the project folder);
- Firms listed as pre-qualified and currently under a subcontract with TestAmerica. A listing of all approved subcontracting laboratories is available on the TestAmerica intranet site. Supporting documentation is maintained by corporate offices and by the TestAmerica laboratory originally requesting approval of the subcontract lab. Verify necessary accreditation, where applicable (e.g. on the subcontractors TNI, A2LA accreditation or State certification.
- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses;
- TNI or A2LA accredited laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

All TestAmerica laboratories are pre-qualified for work-sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the QA Manager/Designee begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures.

8.2.1 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. Once all documents are reviewed for completeness, the Corporate QIM will forward the documents to the Purchasing Manager for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified for JD Edwards.

8.2.2 The client will assume responsibility for the quality of the data generated from the

use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.2.3 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contracts and/or Corporate Quality Departments. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and
- Corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report (Form No. CW-F-WI-009)**.**
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. The CSO personnel will notify all TestAmerica laboratories and Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all CSO Personnel, Laboratory Directors/Managers, QA Managers and Sales Personnel.

8.3 OVERSIGHT AND REPORTING

The PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which flow down the requirements of our clients, either in the subcontract itself or through the mechanism of work orders relating to individual projects. A standard subcontract and the Lab Subcontractor Vendor Package (posted on the intranet) can be used to accomplish this, and the Corporate Counsel can tailor the document or assist with negotiations, if needed. The PM (or AE or CSM, etc.) responsible for the project must advise and obtain client consent to the subcontract as appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented within the project records. For TestAmerica laboratories, certifications can be viewed on the company TotalAccess Database.

The Sample Control department is responsible for ensuring compliance with QA requirements and applicable shipping regulations when shipping samples to a subcontracted laboratory.

All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must be available in TALS for all samples workshared within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilities successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data are incorporated into the laboratories EDD (i.e. imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 CONTINGENCY PLANNING

The Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and Chain-of-Custody. In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time. . The comprehensive approval process must then be initiated within 30 calendar days of subcontracting.

SECTION 9

PURCHASING SERVICES AND SUPPLIES

9.1 OVERVIEW

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica's Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's Company-Wide Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 GLASSWARE

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 REAGENTS, STANDARDS & SUPPLIES

Purchasing guidelines for equipment, consumables and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001 and TestAmerica Buffalo SOP on Solvent Purity, SOP BF-OP-013. Approval information for the solvents and acids tested under SOP CA-Q-S-001 is stored on the TestAmerica Sharepoint, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location. [

9.3.1 Purchasing

Chemical reagents, solvents, glassware and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. Purchase requisitions are placed into the J.D. Edwards system by designated departmental personnel. The listing of items available in the J.D. Edwards system has been approved for use by the corporate purchasing staff. Each purchase requisition receives final approval by the laboratory Operations Manager or purchasing coordinator before the order is submitted.

The analyst may also check the item out of the on-site consignment system that contains items approved for laboratory use.

9.3.2 Receiving

It is the responsibility of the purchasing manager/designee to receive the shipment. It is the responsibility of the department that ordered the materials to document the date the materials were received. Once the ordered reagents or materials are received, the department that submitted the order compares the information on the label or packaging to the original order to ensure that the purchase meets quality level specified. This is documented through the addition of the received date and initials to the information present on the daily order log.

The purchasing manager/designee verifies the lot numbers of received solvents and acids against the pre-approval lists. If a received material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained on the shared “public” folder on the computer network.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented.

Safety Data Sheets (SDSs) are available online through the Company’s intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer’s expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOP expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date cannot not be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.

- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).

- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical meets CCV limits. The comparison studies are maintained along with the calibration raw data for which the reagent was used.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- umho/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25^{o}C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Department Managers/Supervisors must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in the LIMS system, files or binders in each laboratory section. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Technical Manager or QA Manager.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. DOC No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 PURCHASE OF EQUIPMENT/INSTRUMENTS/SOFTWARE

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Manager and/or the Laboratory Director. If they agree with the request the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, is followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained at the bench.

9.5 SERVICES

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Department Managers. The service providers that perform the services are approved by the Department Managers, Operations Manager and/or Technical Manager.

Analytical balances are serviced and calibrated annually in accordance with SOP BF-GP-002,. The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. When the calibration certificates are received (usually within two weeks of the service), they are reviewed, and documentation of the

review is filed with the certificates. If the calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as NIST thermometers, weight sets, etc, are obtained from vendors with current and valid ISO 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department, and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Procurements & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers /vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form (available on the intranet site).

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Manager are consulted with vendor and product selection that have an impact on quality.

Uncontrolled Copy

SECTION 10

COMPLAINTS

10.1 OVERVIEW

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services, e.g., communications, responsiveness, data, reports, invoicing and other functions expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing with both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented in the laboratory SOP related Corrective Action (BF-QA-005).

10.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to BF-QA-005.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likely hood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 INTERNAL COMPLAINTS

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 13. In addition, Corporate Management, Sales and Marketing and Information Technology (IT) may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 MANAGEMENT REVIEW

The number and nature of client complaints is reported by the QA Manager to the laboratory and Quality Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16)

Uncontrolled Copy

SECTION 11

CONTROL OF NON-CONFORMING WORK

11.1 OVERVIEW

When data discrepancies are discovered or deviations and departures from laboratory standard procedures, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the department manager for resolution. The department manager may elect to discuss it with the Technical Manager, QA Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratory's non-conformance and corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Laboratory Director, Technical Manager, Operations Manager or QA Manager, documented and included in the project folder. Deviations must also be noted on the final report with a statement that the compound is not reported in compliance with the analytical method requirements and the reason.

11.2 RESPONSIBILITIES AND AUTHORITIES

Under certain circumstances the Laboratory Director, the Technical Manager, the Operations Manager or a member of the QA team may exceptionally authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's non-conformance and corrective action procedures described in Section 12. This information may also need to be documented in logbooks and/or data review checklists as appropriate. Any

impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility senior laboratory management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, Technical Manager, and QA Manager. Suspected misrepresentation issues may also be reported to any member of the corporate staff as identified in Ethics Policy, CW-L-P-004. The data integrity hotline (1-800-736-9407) may also be used. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO), (e.g., the VP-QA/EHS)and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, Corporate Quality, Executive VP of Operations and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 EVALUATION OF SIGNIFICANCE AND ACTIONS TAKEN

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

Corporate SOP entitled Data Recalls (CW-Q-S-005) is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

Corporate SOP entitled Internal Investigations (CW-L-S-002) is the procedure to be followed for investigation and correction of situations involved alleged incidents of misconduct or violation of the company's ethics policy.

Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-Q-S-005.

11.4 PREVENTION OF NONCONFORMING WORK

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. Periodically as defined by the laboratory's preventive action schedule, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 METHOD SUSPENSION/RESTRICTION (STOP WORK PROCEDURES)

In some cases it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line.

The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate VP of Operations and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (i.e., Project Management, Log-in, etc…). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Manager, Operations Manager, QA Manager, Department Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

Uncontrolled Copy

SECTION 12

CORRECTIVE ACTION

12.1 OVERVIEW

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Non-Conformance Memo (NCM) and Corrective Action Reports (CAR) (refer to Figure 12-1).

12.2 GENERAL

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution

12.2.1 Non-Conformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non matrix related)
- Isolated reporting / calculation errors
- Client complaints
- Project Management concerns regarding specific analytical results
- Discrepancies in materials / goods received vs. manufacturer packing slips.

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the monthly review of NCMs.
- Issues found while reviewing NCMs that warrant further investigation.
- Internal and External Audit Findings

- Failed or Unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic Reporting / Calculation Errors
- Client complaints
- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 CLOSED LOOP CORRECTIVE ACTION PROCESS

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. A NCM or CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Department Manager, Operations Manager, Technical Manager, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCM or CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness. Corporate SOP Root Cause Analysis (No. CA-Q-S-009) describes the procedure.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Department Manager, Operations Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Department Managers and the Operations Manager are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCM is entered into the Laboratory Information Management System (LIMS) and each CAR is entered into the Incident and Corrective Action Tracker (iCAT) database for tracking and trending purposes for review to aid in ensuring that the corrective actions have taken effect.
- TestAmerica laboratories began using the Incident/Corrective Action Tracker (iCAT) database developed by the company in 2015. (Previously, a local spreadsheet database served this purpose.) An incident is an event triggering the need for one or more corrective actions as distinct from a corrective action, a potential deficiency stemming from an incident that requires investigation and possibly fixing. The database is independent of TALS, available to all local and corporate managers, and capable of notifying and tracking multiple corrective actions per event, dates, and personnel. iCAT allows associated document upload, categorization (such as, external/internal audit, client service concerns, data quality issues, proficiency testing, etc.), and trend analysis. Refer to Figure 12-1.

- The QA Manager reviews monthly NCMs and CARs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.
- Also refer to Section 15.1.4, Special Audits)

12.4 TECHNICAL CORRECTIVE ACTIONS

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of a NCM or CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, work instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly at a minimum by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by an NCM and appropriate corrective action (e.g., reanalysis) is taken and documented.

Uncontrolled Copy

12.5 BASIC CORRECTIONS

When mistakes occur in records, each mistake shall be crossed-out, not obliterated (e.g. no white-out), and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Uncontrolled Copy

Figure 12-1.
Example – iCAT Corrective Action Notice

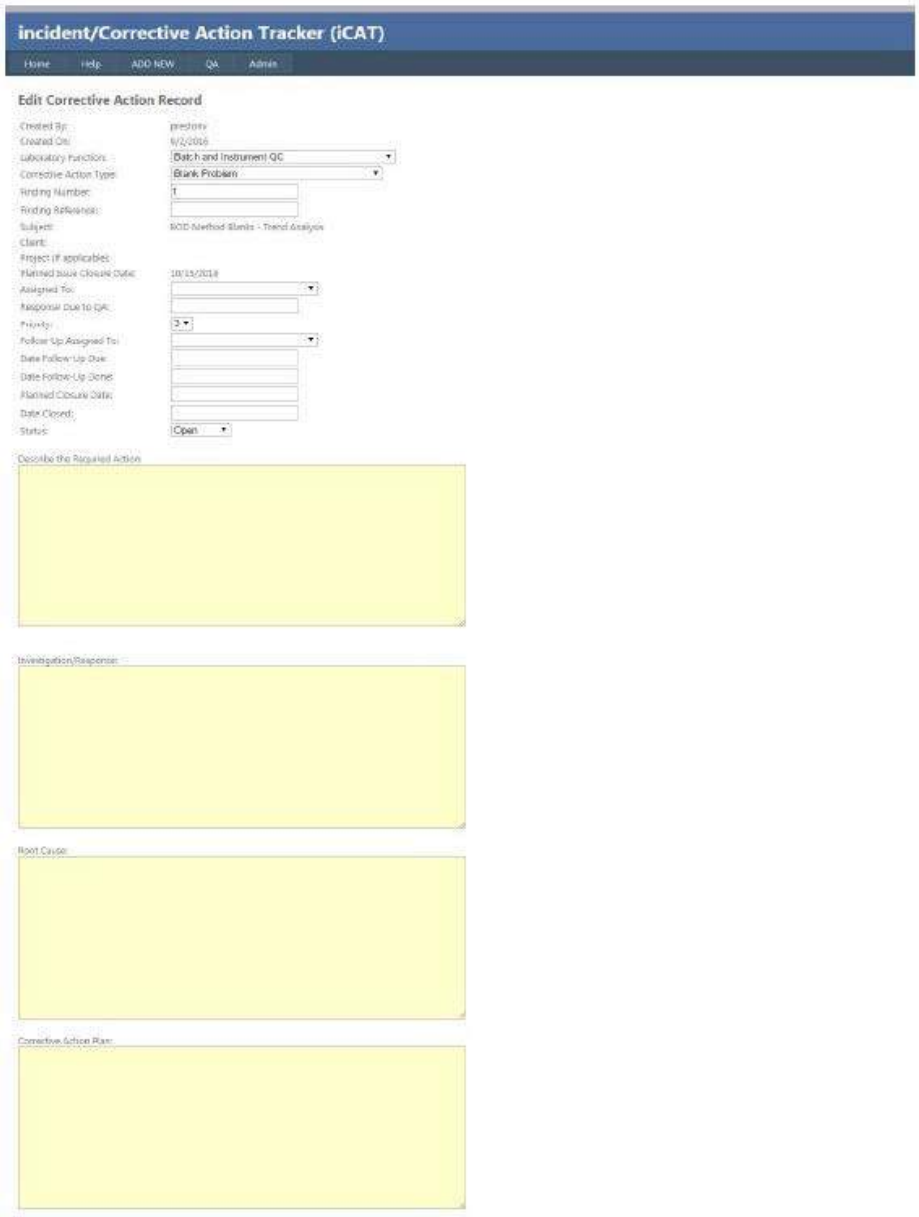


Table 12-1.

Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards *(Analyst, Department Manager)*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Department Manager)*	- % Recovery within control limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Recovery within control limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in LIMs.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. -For matrix spike or duplicate results outside criteria the data for the data for that sample shall be reported with qualifiers.

Uncontrolled Copy

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in LIMs.	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) When the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits of method or within three standard deviations of the historical mean.	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1]	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples *(QA Manager, Department Manager)*	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Internal / External Audits *(QA Manager, Department Manager, Operations Manager, Technical Manager, Laboratory Director)*	- Defined in Quality System documentation such as SOPs, QAM, etc.	- Non-conformances must be investigated through CAR system and necessary corrections must be made.
Reporting / Calculation Errors *(Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Department Manager, QA Manager, Corporate QA, Corporate Management)*	- SOP CW-Q-S-005, Data Recall.	- Corrective action is determined by type of error. Follow the procedures in SOP CW-Q-S-005 or lab SOP BF-QA-005
Client Complaints *(Project Managers, Lab Director, Sales and Marketing, QA Manager)*	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 17 for an example) *(QA Manager, Lab Director, Operations Manager Department Managers)*	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation *(EH&S Coordinator, Lab Director, Operations Manager, Department Manager)*	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through EH&S office.

Note: 1. Except as noted below for certain compounds, the method blank should be below the reporting limit. Concentrations up to five times the reporting limit will be allowed for the

ubiquitous laboratory and reagent contaminants: methylene chloride, acetone, 2-butanone and phthalates provided they appear in similar levels in the reagent blank and samples. This allowance presumes that the reporting limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur. For benzene and ethylene dibromide (EDB) and the other analytes for which regulatory limits are extremely close to the detection limit, the method blank must be below the method detection limit.

.

Uncontrolled Copy

SECTION 13.0

PREVENTIVE ACTION / IMPROVEMENT

13.1 OVERVIEW

The laboratory's preventive action programs improve, or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, the laboratory continually strives to improve customer service and client satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- review of the monthly QA Metrics Report,
- trending NCMs,
- review of control charts and QC results,
- trending proficiency testing (PT) results,
- performance of management system reviews,
- trending client complaints,
- review of processing operations, or
- staff observations.

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. The metrics report is reviewed monthly be the laboratory management, Corporate QA and TestAmerica's Executive Committee. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lesson Learned, Technical Services audit report, Technical Best Practices, or as Corporate or management initiatives.

The laboratory's Corrective Action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

Uncontrolled Copy

13.1.1 The following elements are part of a preventive action system/process improvement system:

- Identification of an opportunity for preventive action or process improvement.
- Process for the preventive action or improvement.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action or improvment.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action or improvement.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/Process Improvement is incorporated into the monthly QA reports, corrective action process and management review

13.1.2 Any Preventive Actions/Process Improvements undertaken or attempted shall be taken into account during the Annual Management Systems Review (Section 17). A highly detailed report is not required; however a summary of success and failure within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 MANAGEMENT OF CHANGE

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of changes covered under this system include: Facility Changes, Major Accreditation Changes, Addition or Deletion to Division's Capabilities or Instrumentation, Key Personnel Changes, Laboratory Information Management System (LIMS) changes.

SECTION 14.0

CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. Exceptions for programs with longer retention requirements are discussed in Section 14.1.2. TestAmerica Buffalo SOP BF-GP-015, Record Storage and Retention, specifies additional storage, archiving and retention procedures.

14.1 OVERVIEW

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. Quality records are maintained by the QA department in a database which is backed up as past of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Hardcopy technical records are maintained by the Laboratory Director and the QA Department while electronic technical records are maintained by the IT Administrator.

Table 14-1. Record Index[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - Policy Memorandums - SOPs - Manuals	5 Years from document retirement date*
QA Records	- Internal & External Audits/Responses - Certifications - Corrective/Preventive Actions - Management Reviews - Method & Software Validation / Verification Data - Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)

	Record Types [1]:	Retention Time:
Project Records	- Sample Receipt & COC Documents - Contracts and Amendments - Correspondence - QAPP -SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Finance and Accounting	10 years
	EH&S Manual, Permits	7 years
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	All HR docs have different retention times: Refer to HR Manual
	Administrative Policies Technical Training Records	7 years

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained according to BF-GP-015 and in such a way that they are secure and readily retrievable at the laboratory facility that provides a suitable environment to prevent damage or deterioration and to prevent loss. Records are maintained for a minimum of five years unless other wise specified by a client or regulatory requirement. All records shall be protected against fire, theft, loss, environmental deterioration and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration. Access to the data is limited to laboratory and company employees and shall be documented with an access log.

If records are archived off-site they are to be stored in a secure location where a record is maintained of any entry into the storage facility.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Uncontrolled Copy

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data. Specific Information related to archival of data for greater than 5 years may be found in TestAmerica Buffalo SOP BF-GP-015.

Table 14-2. Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	5 years (project records) 10 years-Radiochemistry (project records)
Drinking Water Lead and Copper Rule	12 years (project records)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Navy Facilities Engineering Service Center (NFESC)	5 years
NY Potable Water NYCRR Part 55-2	10 years
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

[1]Note: Extended retention requirements are noted with the archive documents or addressed in TestAmerica Buffalo facility-specific records retention procedure BF-GP-015.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. TestAmerica Buffalo SOP BF-GP-015 also contains specific information for archival of scanned data.

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data (any records stored off site should be accessible within 2 business days of a request for such records). The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the chain of custody is stored with the project file and the Job Number in TALS. The chain of custody would indicate the name of the sampler. If any sampling notes are provided with a work order, they are kept with this package.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set). Instrument data is stored sequentially by instrument. Calibration data for a given sequence are maintained in the order of the analysis. Sample data are stored on a job number basis in the project file or as part of the daily batch or sequence. Run logs are maintained for each instrument or method; a copy of each day's run log or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks, bench sheets or excel spreadsheets are used to record and file data. Standard and reagent information is recorded in logbooks or on the raw data for each method as required.

- Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned. The procedure for this verification can be found in TestAmerica SOP BF-GP-015.

- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'**.**

14.2 TECHNICAL AND ANALYTICAL RECORDS

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to

enable the analysis to be repeated under conditions as close as possible to the original. The

records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing of results.

14.2.2 Observations, data and calculations are recorded real-time.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code**;**
- Date of analysis; time of analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a bench sheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in the method specific SOPs, in the instrument method detail records or the instrument maintenance logs where available.
- analysis type**;**
- all manual calculations and manual integrations**;**
- analyst's or operator's initials/signature**;**
- sample preparation including cleanup, separation protocols, incubation periods, ID codes, volumes, weights, instrument printouts, meter readings, temperatures, calculations, reagents**;**
- test results**;**
- standard and reagent origin, receipt, preparation, and use**;**
- calibration criteria, frequency and acceptance criteria**;**
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions**;**
- quality control protocols and assessment**;**
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries.
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats**.**

14.3 LABORATORY SUPPORT ACTIVITIES

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- Procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 ADMINISTRATIVE RECORDS

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 RECORDS MANAGEMENT, STORAGE AND DISPOSAL

14.5.1 All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

14.5.2 All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

14.5.3 Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access**.**

14.5.4 The laboratory has a record management system (also known as document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per instrument or analysis basis, and are numbered sequentially as they are issued. No instrument or analysis has more than one active notebook at a time, so all data are recorded sequentially within a series of sequential notebooks. Bench sheets and raw data sequence files are filed sequentially by date. Standard and reagent information is maintained in LIMS and logbooks which are maintained on a departmental basis and are numbered sequentially as they are issued or as they are archived by QA.

14.5.5 Records are considered archived when noted as such in the records management system (also known as document control). Access to archived hard-copy information is documented with an access log and in/out records is used to note data that is removed and returned.

14.5.6 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.7 Records Disposal

14.5.7.1 Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

14.5.7.2 Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records Management Company is hired to dispose of records, a "Certificate of Destruction" is required**.**

SECTION 15

AUDITS

15.1 INTERNAL AUDITS

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Auditing, SOP No. CW-Q-S-003. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee or Corporate QA	All areas of the laboratory annually
Method Audits QA Technical Data Audits SOP Compliance Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	QA Methods Audits Frequency: All methods are reviewed annually 50% of methods receive a QA Technical Audit 50% of methods receive a SOP Method Compliance Audit
Special	QA Department or Designee	Surveillance or spot checks performed as needed to monitor specific issues
Performance Testing	Coordinated by Corporate QA	Two successful per year for each TNI -NELAP field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The

audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits assess data authenticity and analyst integrity. These audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, Chrom AuditMiner is used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period. All analysts should be reviewed over the course of a two year period through at least one QA Technical Audit

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Manager or qualified designee at least every two years. It is also recommended that the work of each newly hired analyst assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Non-potable Water, Soil, and Air.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 AUDIT FINDINGS

Audit findings are documented using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Department Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. . When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

Uncontrolled Copy

SECTION 16

MANAGEMENT REVIEWS

16.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, Technical Managers, their Quality Director as well as the VP of Operations. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Director prepares a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and VPs of Operations.

16.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team (Laboratory Director, Technical Manager, Operations Manager, and QA Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, objectives and action items that feed into the laboratory planning system. Corporate Operations and Corporate QA personnel may be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that can not be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CW-Q-S-004 & Work Instruction No. CW-Q-WI-003) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective; therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.

Uncontrolled Copy

- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
  - Adequacy of staff, equipment and facility resources.
  - Adequacy of policies and procedures.
  - Future plans for resources and testing capability and capacity.

- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate VP of Operations and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes.

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 POTENTIAL INTEGRITY RELATED MANAGERIAL REVIEWS

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. The TestAmerica Corporate Internal InvestigationsSOP shall be followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's President and CEO, COO, Technical & Operations Support, VP of Client and Technical Services, VPs of Operations and Quality Directors receive a monthly report from the VP QA/EHS summarizing any current data integrity or data recall investigations. The VPs of Operations are also made aware of progress on these issues for their specific labs.

SECTION 17

PERSONNEL

17.1 OVERVIEW

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 EDUCATION AND EXPERIENCE REQUIREMENTS FOR TECHNICAL PERSONNEL

The laboratory makes every effort to hire analytical staff that possesses a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are

located in the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, pipette, quantitation techniques, etc. are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
CVAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC)	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Managers/Department Managers – **General**	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Department Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 TRAINING

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics - Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 20).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- The Human Resource office maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Further details of the laboratory's training program are described in TestAmerica Buffalo SOP BF-QA-004, Laboratory Personnel Training.

17.4 DATA INTEGRITY AND ETHICS TRAINING PROGRAM

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive

training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy No. CW-L-P-004 and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 OVERVIEW

TestAmerica Buffalo is a 32,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for field operations, bottle kit preparation, sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis and administrative functions.

18.2 ENVIRONMENT

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory. Key equipment has been provided with back-up power supply in the event of a power outage.

Uncontrolled Copy

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory.

Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 FLOOR PLAN

A floor plan can be found in Appendix 1.

18.5 BUILDING SECURITY

Building pass cards and alarm codes are distributed to all facility employees.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. [The reason for this is that it is important to know who is in the building in case of a safety emergency. The visitors logbook is used to ensure that everyone got out of the building safely.] In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and

vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

Uncontrolled Copy

SECTION 19.0

TEST METHODS AND METHOD VALIDATION

19.1 OVERVIEW

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 STANDARD OPERATING PROCEDURES (SOPs)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory:

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP CW-Q-S-002, Writing a Standard Operating Procedure (SOP) and Laboratory SOP BF-QA-003, Procedure for Writing, Reviewing and Revising Controlled Quality Documents (QAM, SOP, etc)
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 LABORATORY METHODS MANUAL

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

Uncontrolled Copy

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 SELECTION OF METHODS

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists, etc.), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

19.4.1.1 The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM); Non-polar Material) by Extraction and Gravimetry, EPA-821-R-98-002, February 1999*
- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.*
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule; May 18, 2012*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*

- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *NIOSH Manual of Analytical Methods, 4th ed., August 1994.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th / 21st/ 22nd/on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008; Final Update V, August 2015.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)* ***(DW labs only)***
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*
- *New York State DEC Analytical Services Protocol, 2005*
- *New York State DOH Methods Manual*
- *Massachusetts Contingency Plan 310 CMR 40, April 25, 2014*
- *Connecticut Reasonable Confidence Protocol, July 2006*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

Uncontrolled Copy

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

19.4.2.1 A demonstration of capability (BF-QA-004) is performed whenever there is a significant change in instrument type (e.g., new instrumentation), method or personnel.

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

19.4.2.2 The initial demonstration of capability must be thoroughly documented and approved by the Operations Manager/Designee and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

19.4.2.3 The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct a method detection limit study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).

- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

Procedures for generation of IDOCs are detailed below and in laboratory SOP BF-QA-004, Laboratory Personnel Training.

19.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

19.4.3.3 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (see Figure 19-1) shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

19.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 VALIDATION OF METHODS

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision

guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 METHOD DETECTION LIMITS (MDL)/ LIMITS OF DETECTION (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the Analyst is 99% confident that the true value can be differentiated from blanks. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements (refer to 19.7.10). Generally the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the

analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL. To allow for some flexibility, this low level standard may be analyzed every batch or every week or some other frequency rather than doing the study all at once. In addition, a larger number of data points may be used if the appropriate t-value multiplier is used.

Refer to the Corporate SOP No. CA-Q-S-006 or the laboratory's SOP No. BF-QA-001 for details on the laboratory's MDL process.

19.8 INSTRUMENT DETECTION LIMITS (IDL)

19.8.1 The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

19.8.2 IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation. (For CLP procedures, the IDL is determined using the standard deviation of 7 replicate spike analyses on each of 3 non-consecutive days.)

19.8.3 If IDL is > than the MDL, it may be used as the reported MDL.

19.9 VERIFICATION OF DETECTION AND REPORTING LIMITS

19.9.1 Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, CVAA, etc.) and no more than 4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified or see section 20.7.9 for other options. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually.

19.9.2 When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 the reporting limit and annually thereafter. The annual requirement is waved for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirement.

19.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time

window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory's SOPs.

19.11 EVALUATION OF SELECTIVITY

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, and specific electrode response factors.

19.12 ESTIMATION OF UNCERTAINTY OF MEASUREMENT

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent uncertainties at approximately the 99% confidence level with a coverage factor of k = 3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 ±0.5 mg/L.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g. 524.2, 525, etc) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 SAMPLE REANALYSIS GUIDELINES

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as "reanalysis") may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.

- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Department Supervisor or Laboratory Director/Manager if unsure.

19.14 CONTROL OF DATA

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. The laboratory is currently running the 'TALS Data System' which is a LIMs system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes a SQL server which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

Uncontrolled Copy

19.14.1.1 Maintain the Database Integrity

Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, and data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.14.1.2 Ensure Information Availability

Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 Maintain Confidentiality

Ensure data confidentiality through physical access controls such as password protection or website access approval, when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The data review sheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP CA-Q-S-002, *Acceptable Manual Integration Practices*.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data must be retained in the project job folder, computer file, and/or run log. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1%. Units are defined in each lab SOP.

19.14.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, final inorganic results are reported to 2 significant figures for values less than 10 and 3 significant figures for values greater than 10 on the final report. Organic results are generally reported to 1 significant figure for values less than 10 and 2 significant figures for values greater than 10 on the final report. The number of significant figures may be adjusted based on client or project requirements.

19.14.2.4 For those methods that do not have an instrument printout, an instrumental output or a calculation spreadsheet upload compatible with the LIMS System, the final results and dilution factors are entered directly into LIMS by the analyst, and the software formats the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is automatically transferred to the network server and, eventually, to a back-up tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the Technical Manager/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Review procedures are out lined in several laboratory SOPs (e.g. BF-SR-002, "Receipt of Analytical Samples", BF-GP-012, "Technical Data Review", and BF-PM-001, "Project Information Requirements") to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The laboratory also has an SOP discussing Manual Integrations to ensure the authenticity of the data (BF-GP-013, Manual Integration). The general review concepts are discussed below, more specific information can be found in the SOPs.

19.14.4.1 Log-In Review - The data review process starts at the sample receipt stage. Sample control personnel review chain-of-custody forms and project instructions from the project management group. This is the basis of the sample information and analytical instructions entered into the LIMS. The log-in instructions are reviewed by the personnel entering the information, and a second level review is conducted by the project management staff.

19.14.4.2 First Level Data Review –The next level of data review occurs with the analysts. As data are generated, analysts review their work to ensure that the results meet project and SOP requirements. First level reviews include inspection of all raw data (e.g., instrument output for continuous analyzers, chromatograms, spectra, and manual integrations), evaluation of calibration/calibration verification data in the day's analytical run, evaluation of QC data, and reliability of sample results. The analyst transfers data into LIMS, data qualifiers are added as needed. All first level reviews are documented.

19.14.4.3 Second Level Data Review – All analytical data are subject to review by a second qualified analyst or supervisor. Second level reviews include inspection of all raw data (e.g., instrument output, chromatograms, and spectra) including 100% of data associated with any changes made by the primary analyst, such as manual integrations or reassignment of peaks to different analytes, or elimination of false negative analytes. The second review also includes evaluation of initial calibration/calibration verification data in the day's analytical run, evaluation of QC data, reliability of sample results, qualifiers and NCM narratives. Manual calculations are checked in second level review. All second level reviews are documented.

Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

19.14.4.4 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Director/Manager, Technical Manager, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.14.4.5 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.

19.14.4.6 As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met. The Project Manager may also evaluate the validity of results for different test methods given expected chemical relationships.

19.14.4.7 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report and creates the invoice. When complete, the report is issued to the client.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using SOP CA-Q-S-002 as the guidelines.

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale “after” chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale “before” chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1.
Example - Demonstration of Capability Documentation

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

BF-QA-DOC-004
DOC Cert. Statement
Rev. 3 9/28/2016

TESTAMERICA LABORATORIES, INC.

DEMONSTRATION OF CAPABILITY CERTIFICATION STATEMENT

Employee Name (print): _____

Method Number: _____ Matrix (circle): water / soil / air

Parameters or Analytes: _____

Date Submitted: _____

Initial Demonstration of Capability:

SOP Number: _____ Revision # _____ Date Read_____

Trained By (print name): _____

Date training began: _____

Date training completed: _____

Continued Demonstration of Capability:

SOP Number: _____ Revision # _____ Date Read_____

Demonstration of Capability Reviewed and Analyst Authorized to Perform Method:

_____ _____ _____
Department Manager/Designee Signature Date

_____ _____ _____
QA Manager/Designee Signature Date

SECTION 20

EQUIPMENT (AND CALIBRATIONS)

20.1 OVERVIEW

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory equipment and instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 PREVENTIVE MAINTENANCE

20.2.1 The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

20.2.2 Routine preventive maintenance procedures and frequency, such as lubrication, cleaning, and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

20.2.3 Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Department Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

20.2.4 Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

20.2.4.1 Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.

Uncontrolled Copy

20.2.4.2 Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrumentation records.

20.2.4.3 When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

20.2.5 If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out of service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses

20.2.6 In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

20.3 SUPPORT EQUIPMENT

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance. Laboratory SOPs BF-GP-001,"Calibration of Autopipettes and Repipetters" and BF-GP-002, "Support Equipment: Maintenance, Record Keeping and Corrective Actions of Analytical Balances, Temperature Control Devises and Reagent Water" provide additional detail on the monitoring and record keeping for support equipment.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains "calibration only" ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All reusable thermometers are calibrated on an annual basis with a NIST-traceable thermometer.

- If the temperature measuring device is used over a range of 10°C or less, then a single point verification within the range of use is acceptable;
- If the temperature measuring device is used over a range of greater than 10°C, then the verification must bracket the range of use.

Disposable thermometers are discarded upon expiration and replaced with newly purchased thermometers. IR thermometers should be calibrated over the full range of use, including ambient, iced (4 degrees) and frozen (0 to -5 degrees), per the Drinking Water Manual. The IR thermometers are verified daily and calibrated quarterly. Digital probes and thermocouples are calibrated quarterly.

The NIST Mercury thermometer is recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST digital

thermometer is recalibrated every one year (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories) and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks. More information on this subject can be found in the laboratory SOP BF-GP-020, "Thermometer Calibration".

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and ≤ 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and method-specific logbooks.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically at a minimum on a quarterly basis.

For those dispensers that are not used for analytical measurements, a label is applied to the device stating that it is not calibrated. Any device not regularly verified can not be used for any quantitative measurements.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

20.3.6 Field Sampling Devices (Isco Auto Samplers)

Each Auto Sampler (ISCO) is assigned a unique identification number in order to keep track of the calibration. This number is also recorded on the sampling documentation.

The Auto Sampler is calibrated monthly (or if not utilized monthly, immediately prior to its usage) by setting the sample volume to 100ml and recording the volume received. The results are filed in a logbook/binder. The Auto Sampler is programmed to run three (3) cycles and each of the three cycles is measured into a graduated cylinder to verify 100ml are received.

If the RSD (Relative Standard Deviation) between the 3 cycles is greater than 10%, the procedure is repeated and if the result is still greater than 10%, then the Auto Sampler is taken out of service until it is repaired and calibration verification criteria can be met. The results of this check are kept in a logbook/binder.

Additional calibration and use information is detailed in laboratory SOP BF-FS-006, “Calibration of Field Meter”.

20.4 INSTRUMENT CALIBRATIONS

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points will be used.

20.4.1.1 Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

20.4.1.2 The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

20.4.1.3 The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exceptions to these rules is ICP and ICPMS methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of daily calibration standards.

20.4.1.4 All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.2 Calibration Verification

The calibration relationship established during the initial calibration must be verified at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and 2009 TNI Std. EL-V1M4, section 1.7.1. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met i.e., RPD, per NELAC (2003) Standard, Section 5.5.5.10 and 2009 TNI Std. EL-V1M4 Sec. 1.7.2.

Uncontrolled Copy

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used then bracketing calibration verification standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable under the following special conditions:

a).when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b).when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.2.1 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs.) Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 TENTATIVELY IDENTIFIED COMPOUNDS (TICS) – GC/MS ANALYSIS

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

Uncontrolled Copy

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification. See laboratory SOP's BF-MB-005 and BF-MV-007 for guidelines for making tentative identifications

Note:
For general reporting if TICs are requested, the ten (10), largest non-target analyte peaks whose area count exceeds 10% of the nearest internal standard will be termed "Tentatively Identified Compounds" (TICs). More or fewer TICs may be identified based on client requirements.

20.6 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Uncontrolled Copy

Table 20-1. Laboratory Equipment and Instrumentation – TestAmerica Buffalo

TestAmerica Buffalo
Equipment/Instrument List

Page 1

Equipment/Instrument	Manufacturer	Model Number	S/N from instrument	Year Put into Service	Condition When Received
GC/MS Instrumentation	Agilent	5975	US83110163	2013	good
GC/MS Instrumentation	Agilent	5973	US05605976	2001	good
GC/MS Instrumentation	Agilent	5973	US44621446	2005	good
GC/MS Instrumentation	Agilent	5973	US52420646	2005	good
GC/MS Instrumentation	Agilent	5973	US05060084	2001	good
GC/MS Instrumentation	Agilent	5973	US03950346	2001	good
GC/MS Instrumentation	Agilent	5973	US82321636	2001	good
GC/MS Instrumentation	Agilent	5973	US21854062	2003	good
GC/MS Instrumentation	Agilent	5973	US41720721	2009	good
GC/MS Instrumentation	Agilent	5973	US30965692	2003	good
GC/MS Instrumentation	Agilent	5973	US30965634	2003	good
GC/MS Instrumentation	Agilent	5973	US35120354	2004	good
GC/MS Instrumentation	Agilent	5973	US41720707	2004	good
GC/MS Instrumentation	Agilent	5975	US80838844	2001	good
GC/MS Instrumentation	Agilent	5975	US83130241	2013	good
GC/MS Instrumentation	Agilent	5973	US02450141	2012	good
GC Instrumentation	Agilent	6890 dual uECD	CN10520009	2005	good
GC Instrumentation	Agilent	6890 dual uECD	CN10520010	2005	good
GC Instrumentation	Agilent	6890 dual uECD	CN10448015	2005	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3310A47661	1993	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53325	1993	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53464	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53463	1994	good
GC Instrumentation	Hewlett Packard	5890II dual FID	3336A53727	1994	good
GC Instrumentation	Hewlett Packard	5890II dual FID	3019A28433	1991	good
GC Instrumentation	Hewlett Packard	5890II FID/FID	3336A53729	1994	good
GC Instrumentation	Hewlett Packard	5890II Hall/PID	3121A35782	1990	good
GC Instrumentation	Hewlett Packard	5890II PID/FID	3336A60622	1994	good
GC Instrumentation	Hewlett Packard	5890II PID/FID	3133A37157	1993	good
GC Instrumentation	Hewlett Packard	5890II PID/FID	3336a53465	1994	good
GC Instrumentation	Agilent	6890N dual uECD	CN10839003	2005	good
GC Instrumentation	Agilent	7890N dual FID	CN10833020	2005	good
GC Instrumentation	Perkin Elmer	Clarus 600 dual FID	665S10020401	2012	good
GC Instrumentation	Perkin Elmer	Clarus 600 dual FID	680s10101807	2013	good
GC Instrumentation	Perkin Elmer	Clarus 608 dual uECD	680S10042901	2012	good
Ion Chromatography Instrumentation	Dionex	Ion Chromatograph #DX-120	99110569	1999	good
Ion Chromatography Instrumentation	Dionex	Ion Chromatograph #DX-120	02060196	2002	good
Ion Chromatography Instrumentation	Dionex	Ion Chromatograph #DX-120	20126	2004	good
Ion Chromatography Instrumentation	Dionex	Ion Chromatograph #DX-120	98050413	1999	good
Metals Instrumentation	Environmental Express	AutoBlock Plus	AB4001-1213-042	2013	Good

Revision 09-2016

TestAmerica Buffalo
Equipment/Instrument List

Equipment/Instrument	Manufacturer	Model Number	S/N from instrument	Year Put into Service	Condition When Received
Metals Instrumentation	Leeman	PS200 II	HG0033	2000	good
Metals Instrumentation	Leeman	PS200 II	4026	2000	good
Metals Instrumentation	Perkin Elmer	Elan 9000 ICP-MS	P0230202	2002	good
Metals Instrumentation	Thermo	ICAP 6000 Duo	ICP-20094603	2010	good
Metals Instrumentation	Thermo	ICAP 6000 Duo	ICP-20094602	2010	good
Sample Preparation Equipment	CEM	Microwave MARS	MD3978	2013	good
Sample Preparation Equipment	Gilson	Fractionator Model GX-274	40579	2013	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G1647/C5659	1994	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2665/C5674	1994	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2620/C5660	1994	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2245/C6328	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2621/C6733	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2713/C6732	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G1643/C6837	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2742/C6842	1995	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16902	1999	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16907	1999	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16913	1999	good
Sample Preparation Equipment	TurboVap	II	TV0529N12427	2006	good
Sample Preparation Equipment	TurboVap	II	TV0529N12428	2006	good
Sample Preparation Equipment	TurboVap	II	TV9445N5816	1996	good
Sample Preparation Equipment	TurboVap	II	TV9427N4133	1996	good
Sample Preparation Equipment	TurboVap	II	TV944N5819	1996	good
Sample Preparation Equipment	TurboVap	II	TV944N5820	1996	good
Sample Preparation Equipment	TurboVap	II	TV0024N9623	2000	good

Uncontrolled Copy

TestAmerica Buffalo
Equipment/Instrument List

Equipment/Instrument	Manufacturer	Model Number	S/N from instrument	Year Put into Service	Condition When Received
Sample Preparation Equipment	TurboVap	II	TV0022N9604	2000	good
Sample Preparation Equipment	TurboVap	II	TV0312N11592	2003	good
Sample Preparation Equipment	TurboVap	II	TV0312N11591	2003	good
Water Quality Instrumentation	Flash Point Analyzer	HFP 339	73390092	2007	good
Water Quality Instrumentation	Flash Point Analyzer	Optiflash 104002	Herzog PAC 000334	2015	good
Water Quality Instrumentation	Glastron	CN Midi-distillation	2502	2003	good
Water Quality Instrumentation	Glastron	Phenol Midi-distillation	2069	2003	good
Water Quality Instrumentation	Glastron	Phenol Midi-distillation	2053	2003	good
Water Quality Instrumentation	Horizon	Speed Vap	03-0415	2005	good
Water Quality Instrumentation	Konelab	20	S5019455	2004	good
Water Quality Instrumentation	Konelab	20XT	E3719731	2005	good
Water Quality Instrumentation	Konelab	Aqua20	SEA032	2009	good
Water Quality Instrumentation	Lachat	Quickchem 8000 Autoanalyzer	A83000-1527	2000	good
Water Quality Instrumentation	Lachat	Quickchem 8500 Autoanalyzer	40300001665	2014	good
Water Quality Instrumentation	Lachat	Quickchem 8500 Autoanalyzer	1106 0000 1336	2013	good
Water Quality Instrumentation	Mantech	BOD Analyzer	MT-0B4-215	2015	good
Water Quality Instrumentation	Mantech	BOD Autoanalyzer	MS-1LO-157	2014	good
Water Quality Instrumentation	ManTech	PC Titrator	MS-OK2-607	2003	good
water Quality Instrumentation	Mantech	PC Titrator	MT-1H5-971	2016	good
Water Quality Instrumentation	OI	Carbon Analyzer Model 1030	A547730578	2005	good
Water Quality Instrumentation	OI	Carbon Analyzer Model 1030	E616730030	2006	good

Uncontrolled Copy

TestAmerica Buffalo
Equipment/Instrument List

Page 4

Equipment/Instrument	Manufacturer	Model Number	S/N from instrument	Year Put into Service	Condition When Received
Water Quality Instrumentation	OI	Carbon Analyzer Model 1030	P410730479	2014	good
Water Quality Instrumentation	Thermo Scientific	Spectrophotometer 4001/4	3SGT048005	2015	good
Water Quality Instrumentation	Thermo Scientific	Spectrophotometer 4001/4	3SGP283013	2016	good

Revision 09-2016

Note: The Equipment List is current at the date of publication of this manual. An updated list may be obtained by contacting the TestAmerica Buffalo Quality Department.

Table 20-2.

Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Leeman Mercury Analyzer	Check tubing for wear Fill rinse tank with 10% HCl Change dryer tube Fill reductant bottle with 10% Stannous Chloride	Daily Daily As Needed Daily
ICP & ICP/MS	Check pump tubing Check liquid argon supply Check fluid level in waste container Check re-circulator levels Clean or replace filters Check torch Check sample spray chamber for debris Clean and align nebulizer Change pump oil Change Cones Change printer cartridge Replace pump tubing	Daily Daily Daily Monthly As required Daily Monthly Monthly Monthly As required As required As required
UV-Vis Spectrophotometer	Clean ambient flow cell Precision check/alignment of flow cell Wavelength verification check	As required As required Annually
Auto Analyzers	Clean sampler Check all tubing Clean inside of colorimeter Clean pump well and pump rollers Clean wash fluid receptacle Oil rollers/chains/side rails Clean optics and cells	Daily Daily Daily Quarterly Weekly Weekly Quarterly

Uncontrolled Copy

Instrument	Procedure	Frequency
Agilent GC/MS	Pump oil-level check Pump oil changing Analyzer bake-out Analyzer cleaning Resolution adjustment COMPUTER SYSTEM AND PRINTER: Air filter cleaning Change data system air filter Printer head carriage lubrication Paper sprocket cleaning Drive belt lubrication	Monthly Annually As required As required As required As required As required As required As required As required
Gas Chromatograph	Compare standard response to previous day or since last initial calibration Check carrier gas flow rate in column Check temp. of detector, inlet, column oven Septum replacement Glass wool replacement Check system for gas leaks with SNOOP Check for loose/frayed power wires and insulation Bake injector/column Change/remove sections of guard column Replace connectors/liners Change/replace column(s)	Daily Daily via use of known compound retention Daily As required As required W/cylinder change as required As Required As Required As Required As Required As Required
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Photoionization Detector (PID)	Change O-rings Clean lamp window	As required As required
HPLC	Change guard columns Change lamps Change pump seals Replace tubing Change fuses in power supply Filter all samples and solvents Change autosampler rotor/stator	As required As required Semi-annually or as required As required As required Daily As required

Instrument	Procedure	Frequency
Vacuum Pumps/ Air Compressor	Drained Belts checked Lubricated	Weekly Monthly Semi-annually
Centrifuge	Check brushes and bearings	Every 6 months or as needed

Uncontrolled Copy

Table 20-3.

Periodic Calibration

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using "S" NIST traceable weights. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person annually.	Daily, when used Annual	± 0.2%	Clean, check level, insure lack of drafts, and that unit is warmed up, recheck. If fails, call service.
Top Loading Balance	Accuracy determined using "S" NIST traceable. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person annually.	Daily, when used Annual	± 0.5%	Clean. Replace.
NIST Certified Weights	Accuracy determined by accredited weights and measurement laboratory.	1 year	As per certificate.	Replace.
NIST-Traceable Thermometer-Mercury	Accuracy determined by accredited measurement laboratory.	3 years	As per certificate.	Replace.
NIST-Traceable Thermometer-Digital	Accuracy determined by accredited measurement laboratory.	1 year	As per certificate	Replace.
Thermometer	Against NIST-traceable thermometer	Yearly at appropriate temperature range for intended use	± 2.0°C	Replace
Minimum-Maximum Thermometers	Against NIST-traceable thermometer	Yearly	± 2.0°C	Replace

Uncontrolled Copy

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
InfraRed Temperature Guns	Against NIST-traceable thermometer Accuracy determined by accredited measurement laboratory.	Daily at appropriate temperature range for intended use. Annual	± 2.0°C	Repair/replace
Dial-type Thermometers	Against NIST-traceable thermometer	Quarterly at appropriate temperature range for intended use.	± 2.0°C	Replace
Refrigerator	Temperature checked using NIST-traceable thermometer.	Daily. If out of range, check again in two hours.	0-6°C	Adjust. Repair. While waiting for repair, seal door, attach "Out of Service" sign, move items to functional unit. Notify supervisor.
Freezer	Temperature checked using NIST-traceable thermometer	Daily. If out of range, check again in two hours.	(-10)-(-20)°C	Adjust. Repair. While waiting for repair, seal door, attach "Out of Service" sign, move items to functional unit. Notify supervisor.
Oven	Temperature checked using NIST-traceable thermometer.	When in use.	104 ± 1°C (drying) 180 ± 2°C (TDS)	Adjust. Replace.
Water Bath	Temperature checked using NIST-traceable thermometer.	When in use.	± 2°C	Adjust. Replace.
Volumetric Dispensing Devices (Eppendorf ® pipette, automatic dilutor or dispensing devices)	One delivery by weight. Using DI water or solvent of use, dispense into tared vessel. Record weight with device ID number. Calibrate using 4 replicate gravimetric measurements	Each day of use Quarterly	± 2% Calculate accuracy by dividing weight by stated volume times 100 for percent.	Adjust. Replace.

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Glass Microliter Syringes	None	Accuracy must be initially demonstrated if syringe was not received with a certificate attesting to established accuracy.	± 1%	Not applicable.
Deionized Water	Check in-line conductivity meter on system with conductivity meter in Inorganics Department.	Daily	<1.0 µmho at 25°C	Record on log. Report discrepancies to QA Manager, Operations Manager or Technical Manager.

Uncontrolled Copy

SECTION 21

MEASUREMENT TRACEABILITY

21.1 OVERVIEW

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. For certain programs Microsyringes are verified semi-annually or disposed of after 6 months of use. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g. bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-TRACEABLE WEIGHTS AND THERMOMETERS

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory accreditation Cooperation) or APLAC (Asia – Pacific Laboratory Accreditation Cooperation)..A certificate and scope of accreditation is kept on file at the laboratory.

The calibration report or certificate submitted to ***TestAmerica Buffalo*** contains, in a well designed format, a traceability statement, the conditions under which the calibrations were made in the context of any potential influence, a compliance statement with an identified metrological specification and the pertinent clauses, a clearly identified record of the quantities and functional test results before and after re-calibration, and no recommendation on the calibration interval. Opinions and interpretations of results are presented along with the basis upon which they were made and identified as such. The report may be submitted by facsimile or other electronic means as long as the requirements of the International Standard are achieved. If significant amendments are made to a calibration certificate, a supplemental certificate for the serial-number-specified piece of equipment is so identified. When a new certificate is offered, it uniquely identifies and references the one it replaces. All calibration reports are filed in the QA Office.

Uncontrolled Copy

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

21.3 REFERENCE STANDARDS / MATERIALS

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared standard materials are purchased from vendors accredited by ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method
- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. Method specific information may also be found in the laboratory method SOPs in the "Standards and Reagents" sections. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Uncontrolled Copy

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 DOCUMENTATION AND LABELING OF STANDARDS, REAGENTS, AND REFERENCE MATERIALS

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. Refer to SOP No. CA-Q-S-001, Solvent and Acid Lot Testing and Approval.

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained by each department in bound or electronic folders. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer laboratory SOP BF-GP-019, “Standard Traceability and Preparation” and also to the method specific SOPs.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material. Blended gas standard cylinders use a nominal concentration if the certified value is within +/-15%, otherwise the certified values is used for the canister concentration.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory department’s chemical history log and are assigned a unique identification number. Preparation of working standards or reagents prepared from the stock is documented in the laboratory Department’s Standard Preparation Log. The following information is typically recorded:

- Standard ID
- Description of Standard
- Department
- Preparer’s name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date

- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment section

Records are maintained for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date
- Standard ID from LIMS.
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained in the LIMS system.

21.4.3 In addition, the following information may be helpful:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items
- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and preparation/analytical batch records.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOPs.

