ecology and environment
engineering and geology, p.c.

Sampling and Analysis Plan
Upgradient Subsurface Investigation
Post Road Corridor White Plains Off-Site, Site No. C360129A
White Plains, Westchester County, New York
June 2026

Prepared for: New York State Department of Environmental Conservation (NYSDEC)
Prepared by: Ecology and Environment Engineering and Geology, P.C. (E & E)

1 Objective

Pursuant to NYSDEC Work Assignment Number D009807-26, E & E has prepared this Sampling and Analysis Plan (SAP) to conduct a subsurface investigation in an area located off-site and upgradient of the Post Road Corridor White Plains Site, NYSDEC Brownfield Cleanup Program (BCP) Site No. C360129, located at 77 West Post Road, White Plains, New York (the Site). The off-site area surrounding the BCP Site is identified as NYSDEC Site No. C360129A. The subsurface investigation activities include soil borings, soil sampling, groundwater monitoring well installation, and groundwater sampling to evaluate whether an off-site source of chlorinated volatile organic compounds (CVOCs) has impacted soil and groundwater upgradient of the Site. Environmental activities conducted at the Site by others have identified CVOCs, including tetrachloroethene (PCE) and trichloroethene (TCE), in groundwater samples collected from monitoring wells located along the upgradient boundary of the Site. A site location map is provided as Figure 1, and a site plan showing the off-site area of investigation is provided as Figure 2.

2 Background

2.1 Site Description and Environmental History

The Post Road Corridor White Plains BCP Site is a large parcel (comprising several recently combined parcels) currently under redevelopment in a mixed-use urban setting. The Site is currently being used as a temporary parking lot, and no structures remain. Historically, properties within the Site were used for dry-cleaning operations and gasoline service and automotive repair facilities that included underground storage tanks (USTs), aboveground storage tanks (ASTs), and hydraulic lifts.

Previous environmental investigations conducted at the Site by others have identified a range of contaminants in soil and groundwater. CVOCs, including PCE and TCE, have been identified in groundwater samples collected from monitoring wells located along the upgradient boundary of the Site, indicating there may be a potential upgradient source. Based on these findings, the subsurface investigation described in this SAP is being conducted in the off-site area located upgradient (to the southwest) of the Site.

2.2 Off-Site Area Description and Potential Sources

The off-site area of investigation encompasses approximately 2 acres and is located to the southwest (upgradient) of the Site. The area generally includes the triangular block bounded by West Post Road, Rathbun Avenue, and Maple Avenue, and is characterized by a mix of commercial, residential, and institutional land uses.

The off-site area along West Post Road includes multi-tenant storefront buildings, a restaurant, a gasoline service station, and automotive repair facility, and a municipal parking lot. Surrounding areas include residential properties along Lynton Place and the southeastern side of Maple Avenue, as well as office uses and community facilities.

Based on a desktop review, several properties upgradient to the Site have been identified as potential sources of CVOCs. These include: (1) an active dry cleaning facility; (2) a former dry cleaning facility, where it is not known whether dry cleaning operations were conducted on-site; (3) an active gasoline service station and automotive repair facility; and (4) a former gasoline service station.

2.3 Site Geology and Hydrogeology

The off-site area of investigation generally slopes toward the northeast from approximately 250 feet above mean sea level (ft msl) to 240 ft msl at the southwestern boundary of the BCP Site. The area topography continues to decrease across the Site to approximately 210 ft msl.

Based on a review of previous investigations conducted at the Site, the subsurface geology in the vicinity of the Site consists primarily of historic fill overlying native materials that consist primarily of sand with varying amounts of silt, clay, and gravel, with silt lenses. The fill generally consists of fine to coarse-grained sand with varying amounts of silt, gravel, and construction debris. Native till and weathered bedrock have been encountered. The depth to bedrock has been reported at variable depths (approximately 17 to 52 ft bgs).