Uncontrolled Copy

SECTION 22.0

SAMPLING

22.1 OVERVIEW

The laboratory provides sampling services. Sampling procedures are described in the following SOPs:

BF-FS-001	Chain of Custody Documentation
BF-FS-003	Groundwater Sampling Field Data Collection
BF-FS-004	Equipment Decontamination
BF-FS-005	Groundwater/Surface Water Sampling
BF-FS-006	Calibration of Field Meter
BF-FS-007	Low Flow Sampling Procedures
BF-FS-008	Surface and Subsurface Soil/Sediment Sampling

22.2 SAMPLING CONTAINERS

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Certificates of cleanliness for bottles and preservatives are provided by the supplier and are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory online.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 DEFINITION OF HOLDING TIME

The date and time of sampling documented on the chain-of-custody (COC) form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in

"days" (e.g. 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in "hours" (e.g. 6 hours, 24 hours, etc.) are measured from date and time zero. Holding times for analysis include any necessary reanalysis. However there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is. These programs will be addressed on a case-by-case basis.

22.4 SAMPLING CONTAINERS, PRESERVATION REQUIREMENTS, HOLDING TIMES

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times, this info is in the SOP or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 SAMPLE ALIQUOTS / SUBSAMPLING

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

The following information provides general guidance for homogenization and subsampling. For laboratory specific procedures refer to SOP BF-GP-005, "Sample Homogenization and Subsampling".

Uncontrolled Copy

SECTION 23

HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 CHAIN OF CUSTODY (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The shipping documents are retained with the project files.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC or in the project notes, sample management will initiate Strict Chain of Custody procedures as defined in SOP BF-GP-018, "Strict Internal Chain-of-Custody".

23.2 SAMPLE RECEIPT

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

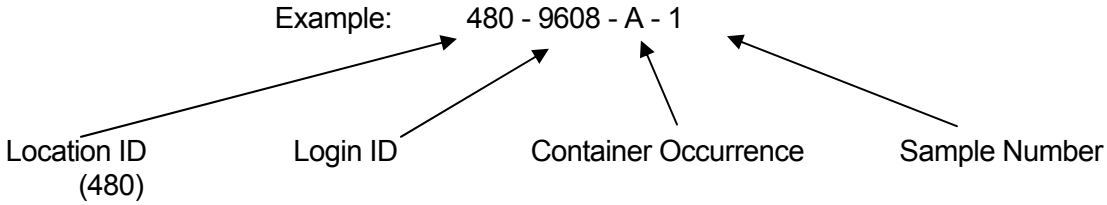
23.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on the Sample Login Form – and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica Buffalo Laboratory (Location 480). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: XXX - 9608 - A - 1 - **A** ← **Secondary Container Occurrence**

Example: 220-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);

- sample holding times must be adhered to (Sampling Guide);
- every sample cooler is given a radiation screen with a standardized Radiation Monitor (Monitor 4 model). This screen has no analytical repercussions; it is just a gross screen for employee safety purposes. Contact TestAmerica Buffalo's Technical Manager, Environmental Health and Safety Coordinator or Sample Control Manager immediately if screening indicates radioactivity in excess of 0.02 mR/hr.;
- The project manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks described in Section 23.1.1.1 that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or

- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMS according SOP No. BF-SR-002.

23.4 SAMPLE STORAGE

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. Aqueous samples designated for metals analysis are stored at ambient temperature. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed at a minimum of every two weeks.

Analysts and technicians provide a request form to the cooler custodian who then retrieves the requested samples. In the absence of the cooler custodian, the analysts may personally retrieve the sample containers allocated to their analysis from the designated refrigerator. The samples are placed on carts, transported the analytical area and analyzed. Following analysis

the remaining sample is returned to the refrigerator from which it originally came. All unused portions of samples are returned to the secure sample control area. All samples are kept in the refrigerators for two to four weeks after analysis, which meets or exceeds most sample holding times. After two to four weeks the samples are moved to dry room temperature, sample archive area where they are retained a minimum of 2 weeks after the final report has been issued to the client at which time disposal occurs. Special arrangements may be made to store samples for longer periods of time. Extended archival periods allow additional metal analyses to be performed on the archived sample and assists clients in dealing with legal matters or regulatory issues.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 HAZARDOUS SAMPLES AND FOREIGN SOILS

To minimize exposure to personnel and to avoid potential accidents, samples which are known or suspected to be hazardous are segregated and a notification is issued to all laboratory personnel.
All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm. All soil samples, including foreign soil samples are heat treated or incinerated in accordance with USDA permit requirements and are transported / disposed by USEPA approved facilities.

Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

23.6 SAMPLE SHIPPING

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). For sample shipments which include water/solid volatile organic analyses (see Note), a trip blank is enclosed when required by method specifications or state or regulatory programs. The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will analyze the trip blanks that were supplied.

23.7 SAMPLE DISPOSAL

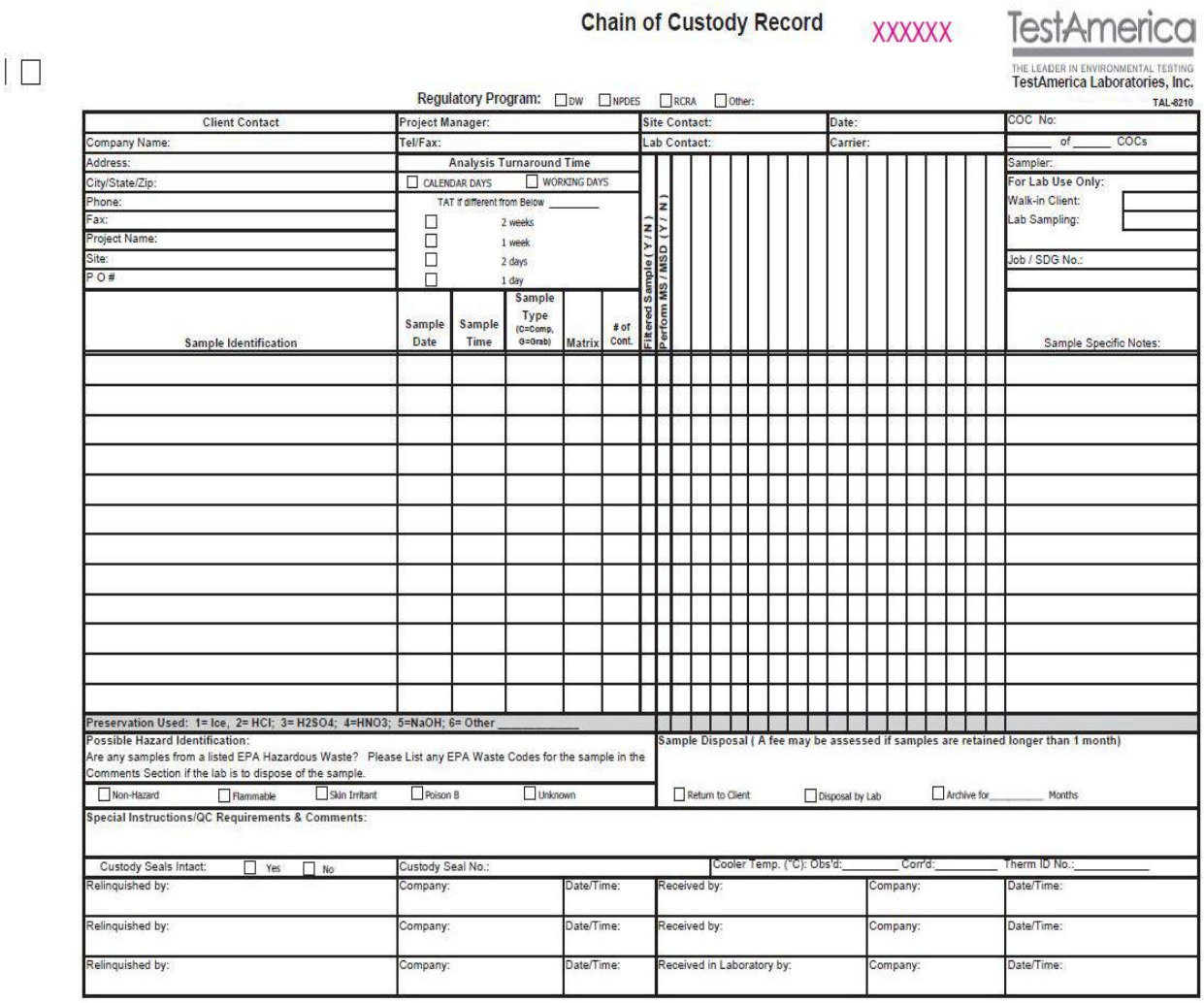
Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP: BF-WM-001, "Waste Management".) All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than six weeks from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample may request to participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal and nature of disposal (such as sample depletion, hazardous waste facility disposal, and return to client). All disposal of sample containers is accomplished through incineration. A Waste Disposal Record should be completed.

Uncontrolled Copy

Figure 23-1.

Example: Chain of Custody (COC)



Chain of Custody Record XXXXXX

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	Project Manager:	Site Contact:	Date:	COC No:
Company Name:	Tel/Fax:	Lab Contact:	Carrier:	____ of ____ COCs
Address:	Analysis Turnaround Time			Sampler:
City/State/Zip:	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone:	TAT if different from Below ____			Walk-in Client:
Fax:	☐ 2 weeks			Lab Sampling:
Project Name:	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P.O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for_____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd:_____ Corr'd:_____ Therm ID No.:_____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Figure 23-2.

Example: Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

1) Samples must arrive with labels intact with a Chain of Custody filled out completely. The following information must be recorded.
   - *Client name, address, phone number and fax number (if available)*
   - *Project name and/or number*
   - *The sample identification*
   - *Date, time and location of sampling*
   - *The collectors name*
   - *The matrix description*
   - *The container description*
   - *The total number of each type of container*
   - *Preservatives used*
   - *Analysis requested*
   - *Requested turnaround time (TAT)*
   - *Any special instructions*
   - *Purchase Order number or billing information (e.g. quote number) if available*
   - *The date and time that each person received or relinquished the sample(s), including their signed name.*
   - ***The date and time of receipt must be recorded between the last person to relinquish the samples and the person who receives the samples in the lab, and they must be exactly the same.***
   - **Information must be legible**

2) Every sample cooler is given a radiation screen with a standardized Radiation Monitor (Monitor 4 model). This screen has no analytical repercussions; it is just a gross screen for employee safety purposes. Contact TestAmerica Buffalo's Technical Manager, Environmental Health and Safety Coordinator or Sample Control Manager immediately if screening indicates radioactivity in excess of 0.02 mR/hr.

3) Per State and/or Federal Regulation, the client is responsible to ensure that samples are shipped in accordance with DOT/IATA requirements, and that radioactive materials may only be delivered to licensed facilities. Any samples containing (or suspected to contain) Source, Byproduct, or Special Nuclear Material as defined by 10 CFR should be delivered directly to facilities licensed to handle such radioactive material. Natural material or ores containing naturally occurring radionuclides may be delivered to any TestAmerica facility or

courier as long as the activity concentration of the material does not exceed 270 pCi/g alpha or 2700 pCi/g beta (49 CFR Part 173).

4) Samples must be properly labeled.
   - Use durable labels (labels provided by TestAmerica are preferred)
   - Include a unique identification number
   - Include sampling date and time & sampler ID
   - Include preservative used.
   - Use indelible ink
   - **Information must be legible**

5) Proper sample containers with adequate volume for the analysis and necessary QC are required for each analysis requested.

6) Samples must be preserved according to the requirements of the requested analytical method. See lab Sampling Guide.
   Note: Samples that are hand delivered to the laboratory immediately after collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

   - Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate improper preservation.

   - For Volatile Organic analyses in drinking water (Method 524.2). Residual chlorine must be neutralized prior to preservation. If there is prior knowledge that the samples are not chlorinated, state it on the COC and use the VOA vials pre-preserved with HCl. The following are other options for a sampler and laboratory where the presence of chlorine is not known:
     - 1. Test for residual chlorine in the field prior to sampling.
       - If no chlorine is present, the samples are to be preserved using HCl as usual.
       - If chlorine is present, add either ascorbic acid or sodium thiosulfate prior to adding HCl.
     - 2. Use VOA vials pre-preserved with sodium thiosulfate or ascorbic acid and add HCl after filling the VOA vial with the sample.
   - **FOR WATER SAMPLES TESTED FOR CYANIDE – for NPDES samples by Standard Methods or EPA 335**
     - In the Field: Samples are to be tested for Sulfide using lead acetate paper prior to the addition of Sodium Hydroxide (NaOH). If sulfide is present, the sample must be treated with Cadmium Chloride and filtered prior to the addition of NaOH.

       - If the sulfide test and treatment is not performed in the field, the lab will test the samples for sulfide using lead acetate paper at the time of receipt and if sulfide is present in the sample, the client will be notified and given the option of retaking the sample and treating in the field per the method requirements

or the laboratory can analyze the samples as delivered and qualify the results in the final report.

- It is the responsibility of the client to notify the laboratory if thiosulfate, sulfite, or thiocyanate are known or suspected to be present in the sample. This notification may be on the chain of custody. The samples may need to be subcontracted to a laboratory that performs a UV digestion. If the lab does not perform the UV digestion on samples that contain these compounds, the results must be qualified in the final report.

- The laboratory must test the sample for oxidizing agents (e.g. Chlorine) prior to analysis and treat according to the methods prior to distillation. (ascorbic acid or sodium arsenite are the preferred choice).

7) Sample Holding Times

- TestAmerica will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (2 working days) remaining on the holding time to ensure analysis.

- Analyses that are designated as “field” analyses (Odor, pH, Dissolved Oxygen, Disinfectant Residual; a.k.a. Residual Chlorine, and Redox Potential) should be analyzed ASAP by the field sampler prior to delivering to the lab (within 15 minutes). However, if the analyses are to be performed in the laboratory, TestAmerica will make every effort to analyze the samples within 24 hours from receipt of the samples in the testing laboratory. Samples for “field” analyses received after 4:00 pm on Friday or on the weekend will be analyzed no later than the next business day after receipt (Monday unless a holiday). Samples will remain refrigerated and sealed until the time of analysis.

8) All samples submitted for Volatile Organic analyses must have a Trip Blank submitted at the same time. TestAmerica will supply this blank with the bottle order.

9) The project manager will be notified if any sample is received in damaged condition. TestAmerica will request that a sample be resubmitted for analysis.

10) Recommendations for packing samples for shipment.

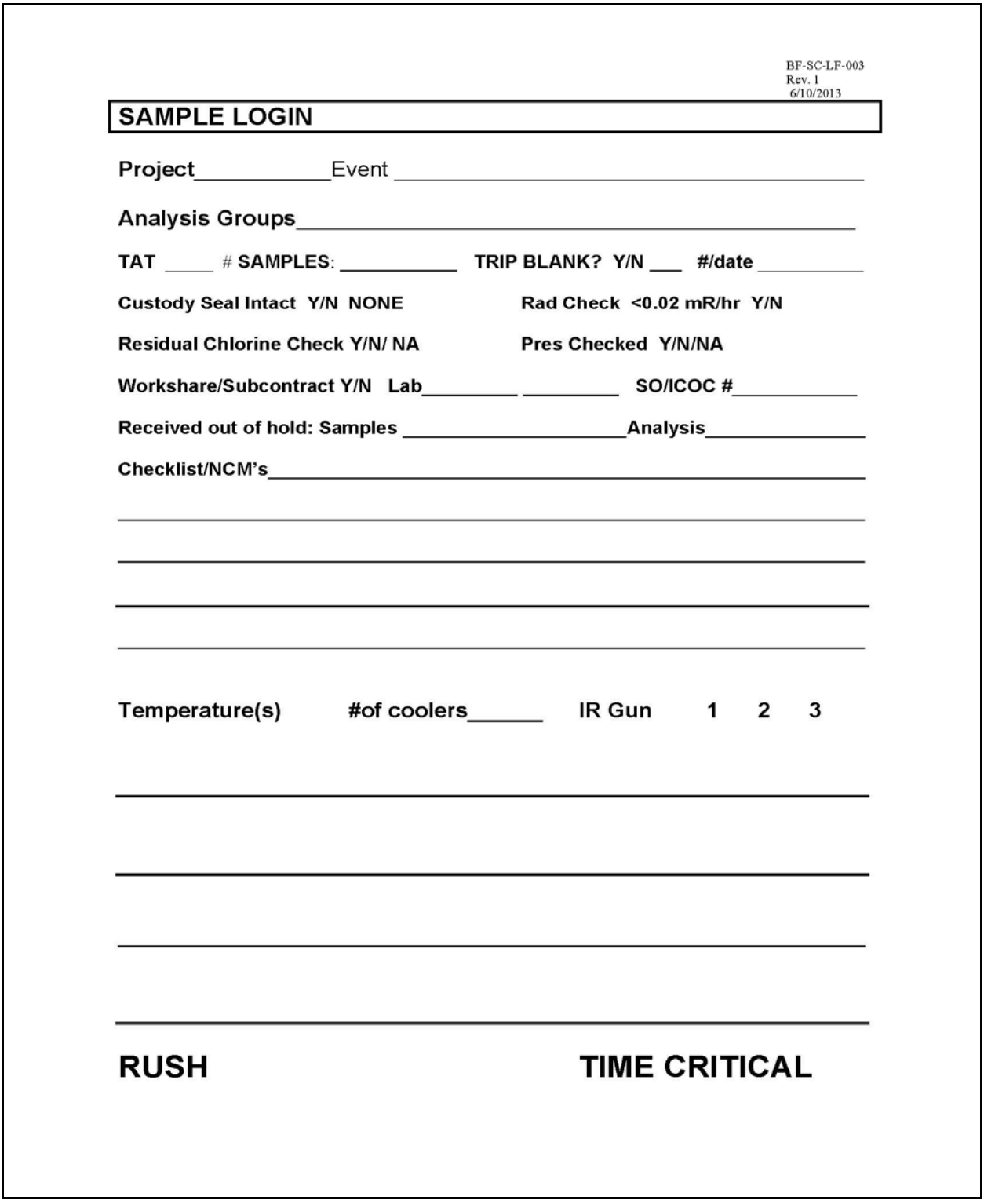
- Pack samples in Ice rather than “Blue” ice packs.

- Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top and do not seal very well and are prone to intrusion from the water from melted ice.

- Water samples would be best if wrapped with bubble-wrap or paper (newspaper, or paper towels work) and then placed in plastic zip-lock bags.

- Fill extra cooler space with bubble wrap.

Figure 23-3.
Example: Cooler Receipt Form (Optional)



BF-SC-LF-003
Rev. 1
6/10/2013

SAMPLE LOGIN

Project_____Event _____

Analysis Groups_____

TAT ____ # SAMPLES: _____ TRIP BLANK? Y/N ___ #/date _____

Custody Seal Intact Y/N NONE Rad Check <0.02 mR/hr Y/N

Residual Chlorine Check Y/N/ NA Pres Checked Y/N/NA

Workshare/Subcontract Y/N Lab_____ _____ SO/ICOC #_____

Received out of hold: Samples _____Analysis_____

Checklist/NCM's_____

Temperature(s) #of coolers_____ IR Gun 1 2 3

RUSH **TIME CRITICAL**

Section 24.0

ASSURING THE QUALITY OF TEST RESULTS

24.1 OVERVIEW

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 CONTROLS

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 NEGATIVE CONTROLS

Table 24-1.

Control Type	Details
Method Blank (MB)	Are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	Are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.

Table 24-1.

Control Type	Details
Instrument Blanks	Are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.
Trip Blank [1]	Are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan) Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	Are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	Are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 POSITIVE CONTROLS

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) (Matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

Uncontrolled Copy

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

24.4.1.1 The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

24.4.1.2 The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard may be reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

24.4.1.3 Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

24.4.1.4 The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

24.4.1.5 If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). In order to meet this requirement, TestAmerica Buffalo spikes with the Corporate Standard Standards primary mix for each analysis. However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

24.4.1.5.1 For methods that have 1-10 target analytes, spike all components.

24.4.1.5.2 For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.

24.4.1.5.3 For methods with more than 20 target analytes, spike at least 16 components.

24.4.1.5.4 Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

24.4.1.5.5 Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.5 SAMPLE MATRIX CONTROLS

Table 24-5. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	Used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	Essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

Uncontrolled Copy

24.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

24.6.1 As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

24.6.2 Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

24.6.3 Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

24.6.3.1 Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).

24.6.3.2 In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

24.6.3.3 The lowest acceptable recovery limit will be 10% (the analyte must be detectable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable.

24.6.3.4 The maximum acceptable recovery limit will be 150%.

24.6.3.5 The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

24.6.3.6 If either the high or low end of the control limit changes by $\leq$ 5% from previous, the data points are inspected and, using professional judgment, the limits may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

24.6.4 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits. This process is outline in BF-QA-002.

24.6.4.1 The control limits are maintained in the laboratory LIMs system. The limits for each analyte/method/matrix combination are assigned effective and expiration dates. The QA department is able to query the LIMs system and print an active list of control limits based on this database. The most current laboratory limits (based on the effective/expiration dates) are reflected on the laboratory worksheets and final reports unless superseded by project specific limits.

24.6.5 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 13) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

24.6.5.1 The analyte results are below the reporting limit and the LCS is above the upper control limit.

24.6.5.2 If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

24.6.6 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.7 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

24.7.1 The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples.

24.7.2 A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

24.7.3 Use of formulae to reduce data is discussed in the method SOPs and in Section 20.

24.7.4 Selection of appropriate reagents and standards is included in Section 9 and 22.

24.7.5 A discussion on selectivity of the test is included in Section 5.

24.7.6 Constant and consistent test conditions are discussed in Section 19.

24.7.7 The laboratories sample acceptance policy is included in Section 23.

Uncontrolled Copy

SECTION 25.0

REPORTING RESULTS

25.1 OVERVIEW

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. A variety of report formats are available to meet specific needs. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client.

The laboratory complies with any state reporting requirements. An example is located in BF-PM-008 – Massachusetts DEP Notification Procedures.

Review of reported data is included in Section 19.

25.2 TEST REPORTS

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report) with a "sample results" column header.

25.2.2 Each report cover page is printed on company letterhead which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. job number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented as # / ##. Where the first number is the page number and the second is the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Practical quantitation limits or client reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits (if requested).

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda). Sample temperatures are recorded in the report case narrative and on the COC. Deviations from normal conditions (e.g., preservation, breakage) are recorded in the report case narrative.

25.2.17 A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error.

25.2.18 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.19 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator.

25.2.20 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Authorized signatories are qualified Project Managers appointed by the Manager of Project Managers.

25.2.21 When NELAP accreditation is required, the lab shall certify that the test results meet all requirements of NELAP or provide reasons and/or justification if they do not.

25.2.22 The laboratory includes a cover letter.

25.2.23 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.24 When Soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

25.2.25 Appropriate laboratory certification number for the state of origin of the sample if applicable.

25.2.26 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g, partial report). A complete report must be sent once all of the work has been completed.

25.2.27 Any non-TestAmerica subcontracted analysis results are provided as an addendum to the report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.28 Certification Summary report, where required, will document that unless otherwise noted, all analytes tested and reported by the laboratory were covered by the noted certifications.

25.3 REPORTING LEVEL OR REPORT TYPE

TestAmerica Buffalo offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level 1 is a report with all of the elements outlined in Section 25.2 above, excluding 25.2.15 (QC data)
- Level II is a Level I report plus summary information, including results for the method blank, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- Level III contains all the information supplied in Level II, but presented on CLP-like summary forms, and relevant calibration information. A Level II report is not included, unless specifically requested. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. Procedures used to ensure client confidentiality are outlined in Section 26.7.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services in addition to the test report as described in section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD . TestAmerica Buffalo offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 SUPPLEMENTAL INFORMATION FOR TEST

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report

25.4.1 Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

25.4.2 Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

25.4.3 Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

25.4.4 Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed

by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in Section 8.

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 CLIENT CONFIDENTIALITY

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

This material is intended only for the use of the individual(s) or entity to whom it is addressed, and may contain information that is privileged and confidential. It is our policy that facsimiles are

intended for and should be used for business purposes only. If you are not the intended recipient, or the employee or agent responsible for delivering this material to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify the sender.

25.7 FORMAT OF REPORTS

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 AMENDMENTS TO TEST REPORTS

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the Archive data server, as is the original report. The revised report is stored in the Archive data server under the sample number followed by "R". The revised report will have the word "revised" appended to the cover letter.

When the report is re-issued, a notation of "revised" is placed on the cover/signature page of the report. A brief explanation of reason for the re-issue is included in the report case narrative.

25.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

25.9.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

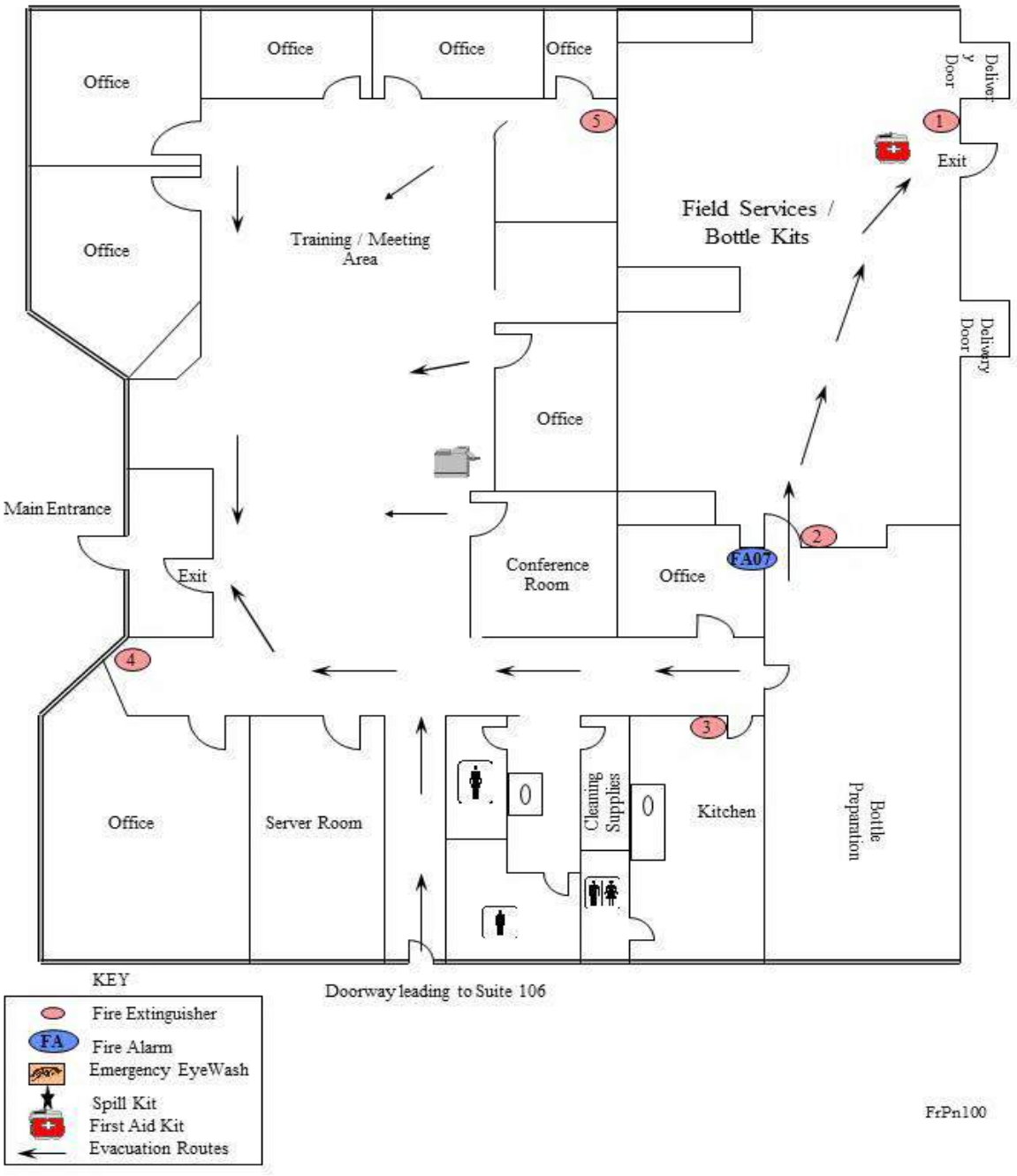
25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same workorder where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

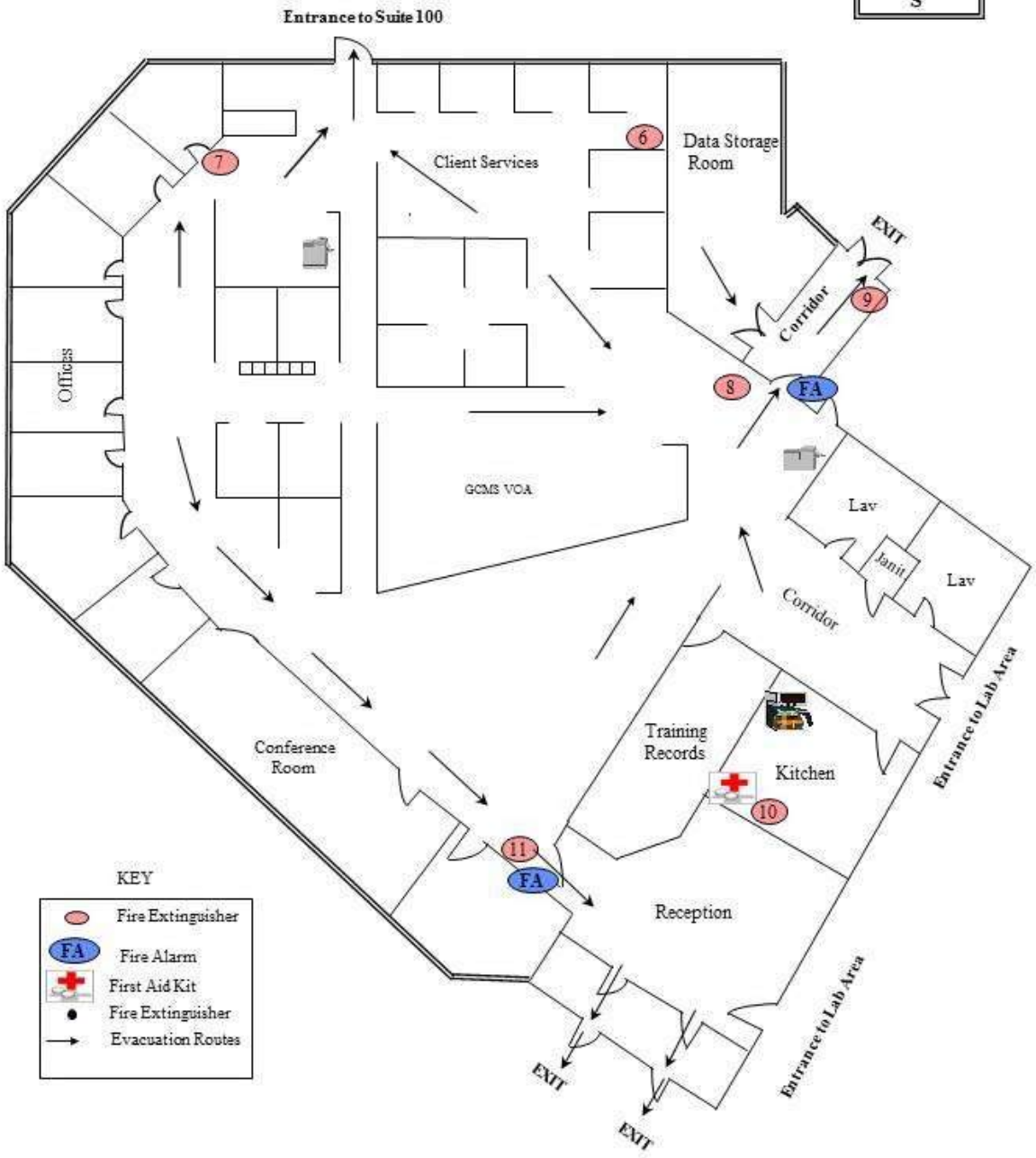
TAL BUFFALO
HAZELWOOD DR. OFFICES, SUITE 100
FLOOR PLAN



Uncontrolled Copy

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

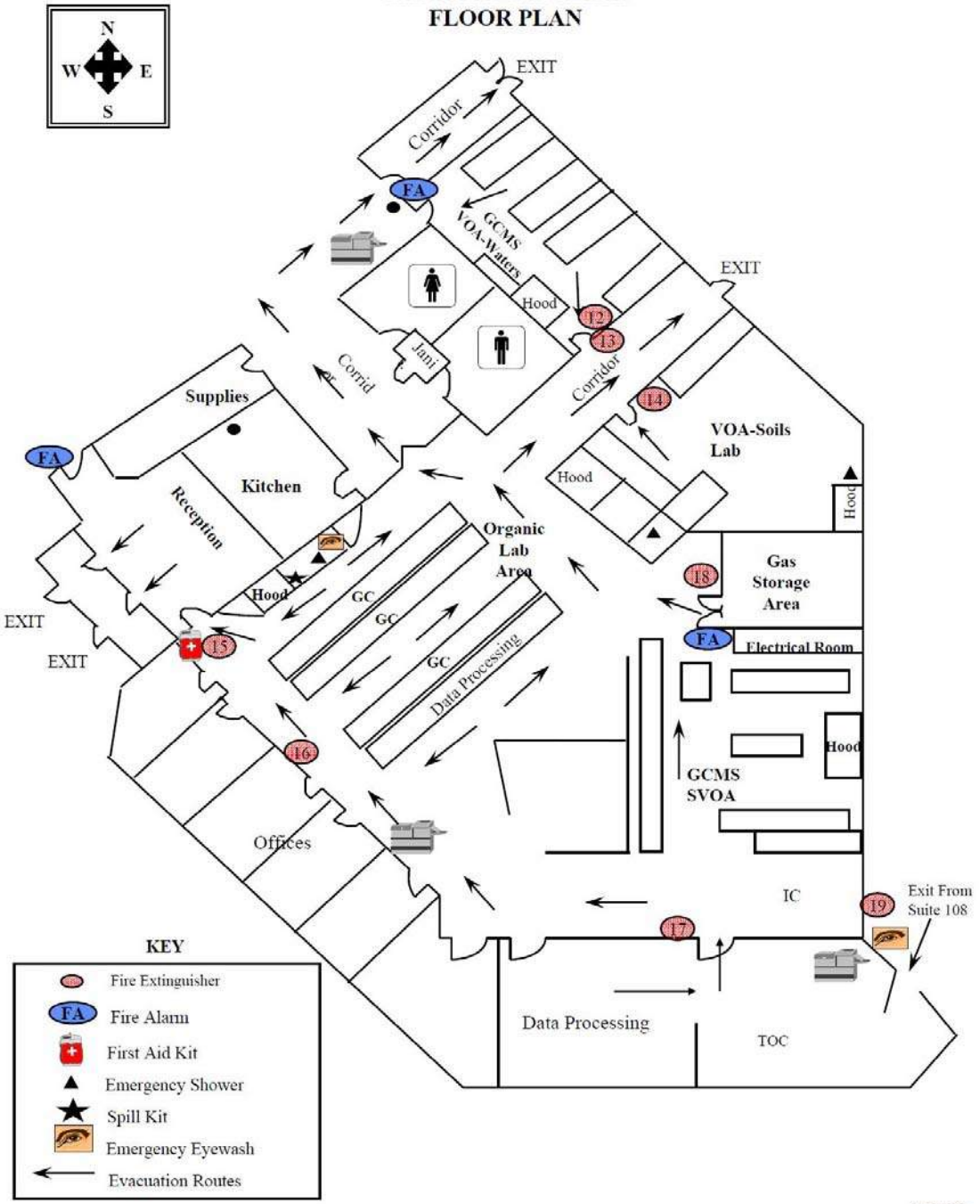
TAL BUFFALO
HAZELWOOD DR. OFFICES, SUITE 106
CLIENT SERVICES/REPORT PREP
FLOOR PLAN



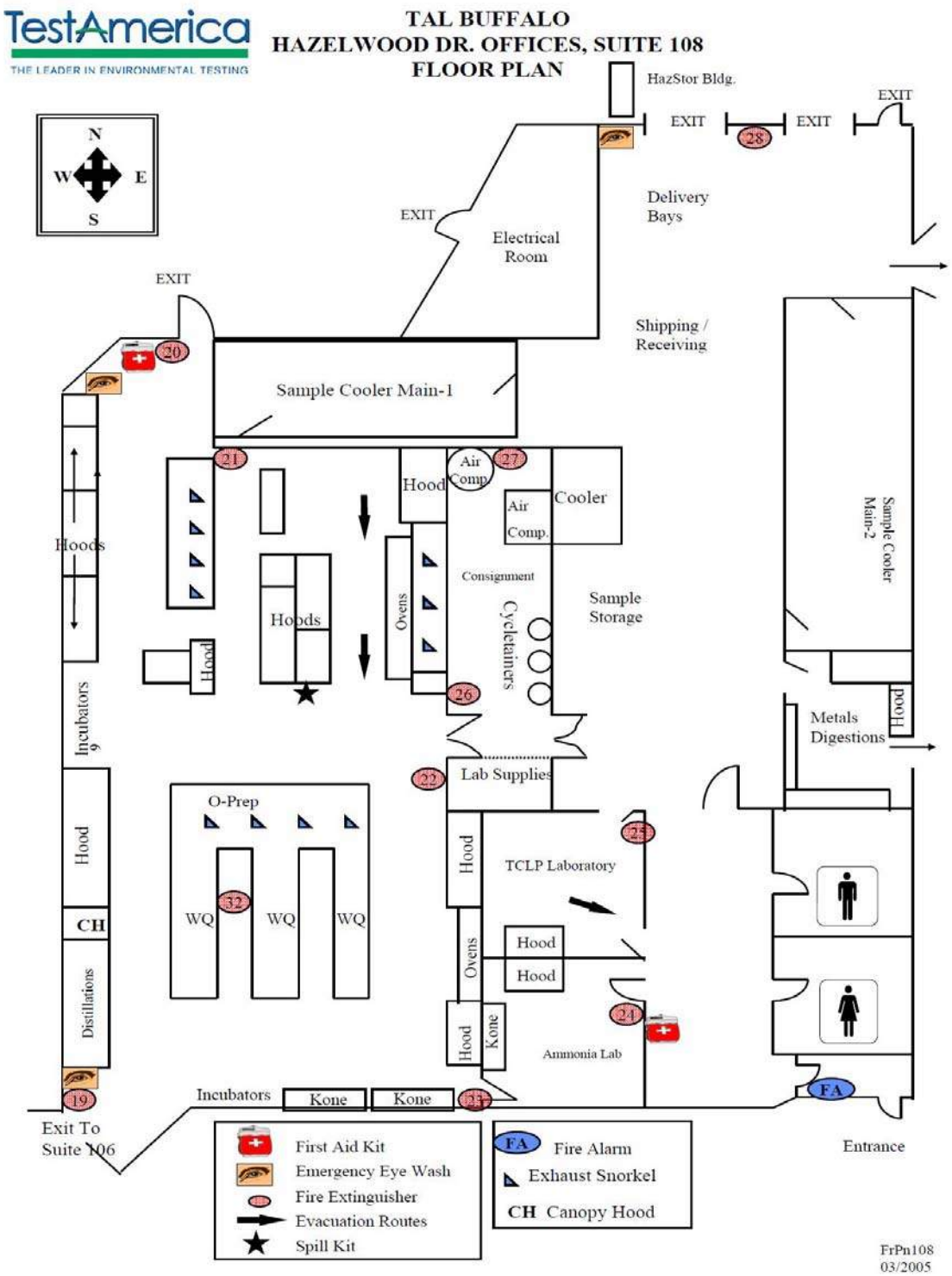
FrP1106L
3/2005

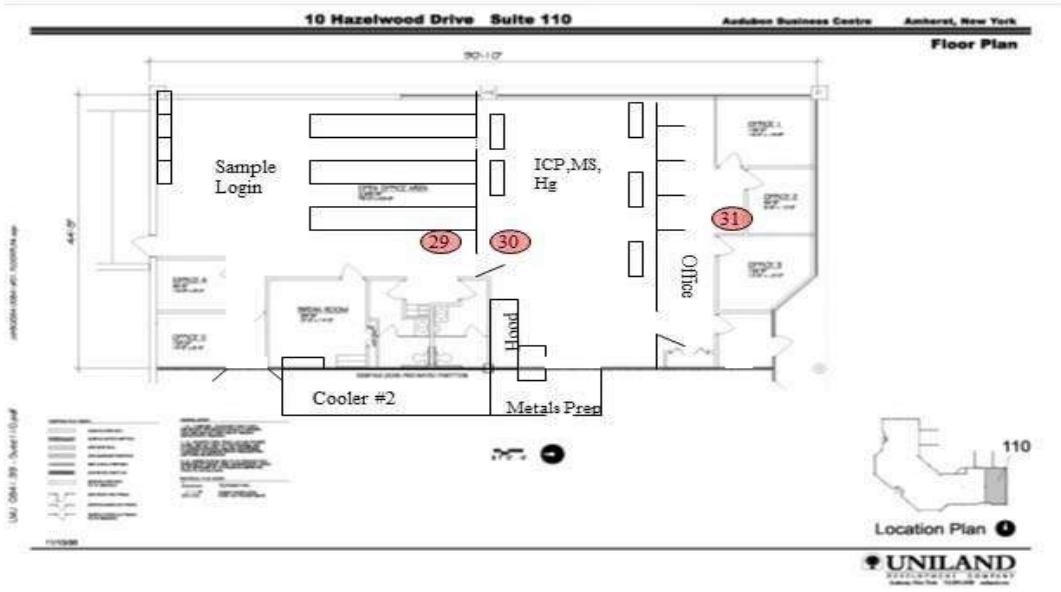
TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL BUFFALO
HAZELWOOD DR. NY OFFICES, SUITE 106
LABORATORY AREA
FLOOR PLAN



FrPn106r
03/2005


TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TAL BUFFALO
HAZELWOOD DR. OFFICES, SUITE 108
FLOOR PLAN
N
W
E
S
HazStor Bldg.
EXIT
EXIT
EXIT
EXIT
EXIT
28
Delivery Bays
Electrical Room
Shipping / Receiving
Sample Cooler Main-1
20
21
Hood
Air Comp.
27
Cooler
Air Comp.
Hoods
Consignment
Sample Storage
Hoods
Ovens
Cycletainers
Hood
26
Sample Cooler Main-2
Incubators
Metals Digestions
Hood
22
Lab Supplies
O-Prep
WQ
32
WQ
WQ
Hood
25
TCLP Laboratory
Hood
CH
Hood
Ovens
Hood
Distillations
Hood
Kone
24
Ammonia Lab
19
Incubators
Kone
Kone
23
FA
Exit To Suite 106
Entrance
First Aid Kit
Emergency Eye Wash
Fire Extinguisher
Evacuation Routes
Spill Kit
FA Fire Alarm
Exhaust Snorkel
CH Canopy Hood
FrPn108
03/2005


10 Hazelwood Drive Suite 110
Floor Plan
Sample Login
ICP,MS, Hg
29
30
31
Office
Hood
Cooler #2
Metals Prep
110
Location Plan
UNILAND

Appendix 2. Glossary/Acronyms

Glossary:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (TNI)

Accrediting Authority: The Territorial, State, or Federal Agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (TNI)

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (TNI)

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly: A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) and /or those samples not requiring preparation, which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices and can exceed 20 samples. (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material, accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI).

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified. (TNI)

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:

Second column confirmation
Alternate wavelength
Derivitization
Mass spectral interpretation
Alternative detectors or
Additional Cleanup procedures
(TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria). (TNI)

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item (ASQC), whether in the laboratory's control or not.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times: The maximum time that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ± 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In

order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for Inorganics.

Limit(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with <15% Settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with >15% Settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which

an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (TNI)

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (TNI)

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Observation: A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (TNI)

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (TNI)

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI) [2.1]

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or and which is accepted as the method for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Uncertainty: A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS-ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection

LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SDS - Safety Data Sheet
SOP: Standard Operating Procedure
TAT – Turn-Around-Time
TNI – The NELAC Institute
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Buffalo maintains certifications, accreditations, certifications, and validations with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation/certification/licensing with the following organizations:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Certifications

Laboratory	Program	Authority	Identification	Expiration Date
TestAmerica Buffalo	Federal	USDA	P330-11-00386	11/26/2017
TestAmerica Buffalo	NELAP	Florida	E87672	06/30/2017
TestAmerica Buffalo	NELAP	Illinois	200003	09/30/2016
TestAmerica Buffalo	NELAP	Kansas	E-10187	10/31/2016
TestAmerica Buffalo	NELAP	Louisiana	02031	06/30/2017
TestAmerica Buffalo	NELAP	Minnesota	036-999-337	12/31/2016
TestAmerica Buffalo	NELAP	New Jersey	NY455	06/30/2017
TestAmerica Buffalo	NELAP	New York	10026	03/31/2017
TestAmerica Buffalo	NELAP	Oregon	NY200003	06/09/2017
TestAmerica Buffalo	NELAP	Pennsylvania	68-00281	07/31/2017
TestAmerica Buffalo	NELAP	Texas	T104704412-15-6	07/31/2017
TestAmerica Buffalo	NELAP	Virginia	460185	09/14/2017
TestAmerica Buffalo	NELAP Primary AB	New Hampshire	2973	09/11/2017
TestAmerica Buffalo	NELAP Secondary AB	New Hampshire	2337	11/17/2016
TestAmerica Buffalo	State Program	Arkansas DEQ	88-0686	07/06/2017
TestAmerica Buffalo	State Program	California	1169CA	09/30/2017
TestAmerica Buffalo	State Program	Connecticut	PH-0568	09/30/2016
TestAmerica Buffalo	State Program	Georgia	956	03/31/2017
TestAmerica Buffalo	State Program	Georgia	N/A	03/31/2017
TestAmerica Buffalo	State Program	Iowa	374	03/01/2017
TestAmerica Buffalo	State Program	Kentucky (DW)	90029	12/31/2016
TestAmerica Buffalo	State Program	Kentucky (UST)	30	03/31/2017
TestAmerica Buffalo	State Program	Kentucky (WW)	90029	12/31/2016
TestAmerica Buffalo	State Program	Maine	NY00044	12/04/2016
TestAmerica Buffalo	State Program	Maryland	294	03/31/2017
TestAmerica Buffalo	State Program	Massachusetts	M-NY044	06/30/2017
TestAmerica Buffalo	State Program	Michigan	9937	03/31/2016 *
TestAmerica Buffalo	State Program	North Dakota	R-176	03/31/2017
TestAmerica Buffalo	State Program	Oklahoma	9421	08/31/2017
TestAmerica Buffalo	State Program	Rhode Island	LAO00328	12/30/2016
TestAmerica Buffalo	State Program	Tennessee	TN02970	03/31/2017
TestAmerica Buffalo	State Program	Washington	C784	02/10/2017
TestAmerica Buffalo	State Program	West Virginia DEP	252	09/30/2016
TestAmerica Buffalo	State Program	Wisconsin	998310390	08/31/2017

Page 1 of 1

* Certification Valid - Laboratory is Pending Renewal with the Program Authority
For more information, or to contact a local TestAmerica representative nearest you, please visit our website at www.testamericainc.com
© 2010, TestAmerica Laboratories, Inc. All rights reserved. TestAmerica & Design ™ are trademarks of TestAmerica Laboratories, Inc.

The certificates and accredited parameter lists are available for each State/Program at www.testamericainc.com under Analytical Services Search – Certifications.

APPENDIX D – COMMUNITY AIR MONITORING PLAN



GEI Consultants

Community Air Monitoring Plan

Woodworth Avenue Works – Former MGP Site

Yonkers, Westchester County, New York
Site ID: 360164

Submitted to:
Consolidated Edison Company of New York
31-01 20th Avenue
Long Island City, NY 11105

Submitted by:
GEI Consultants, Inc. DBA GEI Consultants Engineering, Geology, Architecture & Landscape Architecture
455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
860-368-5300

April 1, 2026
Project No. 2101005



Melissa J. Felter, P.G.
Project Manager

Matthew J. O'Neil, P.E.
Vice President

Table of Contents

Acronyms and Abbreviations iii

1. Introduction 1
1.1. Location and Site Description 1
1.1.1. Site Location and Description 1
1.1.2. Site History and Operations 2
1.2. Potential Air Emissions Related to Investigation and Remedial Activities 2
1.3. Air/Odor Emission Control Measures 3
1.3.1. Vapor and Dust Emissions 3
1.4. Roles and Responsibilities 4
1.4.1. GEI Consultants, Inc. DBA GEI Consultants Engineering, Geology, Architecture & Landscape Architecture 4
1.4.2. Contractor 5
1.4.3. Con Edison 6
1.4.4. New York State Department of Environmental Conservation 6

2. Air Monitoring Procedures 7
2.1. Monitoring Location Selection and Deployment 8
2.1.1. Fixed-Station Monitoring Procedures 8
2.1.2. Tripod Mounted Monitoring Procedures 8
2.1.3. Supplemental Hand-Held Monitoring 9
2.1.4. Equipment Calibration 10
2.2. Volatile Organic Compounds Monitoring 10
2.3. Total Suspended Particulate (Particulate) Monitoring 10
2.4. Periodic Monitoring for MGP-Related Odors 11
2.5. Alert Level, Response Level, and Action Levels 11
2.5.1. Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures 12
2.5.2. Special Requirements for Indoor Work With Co-Located Residences or Facilities 13
2.6. Pre-Construction Baseline Sampling 13
2.7. Meteorological Monitoring 13
2.8. Reporting 13
2.9. Data Management Procedures 14

3. Response Plan 15
3.1. Site Condition 1 15
3.2. Preliminary Site Condition 2 16
3.3. Site Condition 2 16
3.4. Site Condition 3 17
3.5. Visible Dust 17
4. References 18

Tables

Table 1 Target Concentrations for Site Conditions
Table 2 Site Conditions and Response Actions

Figures

Figure 1 Site Location
Figure 2 Operable Units
Figure 3 Communication Flowchart
Figure 4A Example Fixed Station Internal Components
Figure 4B Example Tripod Mounted Station Internal Components
Figure 5 TVOC Decision Diagram
Figure 6 Particulate Matter Decision Diagram

Appendices

Appendix A Community and Environmental Response Plan (CERP)
Appendix B DER-10 Appendix 1A Generic CAMP

MJF/MJO:bdp
B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\01_ADMIN\CAMP\Site-Wide CAMP 04012026\GEI_CAMP Report_Revised_with_DEC_Comments-2026.04.01.docx

Acronyms and Abbreviations

CAMP	Community Air-Monitoring Plan
CERP	Community and Environmental Response Plan
COC	Constituents of Concern
Con Edison	The Consolidated Edison Company of New York, Inc.
DER-10	[Division of Environmental Remediation]-10, Technical Guidance for Site Investigation and Remediation
EWP	Excavation Work Plan
GEI	GEI Consultants, Inc. DBA GEI Consultants Engineering, Geology, Architecture & Landscape Architecture
IRM	Interim Remedial Measure
MGP	Manufactured Gas Plant
NAVD	North American Vertical Datum
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OU	Operable Unit
PID	Photoionization Detector
PM-10	Particulate Matter Less than 10 Micrometers in Size
TVOC	Total Volatile Organic Compounds
USEPA	United States Environmental Protection Agency
$\mu g/m^3$	Micrograms per meter cubed
ppm	Parts per million

1. Introduction

This Community Air Monitoring Plan (CAMP) has been prepared to support the implementation of investigation and remedial activities for the Former Woodworth Avenue Works Manufactured Gas Plant (MGP) site located in Yonkers, New York (Figure 1). The purpose of this CAMP is to describe the monitoring activities that will be conducted by the Engineer to monitor for potential airborne releases of constituents of concern (COCs) during remedial construction. This CAMP specifies the air emission action levels, air monitoring procedures, monitoring schedule and data collection and reporting to be performed during intrusive activities.