Groundwater has been encountered at depths ranging from approximately 3 to 11 ft bgs and is inferred to flow generally to the north-northeast. Based on this flow direction and the observed topography, the off-site area located to the southwest is considered hydraulically upgradient of the Site.

The Site area is within the Manhattan Prong of the Hudson Highlands, where Fordham Gneiss and Manhattan Schist form higher elevations and Inwood Marble underlies nearby valleys, including the Bronx River. The local bedrock is of late Precambrian to early Paleozoic age (McGuire, 1997).

3 General Site Activities

All work activities will be performed in accordance with the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (DER-10, May 2010). All field activities will be performed

in accordance with E & E's Master Quality Assurance Project Plan (QAPP) (2020) and Field Activities Plan (2020).

Work Area Traffic Controls
Field activities will be conducted in accordance with applicable municipal and county permit conditions. Proposed boring locations include the parking lane of West Post Road, Rathbun Avenue right-of-way, and a municipal parking lot. Work will be conducted under an approved traffic control plan, including establishment of designated work zones, implementation of appropriate traffic and pedestrian controls, and coordination with local agencies as necessary.

4 Field Activities

4.1 Subsurface Investigation

Drilling and Soil Sampling
E & E will supervise the drilling of six (6) soil borings in the off-site work area and the installation of groundwater monitoring wells at each boring, as described below. The target termination depth is 20 ft bgs. The proposed boring/well locations (Figure 2) and screen intervals were determined in coordination with NYSDEC based on the current understanding of CVOC impacts observed at the Site. The locations may be adjusted in the field, as necessary, to accommodate access restrictions, utility clearances, or other site-specific considerations.

Core Down Drilling LLC (Core Down) has been subcontracted to provide drilling and monitoring well installation services for the proposed investigation activities. The hollow-stem auger drilling method will be used. The drilling subcontractor will be responsible for securing and adhering to any required road-opening permits, contacting Dig Safely New York prior to intrusive activities, and coordinating with additional utility providers as needed. Private utility locating services and soft-dig hand clearing (to a minimum of 5 ft bgs) will be implemented by the subcontractor where necessary. Additionally, Core Down will conduct a ground penetrating radar (GPR) survey at each proposed drilling location.

Continuous soil sampling will be conducted at all boring locations using either split-spoon or macro-core sampling methods. An E & E geologist will describe the recovered core material on a geologic log and screen it for the presence of VOCs using a photoionization detector (PID). Up to three (3) soil samples will be collected from each boring at selected depth intervals based on field observations (including PID readings, lithologic changes, and visual or odor evidence of potential contamination) and submitted for laboratory analysis of VOCs by USEPA Method 8260. All samples will be collected using laboratory-supplied containers, stored on ice in a cooler, and transported under chain-of-custody documentation to Phoenix Environmental Laboratories, Inc. (PEL) of Manchester, Connecticut. A summary of planned soil sampling is provided in Table 1.

During all ground-intrusive activities, a site-specific Community Health and Safety Plan (CHSP) that includes a Community Air Monitoring Plan (CAMP) will be implemented. The CHSP/CAMP is

included as Appendix A. CAMP stations will be placed upwind and downwind of the work area to monitor airborne VOCs and particulates.

Monitoring Well Installation

A permanent monitoring well will be installed in each of the six (6) borings with screened intervals from approximately 10 to 20 ft bgs. Actual well depths and screened intervals may be adjusted based on field conditions. The proposed monitoring well locations are shown on Figure 2.

The monitoring wells will be constructed using 2-inch diameter Schedule 40 PVC riser pipe and a 10-foot length of 2-inch diameter, 0.010-inch slot PVC well screen. The annular space surrounding the well screen will be filled with No. 1 filter sand from the bottom of the borehole to approximately 2 feet above the top of the screened interval. A bentonite seal with a minimum thickness of 2 feet will be installed above the filter sand. The annular space above the seal will be filled with a cement-bentonite mixture. All wells will be secured with watertight caps and completed at grade (flush mount) with an 8-inch diameter manhole encased in a concrete pad.