1.1. Location and Site Description

1.1.1. Site Location and Description

The Woodworth Avenue former MGP site occupies 4.3 acres of land bounded by Woodworth Avenue to the east, Alexander Street to the west, Ashburton Avenue to the south, and Babcock Place to the north located in Yonkers, Westchester County, New York. The Woodworth Avenue Works former MGP Site is located within an industrial, commercial, storage and light manufacturing area that includes residences to the northeast and east.

The Site encompasses seven tax parcels and is currently occupied by a collapsible structure that is periodically used for film production (95 Woodworth Avenue), a commercial bakery facility (104 Alexander Street), and a Metro North Railroad storage/electrical building (7 Ashburton Avenue). The southwestern portion of the site was developed to include an area of motor oil storage from the 1950s to the 1970s and is now used as a bus turnaround. Metro-North commuter railroad tracks and substation bisect the central portion of the Site. The western portion of the Site is currently used by Greyston Bakery. Properties to the south, and to the west along the Hudson River were recently developed into residential apartment buildings. A Deed Restriction exists for the parcel occupied by the Greyston Bakery that restricts the Site usage to commercial or industrial use.

The majority of the surface area of the Site (approximately 90%) is developed and covered by a collapsible structure that is periodically used for film production, a commercial bakery facility, a Metro North Railroad storage/electrical building, and asphalt surfaces; therefore, immediate exposure to potential subsurface contaminants is limited. The remaining 10% is fill that was likely imported to the Site after the MGP was decommissioned. The eastern portion of the Site is located approximately 25 feet above North American Vertical Datum (NAVD) on a hillside sloping downward toward the Hudson River, to the west. A portion of this property was recently filled by the property owner to level the property, including installation of a retaining wall. The western portion of the Site is approximately 5 feet above NAVD and continues to gradually slope down toward the Hudson River. Surface water and groundwater flow toward the Hudson River. A site location map is included as Figure 1.

The Former Woodworth Avenue Works MGP site consists of the former MGP parcels designated as Operable Unit No. 1 (OU-1) and properties with MGP-related impacts that have potentially migrated from the former MGP Site are designated as Operable Unit No. 2 (OU-2). OU-1 and OU-2 are collectively referred to herein as "the site".

- OU-1 (Figure 2): OU-1 is an approximately 4.3-acre area and is bounded by Babcock Place to the north, Ashburton Avenue to the south, Woodworth Avenue to the east, and Alexander Street to the west. OU-1 includes a bakery, the Metro-North Railroad storage/operations facility, and a collapsible structure that is periodically used for film production.
- OU-2 (Figure 2): OU-2 includes properties with MGP-related impacts that have potentially migrated from the former MGP Site, which at the time of writing this ISMP, have not been fully defined. OU-2 includes adjacent roads and properties to the south, west, and north of OU-1.
- OU-3 (Figure 2): OU-3 is planned to be established and will include the Hudson River sediments.

1.1.2. Site History and Operations

The Woodworth Avenue Works was incorporated in 1854 by the Yonkers Gas Light Company on the eastern portion of the Site. The Yonkers Gas Light Company continued to expand and subsequently purchased the western portion of the site (currently identified as Block 2618, Lots 1, 2, and 200) in 1861. The 1868 Beers Atlas map shows the location of the MGP which consisted of four buildings and one gas holder all located on the eastern portion of the property.

The former MGP site consisted of retorts, coke, and coal storage sheds, two 263,000 cubic foot gas holders, one subsurface gasholder/ tar tank of unspecified size, six above ground crude oil storage tanks of varying sizes, engine room, pump room, meter room, two purifying houses, a drying house, tar barrel area, lard oil tank, coal pile, and oil house. A dock was situated to the west of the former MGP when the Hudson River abutted the western side of the MGP before the area was filled in 1898.

The MGP was dismantled in 1930, with the demolition of remaining structures in 1931. The 1940 aerial photographs and 1942 Sanborn Maps confirm that most of the above ground portions of the plant were removed by that time. However, the two buildings on the northeast corner of the Site along Woodworth Avenue remained.

1.2. Potential Air Emissions Related to Investigation and Remedial Activities

The NYSDOH Generic CAMP (Appendix 1A of DER-10) states that intrusive remedial activities to be performed at work sites have the potential to generate localized impacts to the air quality. Activities that have the potential to generate air emissions include the following:

- Soil boring activities
- Excavation of Soil

- Backfilling
- Material Handling
- Other Intrusive Activities

1.3. Air/Odor Emission Control Measures

Emission control measures to be utilized by the Contractor during material excavation/removal and handling activities are described in the following subsections.

1.3.1. Vapor and Dust Emissions

Air emissions control and fugitive dust suppression measures may be implemented by the Contractor concurrently with the activities identified above (as needed) to limit the potential for organic vapor and dust emissions from the site. Air emissions associated with excavation/removal, backfilling, material handling and stockpiling, other intrusive activities, and certain non-intrusive activities, such as mobilization, transportation, and restoration activities, will be controlled as described below. The following vapor and dust control measures may be used during these activities, depending upon specific circumstances, visual observations, and air monitoring results:

- Water/BioSolve® spray.
- Polyethylene sheeting (e.g., for covering excavation faces, material stockpiles).
- Minimizing excavation surface area to be exposed at any given time.
- Vapor suppression / Rusmar® foam.
- Piian Odor Neutralizing Mist System.
- Alternate odor suppressant methods (e.g., sprays, odor suppressant foams) that are capable of suppressing site related odors may be proposed by the Contractor for review and approval by Con Edison and Engineer.

On many MGP sites, a Tensile Fabric Structure (TFS) that can be maintained under negative pressure relative to the outside atmosphere, such as a Sprung Structure®, can be used over the remedial excavation to contain and reduce odors from the remediation. This was evaluated but is not anticipated to be utilized for the interim remedial measure at this Site due to limited space within and adjacent to the excavation limits. The wall of Gas Holder 2 appears to extend up to the property line and existing fence that runs North to South along Woodworth Avenue. Additionally, a utility pole and overhead utility lines are present approximately 5 feet from the existing fence in the vicinity of the proposed work area. The base of the TFS must be set outside of the proposed excavation limits so that the entire excavation can be completed under the TFS. In this case, the TFS base and wall required to cover the holder excavation and allow excavation to the anticipated depth along the sidewalk would extend through the overhead utility lines and poles and into a portion of the adjacent Woodworth Avenue. These limitations make the mobilization, usage, and demobilization of a structure impracticable for the implementation of the Interim Remedial Measure (IRM). Further the installation of a TFS would require the use of a crane to

install the structure over the excavation. Due to the location of the utility lines along Woodworth Avenue, the crane would have to install the structure with a swing radius extending towards the Metro North Railroad. The railroad has strict limitations on the ability to operate heavy equipment with masts that have the potential to foul the active tracks when they are in operation. These limitations severely limit the ability to install a TFS at this location.

The Contractor is required to mobilize BioSolve® (or approved equivalent), Rusmar® (or approved equivalent) vapor-suppressant foam (including application equipment), and Piian odor neutralizing concentrate to the remediation work area prior to initiating intrusive activities. The Contractor must maintain an adequate supply of such materials for the duration of intrusive activities. The Contractor shall apply the BioSolve® solution using a pressure washer. If required, a dedicated Contractor worker shall be available for application of BioSolve® solution and/or Rusmar® foaming agent. The Contractor shall provide and install a Piian (or equivalent) Odor Neutralizing Mist System prior to any intrusive remedial activities.

1.4. Roles and Responsibilities

GEI Consultants, Inc. DBA GEI Consultants Engineering, Geology, Architecture & Landscape Architecture (GEI) will implement the monitoring and reporting components of this CAMP under contract with Con Edison. The contractor performing intrusive activities is responsible for the selection and implementation of appropriate contingency measures that will mitigate the off-site migration of contaminants in response to Action Levels being approached or exceeded. A Community and Environmental Response Plan (CERP) is included in Appendix A. A communication flow chart is included as Figure 3 with each entity and lines of communication for the CAMP.

1.4.1. GEI Consultants, Inc. DBA GEI Consultants Engineering, Geology, Architecture & Landscape Architecture

The scope of GEI's activities will be limited to CAMP monitoring and reporting used for the CAMP. GEI is responsible for the Health and Safety of their employees. GEI's CAMP roles and responsibilities are as follows:

- GEI will monitor and record total volatile organic compounds (TVOCs) and dust at various locations around the Site as described in the following sections of this CAMP.
- GEI will communicate to the following entities whether TVOC or dust exceeded Response Levels or Action Levels specified in Section 2.5, and suggest corrective actions required to address the situation. GEI will convey the CAMP results to the entities listed below and inform them if the Alert or Response Levels have been exceeded. GEI will direct contractors at the Site to take action if warranted.

- **Contractor – TBD**
- **New York State Department of Environmental Conservation**
  Justin Starr, P.G.
  New York State Department of Environmental Conservation
  Division of Environmental Remediation
  Remedial Bureau C
  625 Broadway
  Albany, NY 12233-7017
  (518) 402-9662
- **New York State Department of Health**
  Angela Martin
  Bureau of Environmental Exposure Investigation
  New York State Department of Health
  Corning Tower, Empire State Plaza
  Albany, NY 12237
  (518) 473- 4671
- **Con Edison**
  Matthew Levinson Project Manager
  Consolidated Edison Company of New York, Inc.
  31-01 20th Avenue-Building 138
  Astoria, NY 11105
  (646) 385-1691

- GEI will provide, maintain, and operate the equipment used to implement the CAMP.
  - GEI will provide data summary reports to the Contractor, Con Edison, NYSDOH and NYSDEC during intrusive activity. The reports will identify Response Level and Action Level exceedances and will include data summary reports for all TVOC and dust data collected.
  - GEI will report mitigative actions taken to address TVOC or dust exceedances above Response Levels or Action Levels, with other relevant information on work activities done the day of the exceedance. Exceedances shall be thoroughly explained so that proactive measures can be taken to prevent future exceedances.
  - GEI will report TVOC or dust exceedances above Response Levels or Action Levels to Con Edison, NYSDEC, and NYSDOH separately via email within 60 minutes of the exceedance via e-mail at a minimum.

1.4.2. Contractor

The Contractor is the lead contractor responsible for site activities pertaining to the intrusive activities. The Contractor will be responsible for taking contingent actions in conjunction with Con Edison in response to Response Level and Action Level exceedances. The Contractor will be responsible for taking

contingent actions for Alert Levels, if required. The Contractor is responsible for the Health and Safety of their employees.

1.4.3. Con Edison

Con Edison has the responsibility to provide mitigation services related to the release of MGP-related vapors in excess of CAMP Response Levels and Action Levels. This includes taking appropriate actions to mitigate releases from the site. Mitigation measures can range from any of the following actions:

- Work stoppages.
- Wetting work areas with water to reduce dust.
- Covering exposed area with tarps during non-work hours.
- Applying odor control products, such as BioSolve® or Rusmar™ Foam to the excavated areas, soil stockpiles, roll-offs, trucks, and containers as necessary. These products may be applied in conjunction with solid tarps or other covers.
- The use of perimeter misting system to minimize nuisance odors to the community.
- If necessary, multiple methods to control odors will be employed simultaneously to ensure that nuisance odors do not impact the local community to include.

As noted above in Section 1.3.1, an evaluation of the use of an enclosure system that can be maintained under negative pressure relative to the outside atmosphere, such as a Sprung Structure® was evaluated for use at this site but was ultimately not selected due to the location of the excavation related to Woodworth Avenue, the existing overhead utilities, and the adjacent Metro North Rail Road.

Con Edison is also ultimately responsible for the investigation and remediation of the Site under approved work plans with NYSDEC. Con Edison will be responsible for directing the Contractor to take contingent actions in conjunction with Con Edison in response to Alert Level (TVOC only), Response Level, and/or Action Level exceedances.

1.4.4. New York State Department of Environmental Conservation

NYSDEC is responsible for the environmental regulatory enforcement for all activities conducted at the site including compliance with this CAMP, storm water runoff mitigation (erosion and sediment control), and all environmental and remediation regulations, policies, and guidance applicable to the Site. NYSDEC may provide on-site oversight personnel for the work being conducted.

2. Air Monitoring Procedures

This section of the CAMP presents a detailed description of the air monitoring, air sampling, and analytical procedures, including data management that will be used during ground intrusive site activities. The intent of the real-time monitoring program is to provide early detection in the field of short-term emissions and off-site migration of site-related TVOC and particulates.

Real-time monitoring methods will be utilized to measure ambient air concentrations during the project. Monitoring for TVOC and respirable particulate matter (particulate matter less than 10 micrometers in size [PM-10]) will occur at a minimum of two locations and wind direction will be monitored in real-time if an automated monitoring system is utilized. The specific number of locations that will be utilized will be provided in the corresponding work plan based on the scope of being conducted. For example, multiple, relatively permanent stations may be required for a remedial excavation, while a single upwind station and single downwind station may be appropriate for the installation of a soil boring. Supplemental monitoring for TVOC and PM-10 will occur along the perimeter of the project site on an as-needed basis. In the event of a possible exceedance of a Response Level or Action Level for TVOC or PM-10, GEI will compare upwind (background) concentrations to downwind concentrations within 60 minutes of the possible exceedance to determine if site activity is causing the Response Level or Action Level exceedance. The air monitoring procedures and equipment are detailed below.

During intrusive activities, perimeter air monitoring will be conducted using a combination of fixed-station, moveable tripod-mounted, and/or hand-held air monitoring equipment. Monitoring will be performed for TVOC and PM-10 along the Site perimeter 24 hours a day when fixed station equipment is used or during working hours if movable tripod-mounted or hand-held air monitoring equipment is used.

Monitoring for TVOC and PM-10 will occur at a minimum of two locations using real-time monitoring equipment. Readings will be checked manually on a predetermined periodic basis if tripod-mounted equipment is used. Readings will be recorded once per minute and transmitted to a centralized data logger system if fixed-station equipment is used. Supplemental hand-held perimeter monitoring for TVOC and PM-10 will occur along the perimeter of the project site on an as-needed basis. Each approach is detailed below.

It is anticipated that fixed station equipment will be used for the remedial excavation work at the Site. It is anticipated that tripod-mounted equipment will be used for minimally intrusive work such as installation of soil borings or monitoring wells. Supplemental hand-held equipment will be used on an as-needed basis. This may include monitoring directed by Con Edison or NYSDEC, or to supplement fixed monitoring station data to prevent visible dust.

2.1. Monitoring Location Selection and Deployment

2.1.1. Fixed-Station Monitoring Procedures

Real-time fixed-station monitoring equipment will be positioned at a minimum of two locations upwind and downwind of the designated work area. Refer to the work plan figures for specific locations and number of stations. The real-time fixed air monitoring stations will be positioned between the work zone and the largest number of potential off-site receptors. Therefore, the placement of the fixed air monitoring stations is based on the need to document all potential off-site migration on the perimeter but also recognizes the potential off-site receptors and the location of the proposed construction activities. Real-time monitors will continuously gather data 24 hours a day 7 days a week.

The air monitoring stations will be supplemented with a meteorological station and a system of transmitting the real-time data to a central data storage location accessible by the project team in the project trailer or similar work area.

Each real-time fixed-station air monitoring station contains the following:

- Station enclosure.
- A photoionization detector (PID).
- A particulate aerosol monitor equipped with a PM-10 impactor.
- A data telemetry device.

Air monitoring equipment will be housed in a protective weather-tight enclosure. Each monitoring station will continuously measure and record TVOC and PM-10 at a rate of one sample per minute and record 15-minute averages. Figure 4A shows an example of a fixed air monitoring station.

In addition to the air monitoring stations, a meteorological monitoring station will be established on site to continuously monitor and record temperature, relative humidity, wind speed, and wind direction. Fifteen-minute averages for each meteorological parameter will be transmitted to the central data storage location to determine upwind and downwind stations for assessing Alert, Response, and Action Levels.

All TVOC, PM-10, and meteorological data will be stored in data loggers located within each monitoring/meteorological station. Stored analytical data along with system performance data from each station will be sent in real-time, via telemetry, to the Site central computer system for monitoring and analysis. In the event of severe weather or power loss at the site, data recording and/or recovery may be affected.

2.1.2. Tripod Mounted Monitoring Procedures

Tripod-mounted monitoring equipment will be positioned along the Site perimeter to monitor the air based on a particular day's ground intrusive activities. At a minimum, one tripod-mounted station will be

positioned upwind and one tripod-mounted station will be positioned downwind of the designated work area. Real-time monitors will continuously gather data during periods of ground intrusive activity during working hours. The equipment will be manually read on a predetermined periodic basis during the work activities.

The readings will be collected at a minimum of 15-minute intervals during periods of intrusive activities. Wind direction will be determined by using a wind sock or flagging placed on a pole at the Site.

Each tripod-mounted air monitoring station would include the following:

- Station enclosure and Tripod.
- A PID.
- A particulate aerosol monitor equipped with a PM-10 impactor.

Air monitoring equipment will be housed in a protective weather-tight enclosure. Each monitoring station will continuously measure and record TVOC and PM-10 at a rate of one sample per minute and record 15-minute averages. Figure 4B shows an example of a typical tripod-mounted air monitoring station.

All TVOC and PM-10 will be stored in data loggers located within each monitoring station. Data from each piece of equipment will be downloaded daily and stored on a central storage location. The location of each station, the work zone, and the wind direction will be recorded daily.

2.1.3. Supplemental Hand-Held Monitoring

Supplemental hand-held monitoring equipment will be recorded at the perimeter of the Site downwind of the designated work area on an as-needed basis. Specific site conditions that may trigger supplemental hand-held monitoring include:

- Visible dust.
- Detection of TVOC and/or PM-10 at an air monitoring station at concentrations exceeding an Alert Level, Response Level, and Action Levels.
- Direction by the Con Edison, or NYSDEC.

Fifteen-minute average TVOC and PM-10 readings will be recorded at a downwind location between the work area and the nearest receptors.

When a triggering condition is observed during ground intrusive activity, the supplemental downwind perimeter monitoring will occur until the conditions that triggered the monitoring have subsided. TVOC concentrations will be monitored and recorded using a PID. PM-10 will be measured and recorded using a particulate aerosol monitor equipped with a PM-10 impactor.

At each monitoring point, the 15-minute average value of TVOC and PM-10, sample time, and sample location will be collected and recorded. Additional temporary monitoring points may be established due to changing site or meteorological conditions.

2.1.4. Equipment Calibration

Equipment calibration will be performed according to the manufacturer's instructions. Each PID will be calibrated once daily using an isobutylene gas mixture. Particulate monitors will be purged and zeroed daily. Other hand-held portable equipment will be calibrated before each use, or a minimum of once per week when not in use.

2.2. Volatile Organic Compounds Monitoring

Real-time monitoring for VOCs will be conducted during remedial activities. As required by the NYSDOH Generic CAMP, VOCs will be monitored continuously during all intrusive and/or potential dust-generating activities (e.g., soil boring and monitoring well installation activities, installation of erosion and sediment control measures, excavation/removal, backfilling, soil mixing/stabilization, material handling activities) using instrumentation equipped with electronic data- logging capabilities. A real-time VOC monitor (RAE MiniRAE 3000 or equivalent), equipped with either a photoionization detector, or flame ionization detector, calibrated to 100 parts per million (ppm). Isobutylene will be used to calibrate for VOCs. All average concentrations (calculated for continuous 15- minute increments and any instantaneous readings taken to facilitate activity decisions will be recorded using an electronic data logger and/or in the field logbook.

2.3. Total Suspended Particulate (Particulate) Monitoring

Real-time monitoring for particulates will be conducted during remedial activities. As required by the NYSDOH Generic CAMP, real-time airborne particulate monitoring will be conducted continuously during all intrusive and/or potential dust generating activities (e.g., soil boring and monitoring well installation activities, installation of erosion and sediment control measures, excavation/removal, backfilling, and material handling activities) using instrumentation equipped with electronic data-logging capabilities. A real-time particulate monitor (TSI 8530 DustTrak II or equivalent) will be used for particulate monitoring. All average concentrations (calculated for continuous 15-minute increments and any instantaneous readings taken to assess appropriate course of action will be recorded using an electronic data logger and/or in the field logbook.

Fugitive dust migration will be visually assessed during all work activities, and reasonable dust suppression techniques outlined in Section 1.3.1 will be used during any site activities that may generate fugitive dust.

2.4. Periodic Monitoring for MGP-Related Odors

Odor monitoring along the Site perimeter will be implemented in addition to monitoring for TVOC and PM-10. During intrusive activities, staff will periodically walk the perimeter of the Site to evaluate if nuisance odors are migrating beyond the Site limits. If nuisance odors are determined to be migrating beyond the Site limits, immediate action will be taken in accordance with this CAMP and the Excavation Work Plan (EWP), which may include but is not limited to, covering of open piles of soil with plastic sheeting, applying odor control solvents or foaming agents, or temporarily halting activities to identify the source of the odors and implement additional control measures prior to resuming activities, as outlined in Section 1.3.1.

2.5. Alert Level, Response Level, and Action Levels

Alert Levels are not established by the NYSDOH or NYSDEC. An Alert Level is an internally established concentration levels for TVOC only. An Alert Level is set below the levels established by the NYSDOH so that action can be taken prior to exceeding a NYSDOH threshold. An Alert Level serves as a preemptive screening tool for TVOC to trigger contingent measures, if necessary, to assist in minimizing off-site transport of contaminants during remedial ground intrusive activities.

Response Levels are NYSDOH thresholds levels established in the May 2010 NYSDOH Generic CAMP presented in Appendix 1A of DER-10 (see Appendix B). A Response Level is a contaminant concentration that triggers a temporary work stoppage, continued monitoring, reporting, and/or potential contingent measures. A Response Level serves as a preemptive tool for PM-10 to trigger contingent measures, if necessary, to assist in minimizing off-site transport of contaminants during remedial ground intrusive activities.

Action Levels are NYSDOH threshold levels established in the May 2010 NYSDOH Generic CAMP presented in Appendix 1A of DER-10 (see Appendix B). An Action Level is a contaminant concentration that triggers work stoppage, continued monitoring, reporting, and implementation of contingent measures to mitigate potential airborne contaminants prior to resuming ground intrusive activities.

For example, if high concentrations of dust are detected on the Site, contingent measures such as spraying water on dry soils may be required to reduce the concentrations and keep them below the Response Level.

Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. The following target parameters and corresponding Alert Levels, Response Levels, and Action Levels were developed in accordance with the NYSDOH Generic CAMP.

Target Parameter	**Alert Level**
TVOC (15-minute average concentration)	3.7 ppm greater than background*
Target Parameter	**Response Level**
Respirable Particulate Matter (PM-10)	100 $\mu g/m^3$ greater than background*
Target Parameters	**Action Level (**)**
TVOC (15-minute average concentration)	5.0 ppm greater than background*
TVOC	25 ppm
Respirable Particulate Matter (PM-10)	150 $\mu g/m^3$ greater than background*

ppm - parts per million
$\mu g/m^3$ - micrograms per meter cubed
TVOC – total Volatile Organic Compounds
* Background is defined as the current upwind fifteen-minute average concentration.
** Action Level Exceedance Requires Work Stoppage and Mitigation of the condition causing the Exceedance

2.5.1. Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures

When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices will be considered to prevent exposures related to the work activities and to control dust and odors. Consideration will be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

- If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 ppm, monitoring will occur within the occupied structure(s). Depending upon the nature of contamination, chemical-specific colorimetric tubes of sufficient sensitivity may be necessary for comparing the exposure point concentrations with appropriate pre-determined response levels (response actions should also be pre-determined). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings will be discussed with NYSDOH prior to commencement of the work.
- If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed 150 mcg/m3, work activities will be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m3 or less at the monitoring point.
- Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen sulfide, carbon monoxide) may also need to be monitored. Response levels and actions will be pre-determined, as necessary, for each site.

2.5.2. Special Requirements for Indoor Work With Co-Located Residences or Facilities

Unless a self-contained, negative-pressure enclosure with proper emission controls will encompass the work area, all individuals not directly involved with the planned work must be absent from the room in which the work will occur. Monitoring requirements shall be as stated above under "Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures" except that in this instance "nearby/occupied structures" are adjacent occupied rooms. Additionally, the location of all exhaust vents in the room and their discharge points, as well as potential vapor pathways (openings, conduits, etc.) relative to adjoining rooms, will be understood and the monitoring locations established accordingly. In these situations, it is strongly recommended that exhaust fans or other engineering controls be used to create negative air pressure within the work area during remedial activities. Additionally, it is strongly recommended that the planned work be implemented during hours (e.g. weekends or evenings) when building occupancy is at a minimum.

2.6. Pre-Construction Baseline Sampling

Pre-construction monitoring will be completed to establish baseline ambient air concentrations prior to the start of excavation activities. Baseline conditions will be developed for TVOC and PM-10 in ambient air using real-time fixed station sampling methods. Monitoring methods will follow those described in subsection 2.2.1. TVOC and PM-10 data will be recorded 24 hours per day for a minimum of three days. In addition, air samples will be collected for time-weighted average VOC analysis.

2.7. Meteorological Monitoring

A meteorological monitoring station will be established on site during remedial activities to continuously monitor and record temperature, relative humidity, wind speed, and wind direction. Fifteen-minute averages for each meteorological parameter will be transmitted to the central data storage location to determine upwind and downwind stations for assessing Alert, Response, and Action Levels.

2.8. Reporting

GEI will report TVOC or dust exceedances above Response Levels or Action Levels to Con Edison, NYSDEC, and NYSDOH separately via email and within 60 minutes of the exceedance via e-mail at a minimum.

GEI will prepare and submit weekly reports during remedial activities to the Contractor, Con Edison, and NYSDEC summarizing the CAMP monitoring data. Each report will consist of a letter-style report and daily charts/tables/graphs summarizing the following:

- Maximum 15-minute average concentrations of TVOC, and PM-10.
- Upwind and downwind comparison of Response Levels and Action Level reached during the weekly period.

- Summary of site activities.
- Air monitoring station locations.
- Meteorological conditions.

Following the completion of all the work, Final Remedial Investigation and Engineering Reports will be prepared for the Site. As part of the reports, the CAMP activities will be documented.

2.9. Data Management Procedures

This section of the Plan discusses the data management procedures that will be used during the remedy. Data may be generated from a variety of sources, including real-time fixed station monitoring, supplemental walk-around monitoring, tripod-mounted monitoring stations, and meteorological monitoring.

These data must be reduced, evaluated, verified, and presented to related parties in a timely manner to facilitate decision-making. The data management process for each source of data is discussed below.

Monitoring data generated at each fixed station are sent to the central computer system via radio telemetry or will be manually downloaded daily. The monitoring data will also be downloaded to the project database for data evaluation. The following daily charts, tables, or figures will be prepared:

- Instantaneous and averaged TVOC concentrations compared to the TVOC Action Level.
- Instantaneous and averaged PM-10 concentrations compared to the PM-10 Action Level.
- Supplemental Hand-Held PM-10 concentrations compared to the Action Level (if any).
- Supplemental Hand-Held TVOC concentrations compared to the TVOC Action Level (if any).
- Air monitoring station locations.

The following daily charts, tables, graphs or figures will be prepared:

- Maximum 15-minute average concentrations of TVOC and PM-10.
- Upwind and downwind comparison of Response Level and Action Levels reached during the week if the daily maximum 15-minute average concentrations of TVOC and PM-10 exceeded a Response Level or Action Levels.
- Summary of site activities.
- Air monitoring station locations.

GEI will review all real-time data in a timely manner following collection and prepare a final summary report for Con Edison.

3. Response Plan

The purpose of this section is to identify the procedures to be followed in response to elevated levels of target compounds measured during intrusive activities. Response actions will be enacted by the Contractor and Con Edison. GEI will report any occurrences where a Response Level or Action Level is exceeded, which would require response measures to be enacted. The NYSDEC and NYSDOH will be notified of any occurrence where a Response Level and/or Action Level (NYSDOH threshold) is exceeded. If there is a verified exceedance, GEI will inform Con Edison, NYSDEC, and NYSDOH within 60 minutes of the exceedance via e-mail at a minimum. In general, a tiered approach to site conditions with corresponding response actions will be implemented during the air monitoring program. The four tiers of site conditions are defined as follows.

- **Site Condition 1.** Normal or ambient air conditions where TVOC and PM-10 are less than the Alert and Response Levels.
- **Preliminary Site Condition 2.** Concentration of TVOC only is equal to or greater than the Alert Level, but less than the Action Level.
- **Site Condition 2.** Concentration of PM-10 is equal to or greater than Response Level, but less than the Action Level.
- **Site Condition 3.** Concentration of TVOC or PM-10 is equal to or greater than the Action Level.

The response plan will rely on real-time data generated from the fixed-station equipment and tripod-mounted equipment, and meteorological equipment. These data sources will be evaluated together in order to make appropriate decisions concerning site conditions and potential control measures.

An explanation of the notification system, specific conditions, and response actions for TVOC and PM-10 are presented below.

TVOC and PM-10 concentrations in air will be measured and recorded by station monitors. PM-10 may be temporarily suspended during periods of rain. Figure 5 presents the TVOC decision diagram that will be used to determine the appropriate site condition based on contaminant concentrations. Figure 6 presents the PM-10 decision diagram.

Specific TVOC target concentrations for Site Condition 1, Preliminary Site Condition 2, Site Condition 2, and Site Condition 3 are summarized in Table 1.

3.1. Site Condition 1

Site Condition 1 represents normal site conditions and will be in effect when the TVOC concentration is less than the Alert Level of 3.7 ppm and PM-10 is less than the Response Level of 100 $\mu g/m^3$. Under a Site Condition 1, each PID and particulate monitor located at the monitoring stations will collect and analyze TVOC and PM-10 at a frequency of one sample per minute.

3.2. Preliminary Site Condition 2

Preliminary Site Condition 2 will be in effect if the TVOC concentration is greater than or equal to the Alert Level of 3.7 ppm but less than the Action Level of 5.0 ppm.

At this time, the upwind and downwind concentrations will be compared to determine if the Preliminary Site Condition 2 is due to site activities. If downwind TVOC concentrations are greater than upwind concentrations, then it will be assumed that the Preliminary Site Condition 2 is due to site activities.

If the above condition is true, then a Preliminary Site Condition 2 will be verified. Under a verified Preliminary Site Condition 2, GEI will inform Con Edison and the Contractor. The contractor will implement mitigation control measures to abate the emissions and reduce levels back below the Alert Level. Possible Preliminary Site Condition 2 response actions are listed in Table 2. The site will remain in Preliminary Site Condition 2 as long as the TVOC concentration is between 3.7 ppm (Alert Level) and 5.0 ppm (Action Level), based on 15-minute averages.

The site will return to Site Condition 1 if the 15-minute average concentration of TVOC is less than the Alert Level of 3.7 ppm.

3.3. Site Condition 2

Site Condition 2 will be in effect if the average 15-minute PM-10 concentration at a station is greater than 100 μg/m3 and related to site activities.

The upwind and downwind PM-10 concentrations will be compared to determine if the elevated PM-10 concentrations are due to site activities. If downwind PM-10 concentrations are 100 μg/m3 greater than upwind concentrations (Response Level), then it will be assumed that the Site Condition 2 is due to site activities.

Under Site Condition 2, GEI will inform Con Edison, the Contractor, NYSDEC, and NYSDOH. The Site Condition 2 will remain in effect as long as the average PM-10 concentration is greater than or equal to 100 μg/m3 above upwind conditions (Response Level), and less than or equal to 150 μg/m3 (Action Level). Under a verified Site Condition 2, dust suppression techniques must be implemented by the Contractor. At this point, routine monitoring continues, and 15-minute averages continue to be evaluated. Work may continue with dust suppression techniques if downwind PM-10 levels do not exceed 150 μg/m3 above the upwind level (Action Level) and if no visible dust is migrating off site from the work area.

A contingency meeting/conference call attended by GEI, the Contractor, Con Edison, and NYSDEC will be held within 60 minutes of the verified Site Condition 2 if the condition is not mitigated by dust suppression techniques. Possible response actions for dust control are listed in Table 2.

3.4. Site Condition 3

Site Condition 3 will be in effect if the TVOC concentration increases to greater than the Action Level of 5.0 ppm or the average 15-minute PM-10 concentration exceeds 150 $\mu g/m^3$ above the current average upwind concentration (Action Level). Site Condition 3 will remain in effect if one of the following conditions is true.

- The TVOC concentration is greater than 25 ppm (Action Level).
- The average 15-minute PM-10 concentration exceeds 150 μg/m3 above the current average upwind concentration (Action Level).

Under Site Condition 3, GEI will inform Con Edison, the Contractor, NYSDEC, and NYSDOH. All construction activities will be halted. The contractor will implement mitigation control measures to abate the emissions and reduce levels back below the Action Levels. Possible Site Condition 3 corrective measures/actions are listed in Table 2. After appropriate corrective measures/actions are taken, work activities may resume if the following conditions are met:

- TVOC concentration at the Site perimeter is no more than 5.0 ppm above background for the 15-minute average; and
- Dust suppression measures and other controls are successful in reducing the downwind PM-10 concentration to within 150 $\mu g/m^3$ of the upwind level and in preventing visible dust migration.

3.5. Visible Dust

In addition to measured PM-10 levels, the CAMP requires monitoring of visible dust conditions. Best Management Practices will be utilized to minimize dust generation, with dust suppression techniques in-place and ready for utilization in the event that visible dust migration occurs Proactive measures will be implemented to prevent visible dust and the potential for visible dust to leave the site. Work may continue with dust suppression techniques if downwind PM-10 levels do not exceed the Action Level concentration of 150 $\mu g/m^3$ above the upwind level and if no visible dust is migrating from the work area.

4. References

New York State Department of Environmental Conservation (2010). DER-10/Technical Guidance for Site Investigation and Remediation. Division of Environmental Remediation. May 3, 2010. Appendix 1A. pp. 204-206.

New York State Department of Environmental Conservation (2010). DER-10/Technical Guidance for Site Investigation and Remediation. Division of Environmental Remediation. May 3, 2010. Appendix 1B. pp. 207-208.

Tables

Table 1 Target Concentrations for Site Conditions

Table 2 Site Conditions and Response Actions

Table 1. Target Concentrations for Site Conditions
Community Air Monitoring Plan
Woodworth Avenue Former MGP Site
Yonkers, New York

Target Parameter	Internal Requirement[1]	DER-10 generic CAMP requirements[2]	
	Alert Level	Response Level	Action Level
TVOC (15-minute Average Concentration)	3.7 ppm	NA	5.0 ppm
TVOC (1-minute Measured Concentration)	NA	NA	25 ppm
PM-10 (15-minute Average Concentration)	NA	100 µg/m^3	150 µg/m^3

Site Condition	TVOC	PM-10	Notification Required
Site Condition 1	Less than Alert Level (<3.7 ppm)	Less than Response Level (<100 µg/m^3)	NA
Preliminary Site Condition 2	Greater than or equal to Alert Level less than Action Level (≥3.7 ppm and <5 ppm)	NA	Con Edison, Construction manager (if applicable), Contractor
Site Condition 2	NA	Greater than or equal to Response Level and less than Action Level (≥100 µg/m^3 and <150 µg/m^3)	Con Edison, Construction manager (if applicable), Contractor, NYSDEC, and NYSDOH
Site Condition 3	Greater than or equal to Action Level (≥5 ppm or ≥25 ppm)	Greater than or equal to Action Level (≥150 µg/m^3)	

Notes:

[1] Alert Levels are not established by the NYSDOH or NYSDEC and are internally established concentration levels for total volatile organic compounds. Alert Levels are set below the levels established by the NYSDOH so that actions can be taken prior to exceeding a NYSDOH threshold. An Alert Level serves as a preemptive tool to trigger contingent measures, if necessary, to assist in minimizing off-site transport of contaminants during remedial activities.

[2] Response Levels and Action Levels are defined in Appendix 1A of the New York State Department of Environmental Conservation *DER-10 / Technical Guidance for Site Investigation and Remediation* (NYSDEC, 2010).

µg/m^3 - micrograms per cubic meter

ppm - parts per million by volume

TVOC - total volatile organic compounds

PM-10 - particulate matter (i.e. dust) less than 10 microns in diameter

NA - not applicable

Table 2. Site Conditions and Response Actions
Community Air Monitoring Plan
Woodworth Avenue Former MGP
Yonkers, New York

Site Condition	Control Measure
Site Condition 1	Normal site activities - No control measures required
Site Condition 2	Establish trend of data and determine if evaluation/wait period is warranted Temporarily stop work Temporarily relocate work to an area with potentially lower emission levels Apply water to area of activity or haul roads to minimize dust levels Reschedule work activities Cover all or part of the excavation area Apply VOC emission suppressant foam over open excavation areas Slow the pace of construction activities Change construction process or equipment that minimize air emissions Install a perimeter barrier fence Apply water on haul roads* Wet equipment and excavation faces* Spray water on buckets during excavation and dumping* Haul materials in properly tarped or watertight containers* Restrict vehicle speeds to 10 mph* Cover excavated areas and material after excavation ceases* Reduce the excavation size and/or number of excavations*
Site Condition 3	Halt work Encapsulate construction area and treat air exhaust Perform work during cold weather Cease construction activities Re-evaluate air monitoring work plan

Notes:

The control measures specified under each site condition can be implemented in any order that is most appropriate under the existing site conditions.

* Control measures suggested in the New York State Department of Environmental Conservation *DER-10 / Technical Guidance for Site Investigation and Remediation* (NYSDEC, 2010)

VOC - volatile organic compound

mph - miles per hour

Figures

Figure 1 Site Location

Figure 2 Operable Units

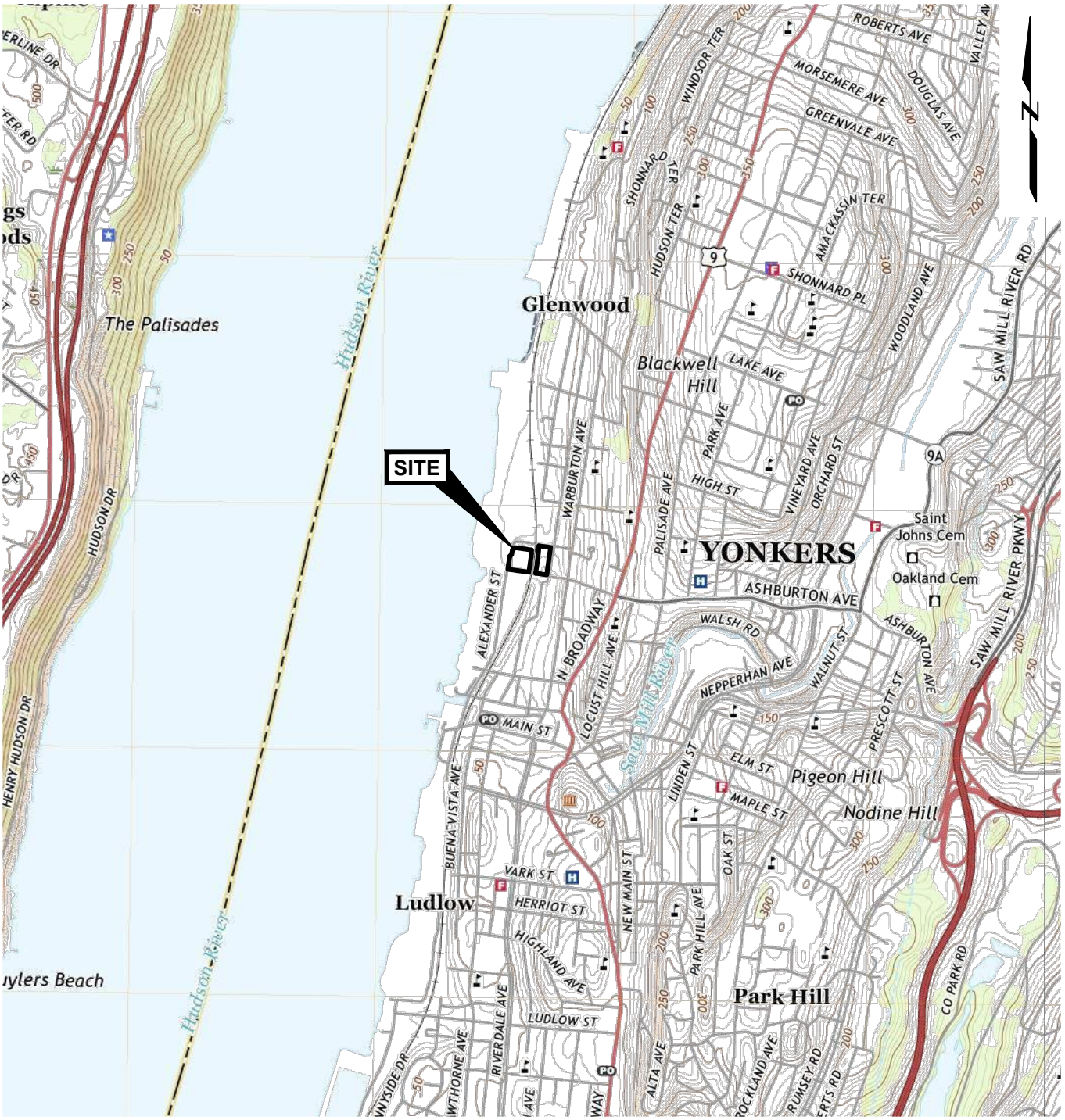
Figure 3 Communication Flow Chart

Figure 4A Example Fixed Station Internal Components

Figure 4B Example Tripod Mounted Station Internal Components

Figure 5 TVOC Decision Diagram

Figure 6 Particulate Matter Decision Diagram



0 2000 4000

SCALE, FEET



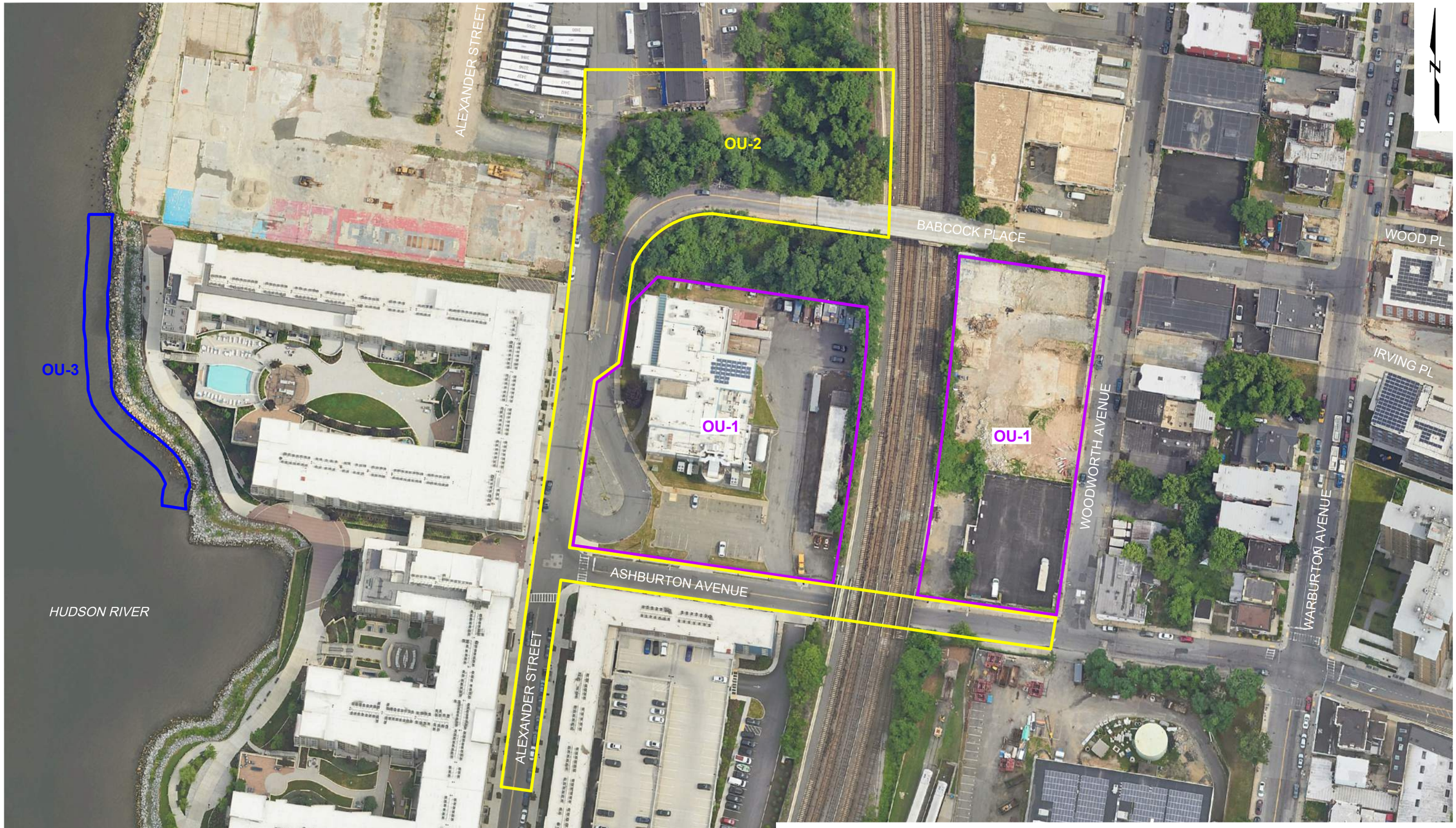
QUADRANGLE LOCATION

SOURCE:

USGS TOPOGRAPHIC QUADRANGLES, 7.5 MINUTE SERIES:
MOUNT VERNON AND YONKERS, NY, 2019.
NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88)
10-FOOT CONTOUR INTERVAL

OU-2 Remedial Investigation Work Plan Woodworth Avenue Works Former MGP Site City of Yonkers, New York	GEI Consultants	SITE LOCATION MAP
Consolidated Edison Company of New York New York, New York	Project 2101005	April 2026 Fig. 1

---- B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\00_CAD\Figures\OU2RIWP\1_2101005_O2RIWP_SLM.dwg - 10/2/2025



0 100 200

SCALE: 1" = 100'

SOURCE:

GOOGLE EARTH PRO, ©2022 GOOGLE LLC,
IMAGE DATE: 6/13/2022.

OU-2 Remedial Investigation Work Plan
Woodworth Avenue Works Former MGP Site
City of Yonkers, New York

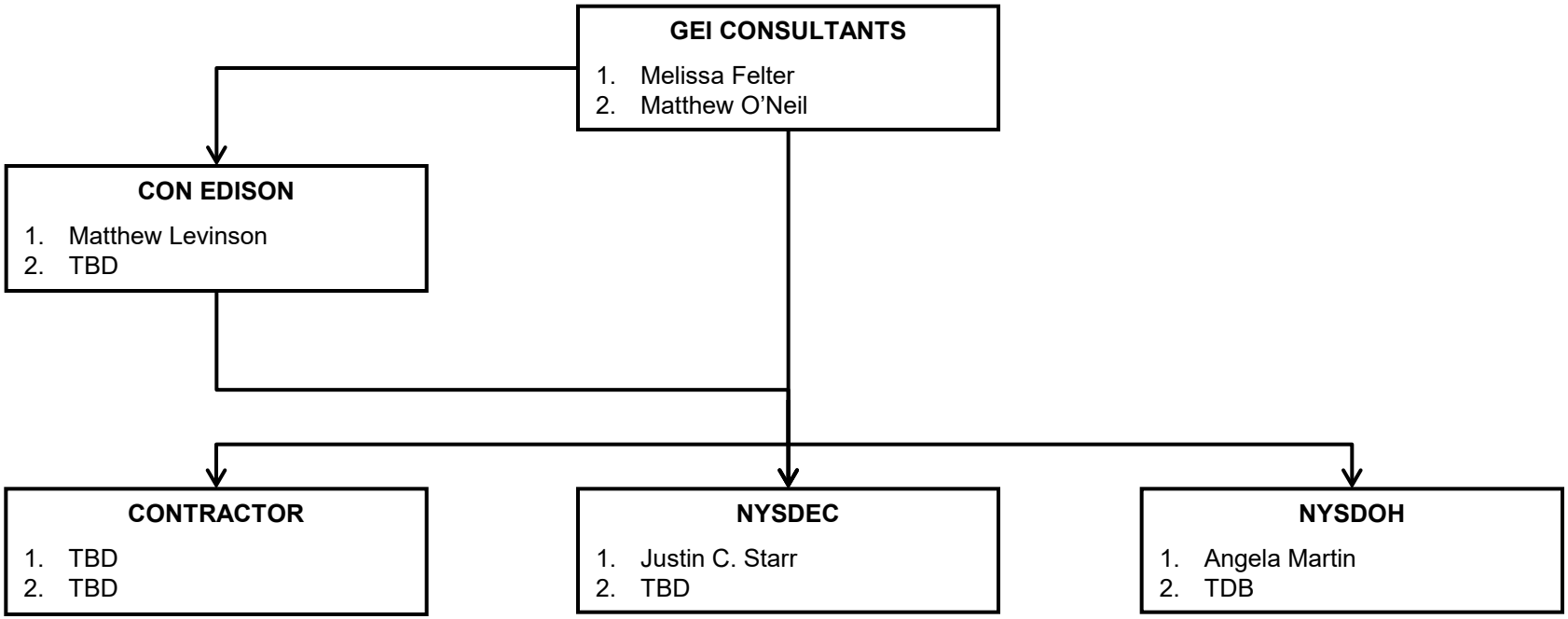
Consolidated Edison Company of New York
New York, New York

GEI Consultants

OPERABLE UNITS

Project 2101005 | April 2026 | Fig. 2

---- B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\00_CAD\Figures\OU2RIWP\2_2101005_O2RIWP_OUS.dwg - ----



If the primary contact is unavailable, contact alternatives in the order shown

All applicable parties will be notified within 60 minutes of an exceedance of a Response Level or Action Level at the site perimeter.

NOTE:
TBD = To Be Determined

Community Air Monitoring Plan
Woodworth Avenue Former MGP Site
Westchester County, Yonkers, New York

Consolidated Edison Company Of New York, Inc.
New York, New York

GEI Consultants

COMMUNICATION FLOWCHART

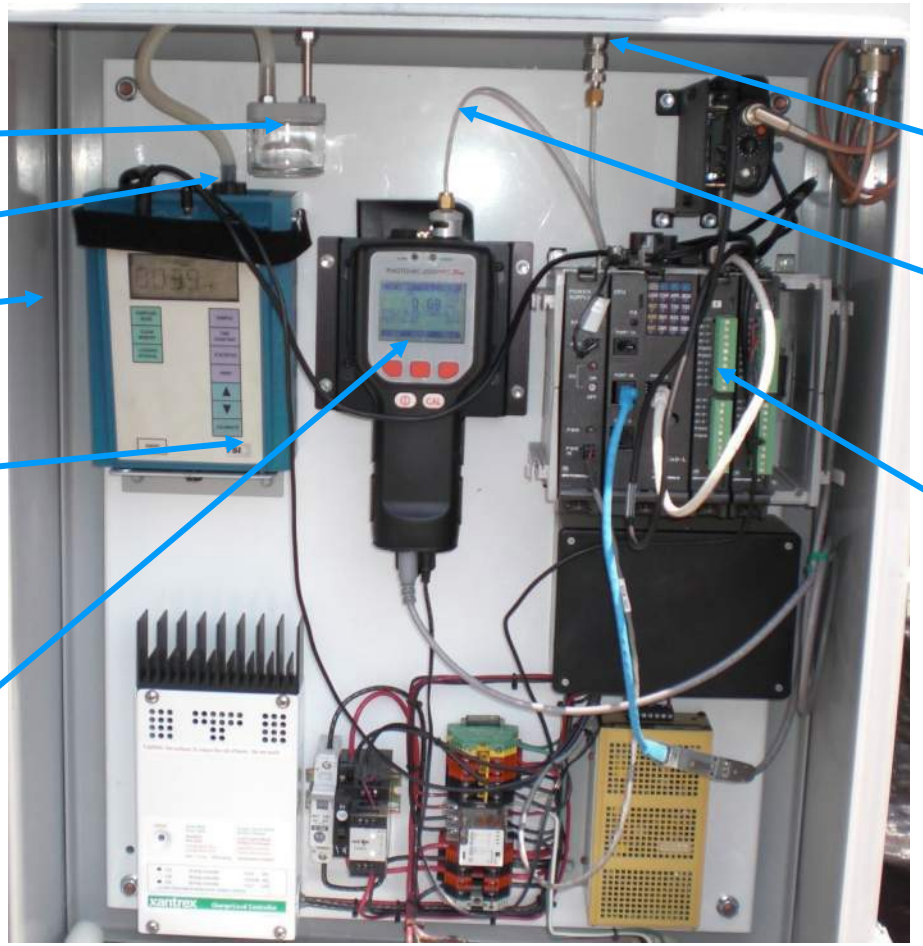
Project 2101005

April 2026

Figure 3

B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\Reports\IRM Work Plan\Appendix C CAMP\template





1. Solar Panel
2. Particulate aerosol monitor sample tubing with in-line condenser
3. Particulate aerosol monitor sample inlet with PM-10 impactor
4. Station enclosure
5. Particulate Aerosol Monitor
6. Photoionization detector (PID)
7. PID sample inlet
8. PID sample inlet tubing
9. Data communications device

NOTE:
Figure depicts an AirLogics™, LLC Light air monitoring station as an example and may not be representative of the actual system or components that will be employed at the site

Community Air Monitoring Plan
Woodworth Avenue Former MGP Site
Westchester County, Yonkers, New York

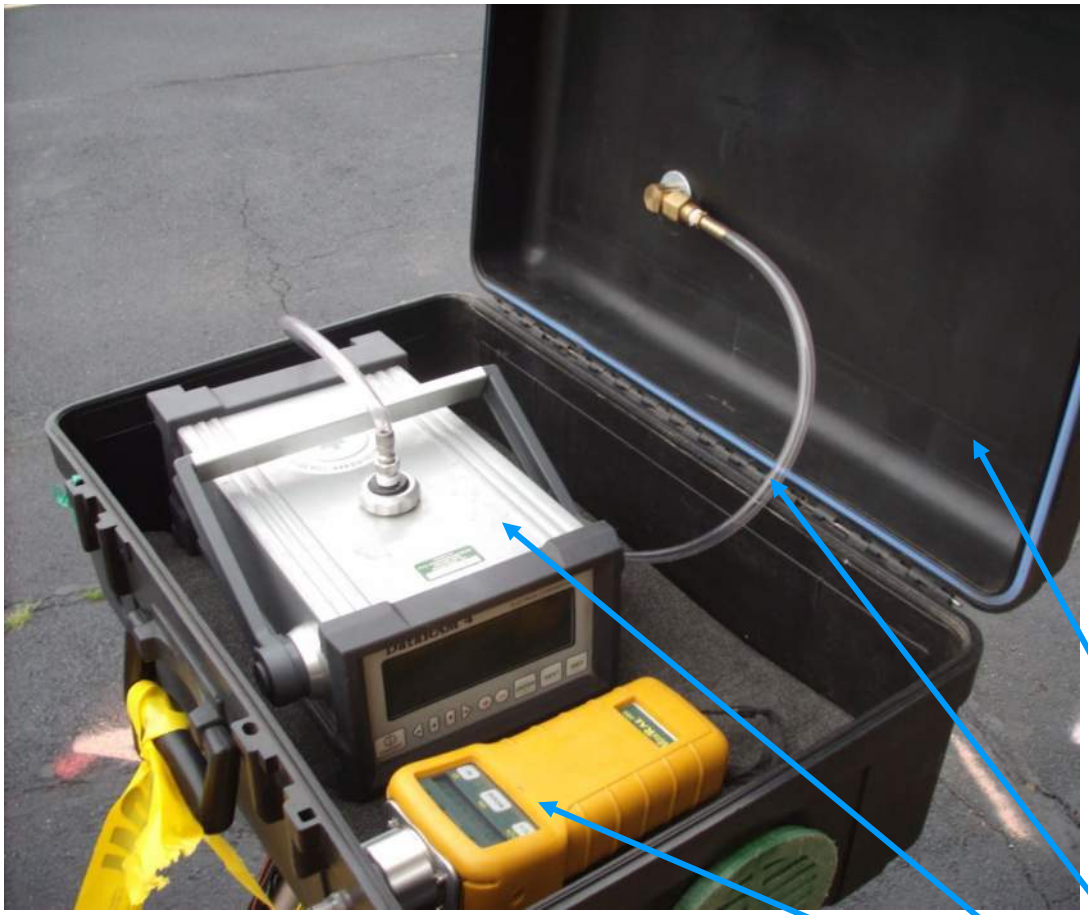
Consolidated Edison Company Of New York, Inc.
New York, New York

GEI Consultants

Project 2101005

EXAMPLE FIXED STATION INTERNAL COMPONENTS

April 2026 Figure 4A





(1) (2) (3) (4)

1. Photoionization detector (PID)
2. Particulate aerosol monitor
3. Particulate aerosol monitor sample tubing
4. Station enclosure

NOTE:
Figure depicts a Pine Environmental air monitoring station as an example and may not be representative of the actual system or components that will be employed at the site

Community Air Monitoring Plan
Woodworth Avenue Former MGP Site
Westchester County, Yonkers, New York

Consolidated Edison Company Of New York, Inc.
New York, New York

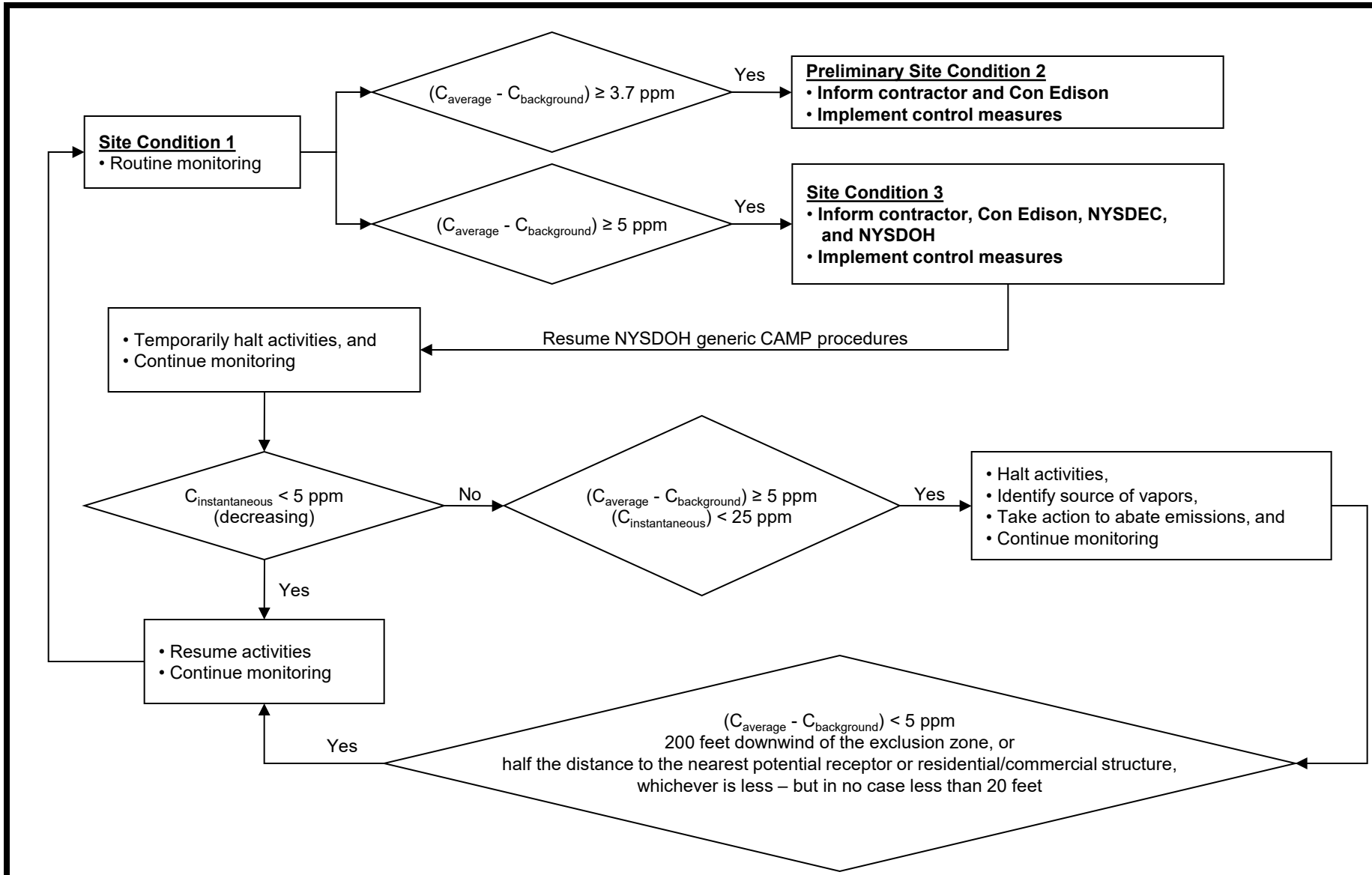
GEI Consultants

Project 2101005

EXAMPLE TRIPOD MOUNTED STATION INTERNAL COMPONENTS

April 2026 Figure 4B

B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\Reports\IRM Work Plan\Appendix C CAMP\template



NOTES:

1. TVOC – Total Volatile Organic Compound
2. ppm – parts per million
3. $C_{average}$ = 15-minute average concentration
4. $C_{background}$ = 15-minute average concentration upwind
5. $C_{instantaneous}$ = 1-minute measured concentration

Community Air Monitoring Plan
Woodworth Avenue Former MGP Site
Westchester County, Yonkers, New York

Consolidated Edison Company Of New York, Inc.
New York, New York

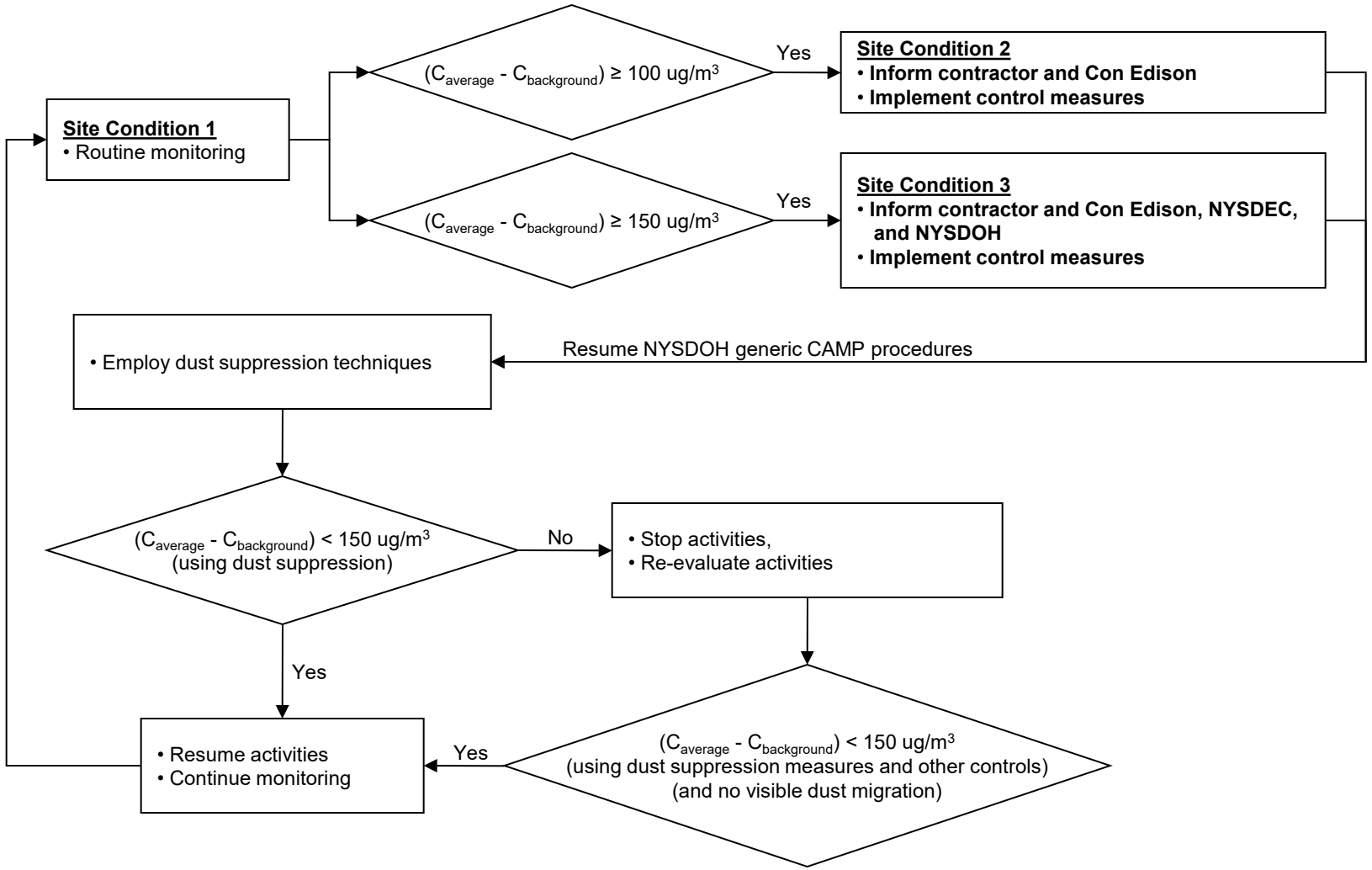
GEI Consultants

Project 2101005

TVOC
DECISION DIAGRAM

April 2026 Figure 5

B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\Reports\IRM Work Plan\Appendix C CAMP\template



NOTES:

1. PM-10 – particulate matter
2. µg/m^3 – micrograms per cubic meter
3. $C_{average}$ = 15-minute average concentration
4. $C_{background}$ = 15-minute average concentration upwind

Community Air Monitoring Plan
Woodworth Avenue Former MGP Site
Westchester County, Yonkers, New York

Consolidated Edison Company Of New York, Inc.
New York, New York

GEI Consultants

PARTICULATE MATTER DECISION DIAGRAM

Project 2101005 | April 2026 | Figure 6

B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\Reports\IRM Work Plan\Appendix C CAMP\template

Appendix A Community and Environmental Response Plan (CERP)



GEI Consultants

Community and Environmental Response Plan

Woodworth Avenue Works – Former MGP Site

Yonkers, Westchester County, New York
Site ID: 360164

Submitted to:
Consolidated Edison Company of New York
31-01 20th Avenue
Long Island City, NY 11105

Submitted by:
GEI Consultants, Inc. DBA GEI Consultants Engineering, Geology, Architecture & Landscape Architecture
455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
860-368-5300

December 2025
Project No. 2101005



Melissa J. Felter, P.G.
Project Manager

Matthew J. O'Neil, P.E.
Vice President

Table of Contents

Acronyms and Abbreviations iii

1. Introduction 1
1.1. CERP Organization 1

2. Public Communication and Outreach 2
2.1. Con Edison Contact Information 2
2.2. Document Repositories 2
2.3. Regulatory Agency Contact Information 2

3. Public Protection Measures 4
3.1. Warning Signs 4
3.2. Site Fencing 4

4. Community Air Monitoring Program (CAMP) 5
4.1. Odor Control Plan 6
4.2. Fugitive Dust Control 6

5. Site Security Plan 7
5.1. Perimeter Security 7
5.2. Equipment Security 7

6. Erosion and Sediment Control Plan 8
6.1. Description of Construction Activities 8
6.2. Implementation of Erosion Control Measures 8
6.3. Stormwater Runoff Control 8

7. Waste Management Plan 10
7.1. Material Shipping Procedures 10
7.1.1. Non-Impacted Soils for Reuse 10
7.1.2. MGP Impacted Soils and Bulky Waste 10
7.1.3. Uncontaminated Bulky Waste 11
7.1.4. Impacted Groundwater and Decontamination Water 11

8. Traffic Management Plan 12

Figures

Figure 1 Communication Flow Chart
Figure 2 TVOC Decision Diagram
Figure 3 Particulate Matter Decision Diagram

MJF/MJO:bdp
B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\CAMP Data\Site-Wide CAMP\CERP_2025.12.12.docx

Acronyms and Abbreviations

CAMP	Community Air-Monitoring Plan
CERP	Community and Environmental Response Plan
COC	Constituents of Concern
Con Edison	The Consolidated Edison Company of New York, Inc.
DER-10	[Division of Environmental Remediation]-10, Technical Guidance for Site Investigation and Remediation
EWP	Excavation Work Plan
GEI	GEI Consultants, Inc. DBA GEI Consultants Engineering, Geology, Architecture & Landscape Architecture
MGP	Manufactured Gas Plant
NAVD	North American Vertical Datum
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OU	Operable Unit
PID	Photoionization Detector
PM-10	Particulate Matter Less than 10 Micrometers in Size
TVOC	Total Volatile Organic Compounds
USEPA	United States Environmental Protection Agency
$\mu g/m^3$	Micrograms per meter cubed
ppm	Parts per million

1. Introduction

Con Edison Company of New York, Inc. (Con Edison) has prepared this Community and Environmental Response Plan (CERP) to summarize the controls, monitoring and/or work practices that will be implemented during the remediation of the Woodworth Avenue Works Former Manufactured Gas Plant (MGP) site (the Site) to address the potential for short-term impacts to the surrounding community or environmental resources. The remediation will include the removal of MGP-related source material observed in the subsurface at the Site. The Site is comprised of two Operable Units (OU). OU-1 includes the former MGP Site, which is comprised of three blocks and seven lots bounded by Woodworth Avenue to the east, Alexander Street to the west, Ashburton Avenue to the south, and Babcock Place to the north. OU-2 includes the side- and down-gradient impacts associated with the former operations of OU-1.

The CERP is a concise summary of the controls, monitoring, and work practices and how they combine to provide the necessary protection of the community and ecological resources. Information on where to find site-related documents and information is located in Section 2. The purpose of the CERP is to provide members of the community with information on the steps and programs that have been put in place in order to protect their health and minimize the disturbance caused by construction activity. This effort will be performed under the approval and oversight of the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH).

This CERP has been prepared in accordance with the Order on Consent, Index Number CO0-20180516-519, Site No. 360164 (the Order) signed by Con Edison and the NYSDEC, the NYSDEC-Interim Remedial Measure Work Plan (IRMWP) presenting the selected IRM for OU-1, and Section 5.1(f) NYSDEC *Final DER-10 Technical Guidance for Site Investigation and Remediation,* dated May 2010.

1.1. CERP Organization

This CERP has been organized in general accordance with the Section 5.1(f) NYSDEC *DER-10* as follows:

- Section 1 – Introduction, describes the purpose and objectives of the CERP
- Section 2 – Public Communication and Outreach
- Section 3 – Public Protection Measures
- Section 4 – Community Air Monitoring Plan (CAMP)
- Section 5 – Site Security Plan
- Section 6 – Erosion and Sediment Control Plan
- Section 7 – Waste Management Plan
- Section 8 – Traffic Management Plan

2. Public Communication and Outreach

2.1. Con Edison Contact Information

If members of the community have questions or wish to report a concern, they can contact Con Edison at 877-602-6633.

2.2. Document Repositories

Con Edison has established local document repositories for site-related documents. The documents are available to the community to review throughout the remedial program at the following locations. A telephone number is provided for each location so that members of the public can call ahead for an appointment.

NYSDEC Central Office,
625 Broadway, 11th Floor
Albany, New York 12233-7014
Attn: Justin Starr, P.G.
(518) 402-9662

Riverfront Library
1 Larkin Center
Yonkers, NY 10701
Call for information: (914) 375-7940

Access to project documents is also available through the DECinfo Locator website and at: https://www.dec.ny.gov/data/DecDocs/360164/.

2.3. Regulatory Agency Contact Information

The remediation work at the Site is being performed under the oversight of the NYSDEC. The contact information for the NYSDEC and other regulatory agencies involved in providing oversight for the remedial work being performed at the Woodworth Avenue Works site are presented below.

New York State Department of Environmental Conservation:

Justin Starr, P.G.
Project Manager
Remedial Bureau C Division of Remediation
New York State Department of Environmental Conservation
625 Broadway
Albany, New York, 12233
(518) 402-9662

New York State Department of Health:

Angela Martin
Project Manager
Bureau of Environmental Exposure Investigation
New York State Department of Health
Corning Tower
Empire State Plaza
Albany, NY 12237
(518) 473-4671
Angela.Martin@health.ny.gov

3. Public Protection Measures

Con Edison and their Contractor will implement a number of plans to protect the public from physical hazards at the Site. Each of these measures is designed to make the area surrounding the remediation safe for the general public.

3.1. Warning Signs

The contractor will place signs at the Site entrance indicating that the Site is being remediated by Con Edison under the oversight of the NYSDEC. In addition, signs will be placed on the gate indicating that the Site is an active construction site and only authorized personnel are allowed onto the Site.

3.2. Site Fencing

As discussed in Section 5, temporary fencing/barriers will be constructed around the work area. The perimeter fencing is intended to prevent public access to the construction site. This fencing will be monitored during non-working hours by site security as described in Section 5.

4. Community Air Monitoring Program (CAMP)

A site-specific CAMP has been prepared for OU-1. The CAMP is designed to provide monitoring procedures, Alert Limits, Action Limits, and contingency measures if Action Limits are approached. An Alert Limit is a contaminant concentration or odor intensity that triggers contingent measures. An Alert Limit does not suggest the existence of a health hazard but serves instead as a screening tool to trigger contingent measures, if necessary, to assist in minimizing off-site transport of contaminants and odors during remedial activities. An Action Limit is a contaminant concentration or odor intensity that triggers work stoppage. In the event an Action Level has been exceeded, in accordance with the site-specific CAMP, Con Edison, NYSDEC, and NYSDOH will be notified immediately via phone, followed by email and the appropriate response actions will be deployed. Figures 1 through 3 of this document replicate the communications flow and decision tree diagrams included in the CAMP.

During times of ground intrusive activities, fixed air monitoring stations will be placed upwind and downwind of the work area. VOCs and respirable particulates (PM-10) will be monitored at the upwind and downwind stations on a continuous basis. Field monitoring data and a monitoring summary report will be submitted by email on a weekly basis. The CAMP includes a Contingency Plan that defines Alert Levels, Action Levels, and specific response activities to be implemented during working hours if an exceedance of an Alert Limit or Action Limit for a measured compound occurs. The response actions, potentially including work stoppage, are intended to prevent or significantly reduce the migration of airborne contaminants from OU-1.

If the real-time perimeter Action Limits are exceeded or significant nuisance odors are noted, Con Edison, the Engineer, and the Contractor will consult to determine what type of emission control action is appropriate. Actions that may be taken to reduce emissions include the following:

- Spraying water on exposed soil surfaces and/or roadways to suppress windblown dust.
- Covering working areas of exposed impacted soils, trucks loaded with impacts soils, or stockpiles of impacted soils with tarpaulins with vapor-suppressing foam or another vapor control agent.
- Temporarily relocating work to an area with potentially lower emission levels.
- Reduce the production rate or change the sequence of work activities.
- Change the work methods or equipment to alternatives that minimize air emissions.

In practice, these actions will typically be employed proactively to prevent action levels from being reached at the exclusion zone perimeter in the first instance. These above-mentioned Alert and Action Level Concentrations are included in the CAMP and will be summarized in the Contract Documents.

4.1. Odor Control Plan

Construction activities will be performed in such a manner that limits the potential for nuisance odor emissions. All procedures typically used to limit or control MGP impacts to the surrounding community will be used proactively as needed. No work is expected to be conducted within 20 feet of occupied structures. Odor control measures will include the use of odor suppressant foams or solvents. The Contractor will provide materials to act as an odor suppressant. This may include chemical foam (e.g., Rusmar™ Foam), chemical solvents (e.g., BioSolve®) or other Con Edison-approved methods. The Contractor will keep sufficient odor suppressant materials on-site to suppress nuisance odors from open excavations, stockpiles, roll-off containers, or material transport vehicles. The odor suppressant materials and application equivalent will be readily available for use at the excavation and soil staging/stockpile areas at all times. The Contractor will apply odor-suppressing materials to the excavated materials as necessary when stockpiled, during excavation and loading operations, or at any other time and location as directed by Con Edison or NYSDEC to mitigate nuisance odors.

4.2. Fugitive Dust Control

Construction activities will be performed to limit the potential for fugitive dust emissions. Dust control measures will be implemented to minimize the potential for dust generation during soil excavation and handling, and placement of fill. Dust control measures will include water spraying, and/or suppressant foams. The Contractor will provide materials to act as a dust suppressant. This may include tarps and/or water, or chemical foam, (e.g., Rusmar™ Foam), or other Con Edison-approved methods. The Contractor will keep sufficient dust suppressant materials on site to suppress fugitive dust from the excavation. The material will be stored near the excavation and will be easily mobile in case of need.

Truck routes will be continuously monitored for excessive dirt or dust. Proper cleaning of trucks exiting the exclusion zone will aid in minimizing/eliminating dusty conditions on-site. A decontamination pad large enough to accommodate equipment and truck traffic will be constructed at exit points to clean tires of transport trucks exiting OU-1.

Transport trucks exiting the exclusion zone will pass through an inspection area and/or be inspected to ensure tires and undercarriages are clean and that tarps are secured. Excessive mud and loose dirt observed on the trucks will be manually removed with brooms, brushes, and water spray, as necessary.

5. Site Security Plan

The objectives of the Site security plan are to prevent the vandalism/destruction of construction equipment, prevent access, and minimize health and safety concerns for the surrounding area.

5.1. Perimeter Security

The Contractor will erect a temporary fence around the perimeter of each work area location. At a minimum, this will consist of temporary construction fencing, barriers, and lighting surrounding all work areas to include waste handling equipment, storage areas, excavation areas, and construction equipment. Where possible, the Contractor will utilize existing fencing. The fence will be secured at the end of each working day. Barriers or fencing extending onto or adjacent to site access roads shall be visible during day and evening hours.

5.2. Equipment Security

All vehicles and/or equipment left in the work area will be secured at the end of each working day. In addition, vehicles and equipment must remain in a secure location overnight or during non-workdays. No vehicles or equipment may be left overnight in an unsecured location. The Contractor will ensure that all non-essential equipment is de-energized when left on-site and not in use to prevent electrical/fire/explosive hazards. No equipment will be run overnight and/or on non-working days.

The Contractor will make every effort to minimize the storage of equipment or materials in areas other than the specified storage area.

6. Erosion and Sediment Control Plan

The erosion and sediment controls are intended to mitigate erosion and sedimentation from OU-1 as indicated in the Contract Documents.

6.1. Description of Construction Activities

This project involves the excavation of approximately 1,400 cubic yards of MGP-impacted material. The excavation to remove MGP source material within Former Holder No. 2 will be performed to a depth of approximately 19 feet bgs. Dewatering is not anticipated so the work can be executed without compromising the holder foundation walls. Controlled Low Strength Material will be utilized beneath the groundwater table to equalize hydrostatic pressure within the holder and to solidify any residual impacts along the interior walls of the holder.

All storm water runoff from the exterior of the excavation area will be collected, routed, and discharged into the local drainage structures prior to contact with any impacted materials.

Access areas between the excavation area and the adjacent public streets will contain decontamination stations for all trucks and equipment. The decontamination waters will be collected and stored on-site in drums or a tank to be properly disposed of, as necessary.

6.2. Implementation of Erosion Control Measures

Sediment fence will be installed around the entire perimeter of the remediation including all areas to be excavated. The sediment fence acts to trap soil that may be carried by water running across the Site as a result of heavy rain.

Decontamination stations will act as anti-tracking pads, thereby removing all soil and sediment from all trucks/equipment wheels and bodies that are exiting OU-1 onto public streets. All trucks shall have watertight compartments to prevent seepage from wet soil from leaking onto public streets.

The Contractor shall install and maintain the erosion control measures for the duration of the excavation work. Additional erosion control measures may be needed due to unforeseen conditions. The Contractor will install additional measures as necessary and as directed by Con Edison.

6.3. Stormwater Runoff Control

In preparation for and throughout the duration of the remedial activities, the control and diversion of stormwater runoff is essential to reduce the potential for impacted material discharges off site. Stormwater contact with the impacted soils will be limited due to the erosion and sediment control barriers around the area of excavation. Therefore, it is not anticipated that runoff from the exterior will come in contact with the excavation area. The Contractor will be required to utilize appropriate control measures to route the runoff from the collection system to the municipal storm sewer. Stormwater

runoff control measures may include the installation of berms, barriers, and a sump for the collection and discharge of the water.

7. Waste Management Plan

The objectives of the waste management plan at OU-1 are to provide the Contractor with the identification of waste streams to be generated for the proposed activities and management/disposal guidelines for each waste stream. The Contractor will dispose of all waste materials generated as a result of these activities in accordance with all applicable laws and regulations at a Con Edison-approved disposal facility. The procedures outlined in this waste management plan will be followed for all derived wastes.

7.1. Material Shipping Procedures

All material transportation vehicles leaving OU-1 must be watertight and will be decontaminated in accordance with the decontamination plan prior to departing OU-1. In addition, all vehicles transporting impacted soil from OU-1 must have lined beds to prevent leakage, bed covers, and watertight gates.

Individual waste streams will be handled as follows.

7.1.1. Non-Impacted Soils for Reuse

Excavated material from the proposed locations that is not impacted may be suitable for reuse as backfill beneath the cover system. Any excavated soils suitable for reuse that are not used to backfill will be transported off-site for disposal/landfill at an appropriately licensed Con Edison-approved disposal facility capable of handling such material.

7.1.2. MGP Impacted Soils and Bulky Waste

All excavated MGP-related material will be staged on a temporary stockpile until sufficient material is generated for a haul vehicle. The material from the stockpile will be placed directly into haul vehicles and transported directly to an appropriately licensed Con Edison-approved disposal facility. The Contractor will have a primary and an alternate receiving facility prepared to receive the impacted soils prior to excavation.

Vehicles containing excavated soils will be covered with a solid plastic tarp. If necessary, spray-on odor suppressing materials such as Rusmar™ Foam or BioSolve® may be used to reduce potential naissance odors during transit.

Impacted soils that contain too high a water content to be transported safely (e.g., without risk of a liquid spill off-site) must be amended on-site within the excavation area, by the Contractor prior to shipment off-site. All amendments used at OU-1 will meet NYSDEC requirements.

7.1.3. Uncontaminated Bulky Waste

Uncontaminated bulky waste (i.e., asphalt pavement sections, concrete, and debris) will be separated, if possible, from impacted soil upon excavation, immediately placed in a roll-off container or temporarily placed in a stockpile for future loading and transported for disposal as construction debris at an appropriately licensed Con Edison-approved disposal facility.

The Contractor will not conduct on-site crushing of debris due to the limited space available, the potential for additional volatilization, and the generation of additional noise.

7.1.4. Impacted Groundwater and Decontamination Water

Contaminated liquids from decontamination of equipment and personnel will be pumped into drums or a frac tank(s) and disposed of off-site. The drums or tank(s) must be sufficiently sized to contain the wastewater. Tanks should provide some measure of primary treatment (settling) with weirs, baffles or other appropriate technology, and flow equalization, if needed.

The Contractor will arrange for the off-site disposal of all generated wastewater. The Contractor will retain a licensed liquid waste hauler to remove this liquid from OU-1 and properly dispose of this material in accordance with all applicable regulations. The Contractor will be responsible for obtaining any appropriate Federal, State, and/or local permits that may be required. The Contractor will have a primary and an alternate properly permitted, Con Edison-approved receiving facility prepared to receive all liquid wastes generated.

Groundwater measurements from previous investigations indicate that the approximate depth to water in the excavation area ranged between 0.8 and 13.1 ft. bgs. Due to the depth to groundwater at OU-1, it is not anticipated that groundwater will be collected during excavation. However, if impacted groundwater is collected, it will be containerized for off-site disposal.

Solid material collected in the frac tank(s) from settling will be bulked with the MGP-impacted soil and sent to an appropriately licensed Con Edison-approved disposal facility, as necessary.

8. Traffic Management Plan

A traffic management plan is provided in the IRM WP which shows Site location, direction of traffic flow, and the location of flaggers or traffic control personnel as needed for trucks arriving and departing OU-1.

Traffic control personnel will be provided when all trucks are exiting onto Woodworth Avenue from OU-1. Traffic control personnel shall also direct traffic as needed upon delivery of equipment, etc., or during work performed in the road right-of-way in accordance with the applicable permit requirements. No trucks will be allowed to idle for longer than five minutes while at the work area location. All the roadways utilized by the contractor during the work will be checked daily for spillage and seepage, and cleaned to the satisfaction of National Grid, as necessary.

Truck Route Notes:

1. Do not queue trucks and equipment in local streets.
2. Do not idle trucks delivering materials or awaiting loading on OU-1 or on local streets.
3. Provide all necessary flagging for trucks entering/exiting OU-1.
4. Inform all authorities required as to the truck traffic and routes.
5. Follow approved local route to/from I-87.
6. Use only New York City Department of Transportation-approved through truck routes to exit New York City.

Directions Entering OU-1:

Heading North on Route 87:

1. Take Exit 10A for Yonkers Ave toward Mount Vernon (0.2 mi).
2. Turn left onto Mt Vernon Ave/Yonkers Ave (2.6 mi).
3. Turn right toward Ashburton Ave (161 ft).
4. Continue onto Ashburton Ave (1.2 mi).
5. Turn right onto Woodworth Ave, Destination on the left (98 ft).

Heading South on Route 87:

1. Take Exit 10B for Bronx River Rd toward Mount Vernon/Yonkers (233 ft).
2. Turn left onto Bronx River Rd (0.3 mi).
3. Turn right onto Yonkers Ave (2.6 mi).
4. Turn right toward Ashburton Ave (161 ft).

5. Continue onto Ashburton Ave (1.2 mi).
6. Turn right onto Woodworth Ave, Destination on the left (98 ft).

Directions Leaving OU-1:

To Points North:

1. Turn right onto out of OU-1 onto Woodworth Ave toward Ashburton Ave (98 ft).
2. Turn left onto Ashburton Ave (1.2 mi).
3. Turn left onto Yonkers Ave (2.6 mi).
4. Sharp left onto Bronx River Rd (499 ft).
5. Turn right onto Oak St (187 ft).
6. Turn left onto the Bronx River Pkwy N ramp (466 ft).
7. Merge onto Bronx River Pkwy.

To Points South:

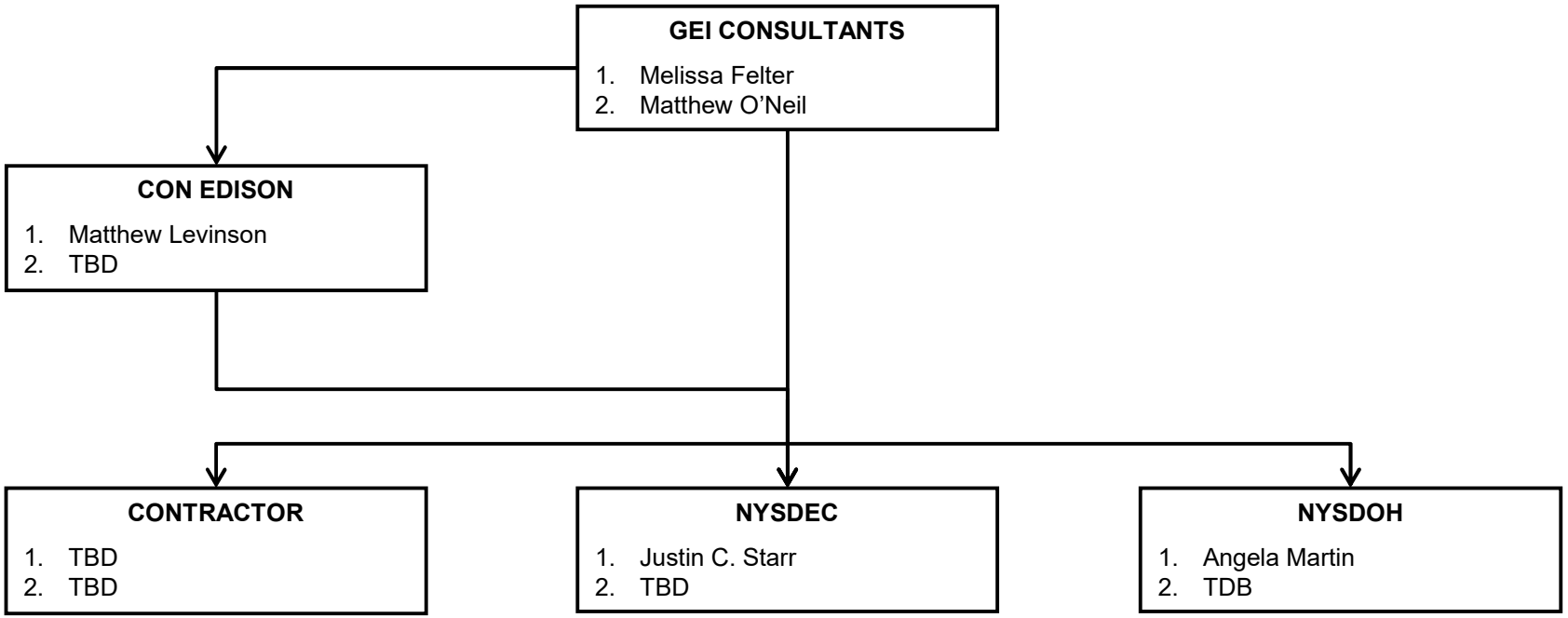
1. Turn right onto out of OU-1 onto Woodworth Ave toward Ashburton Ave (98 ft).
2. Turn left onto Ashburton Ave (1.2 mi).
3. Turn left onto Yonkers Ave (2.2 mi).
4. Turn right onto Raybrook Rd (0.2 mi).
5. Turn right onto Bronx River Rd (0.4 mi).
6. Turn left to merge onto Bronx River Pkwy.

Figures

Figure 1 Communication Flowchart

Figure 2 TVOC Decision Diagram

Figure 3 Particulate Matter Decision Diagram



If the primary contact is unavailable, contact alternatives in the order shown

All applicable parties will be notified within 60 minutes of an exceedance of a Response Level or Action Level at the site perimeter.

NOTE:
TBD = To Be Determined

Community and Environmental Response Plan
Woodworth Avenue Former MGP Site
Westchester County, Yonkers, New York

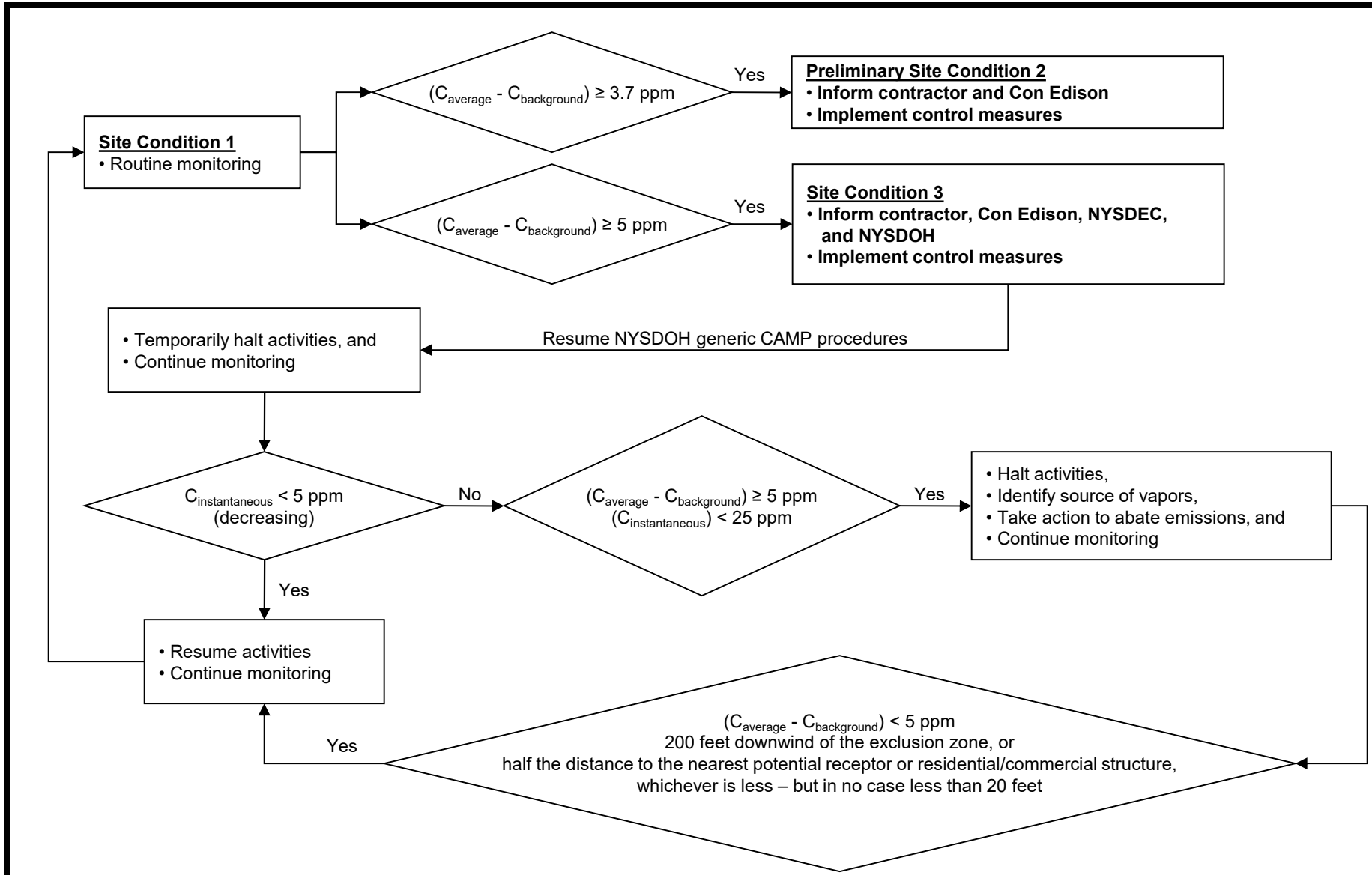
Consolidated Edison Company Of New York, Inc.
New York, New York

GEI Consultants

COMMUNICATION FLOWCHART

Project 2101005 | December 2025 | Figure 1

B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\Reports\IRM Work Plan\Appendix C CAMP\template



NOTES:

1. TVOC – Total Volatile Organic Compound
2. ppm – parts per million
3. $C_{average}$ = 15-minute average concentration
4. $C_{background}$ = 15-minute average concentration upwind
5. $C_{instantaneous}$ = 1-minute measured concentration

Community and Environmental Response Plan
Woodworth Avenue Former MGP Site
Westchester County, Yonkers, New York

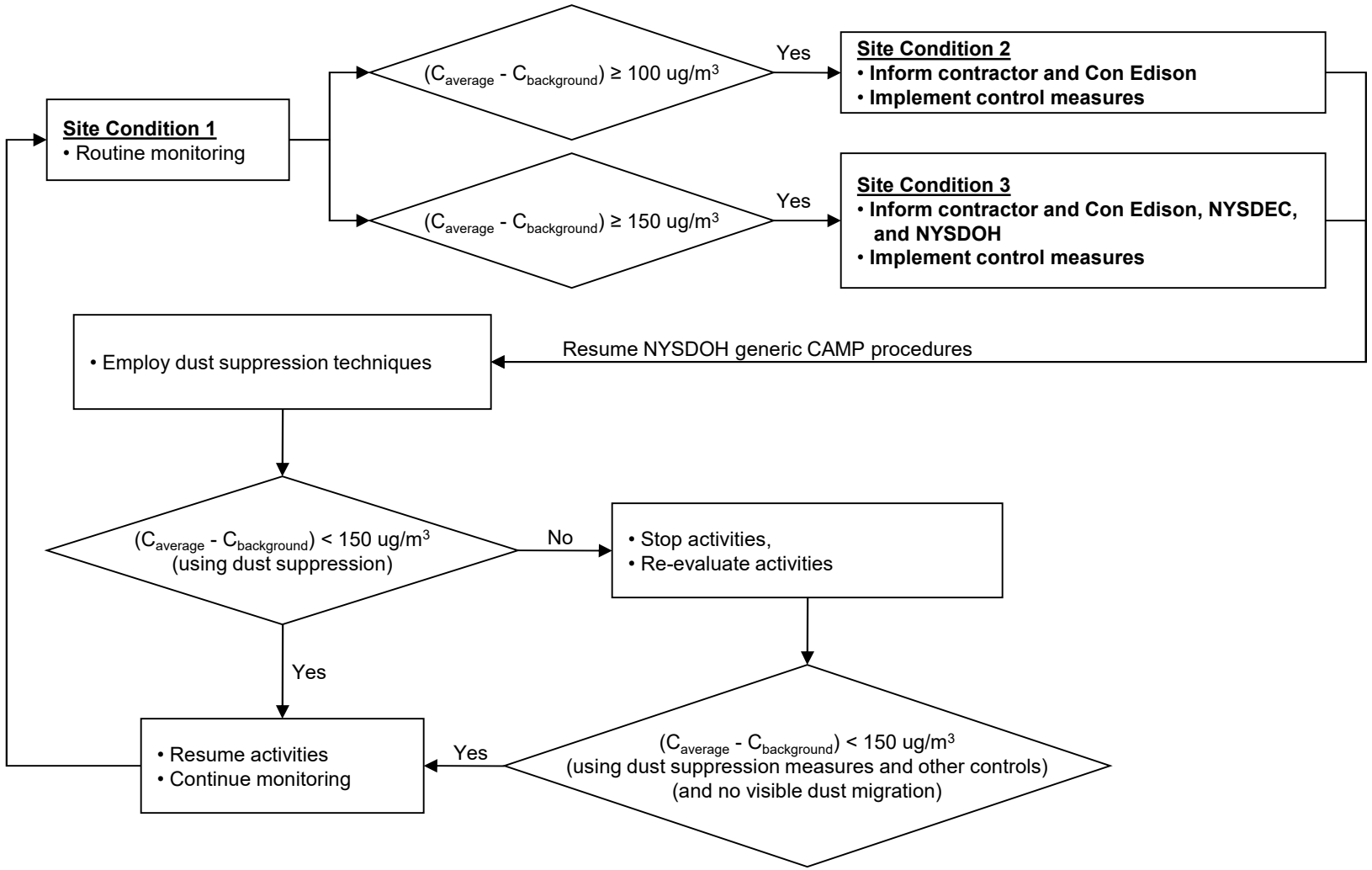
Consolidated Edison Company Of New York, Inc.
New York, New York

GEI Consultants

TVOC
DECISION DIAGRAM

Project 2101005 | December 2025 | Figure 2

B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\Reports\IRM Work Plan\Appendix C CAMP\template



NOTES:

1. PM-10 – particulate matter
2. µg/m^3 – micrograms per cubic meter
3. $C_{average}$ = 15-minute average concentration
4. $C_{background}$ = 15-minute average concentration upwind

Community and Environmental Response Plan
Woodworth Avenue Former MGP Site
Westchester County, Yonkers, New York

Consolidated Edison Company Of New York, Inc.
New York, New York

GEI Consultants

PARTICULATE MATTER DECISION DIAGRAM

Project 2101005 | December 2025 | Figure 3

B:\Working\CON ED\1900674 Former Woodworth Ave MGP Site\Reports\IRM Work Plan\Appendix C CAMP\template

Appendix B DER-10 Appendix 1A Generic CAMP

Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

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

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

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

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

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

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

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

Particulate Monitoring, Response Levels, and Actions

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

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

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

December 2009