Monitoring Well Development

All newly installed wells will be developed no sooner than 24 hours after completion of well construction. Well development will be conducted by E & E by surging and pumping to remove fine-grained material introduced during drilling and to improve hydraulic communication with the surrounding formation. Development will continue until the turbidity of the recovered groundwater is less than 50 nephelometric turbidity units (NTU) or asymptotic conditions have been reached; not to exceed 10 total well volumes of purge water or 1 hour of active development time per well. Field parameters, including pH, temperature, and conductivity, will be measured during development activities. Development water will be containerized and managed as investigation-derived waste in accordance with applicable requirements.

Groundwater Sampling

Groundwater samples will be collected from the newly installed wells no sooner than one week following completion of well development. Prior to sampling, groundwater elevations and total well depths will be measured using an electronic water-level indicator capable of measurements to 0.01 foot to evaluate groundwater conditions and assess the potential presence of non-aqueous phase liquid (NAPL).

Groundwater sampling will be conducted at a total of eight (8) monitoring wells, including the six (6) newly installed wells (MW-B1 through MW-B6) and two (2) existing wells along the upgradient boundary of the BCP Site (RW-21 and RW-22). Sampling locations are shown on Figure 2.

Groundwater samples will be collected using USEPA low-flow purging and sampling techniques, utilizing a peristaltic pump, flow-through cell, and dedicated high-density polyethylene (HDPE) tubing. The tubing intake will be positioned approximately 2 feet from the bottom of each screened interval during sampling. Groundwater will be purged at a constant low-flow rate, and samples will be collected following stabilization of groundwater field parameters, including pH,

temperature, and specific conductance, in accordance with USEPA low flow sampling guidance. All groundwater samples will be submitted for laboratory analysis of VOCs by USEPA Method 8260. Samples will be collected using laboratory-supplied containers, stored on ice in a cooler, and transported under chain-of-custody documentation to PEL. A summary of planned groundwater sampling is provided in Table 1.

Survey of Monitoring Well Top-of-Casing

Surveying services for newly installed monitoring wells will be performed by an E & E survey team. The well locations will be surveyed to a minimum horizontal accuracy of ±0.5 foot, and vertical elevations will be provided in feet relative to the North American Vertical Datum of 1988 (NAVD88) to a minimum accuracy ±0.05 foot (reported to 0.01 foot).

5 Decontamination Procedures

All non-dedicated equipment and tools used during field activities will be decontaminated to prevent cross-contamination between sampling locations. Drilling and sampling equipment will be decontaminated between each boring location by removal of visible soil followed by washing with a solution of potable water and laboratory-grade detergent (e.g., Alconox), and a subsequent potable water rinse. Drilling equipment may also be decontaminated by removal of adhered soil and washing with high-pressure water or steam. A final rinse using deionized (DI) water will be performed for sampling equipment. Decontamination water will be placed in Department of Transportation (DOT) compliant 55-gallon drums and managed as investigation-derived waste (IDW), as described below.

6 Sample Quality Assurance/Quality Control

Sample quality assurance/quality control (QA/QC) procedures will be implemented in accordance with E & E's 2020 *Master Quality Assurance Project Plan for New York State Department of Environmental Conservation Projects*, *Contract No. D009807*. Specific QA/QC activities applicable to the implementation of this SAP include:

- Collection of field duplicate samples and matrix spike/matrix spike duplicate (MS/MSD) samples at a frequency of one (1) per twenty (20) samples per matrix;
- Collection of a field blank using laboratory-supplied, analyte-free water; and,
- Inclusion of laboratory trip blanks in each cooler containing samples submitted for VOC analysis.

7 Project Documentation

E & E field personnel will document field activities in a logbook, and photographs will be taken to document site conditions and drilling/sampling locations. Laboratory analytical data will be submitted electronically to NYSDEC and summarized in the work assignment report.

8 Laboratory Information

In consultation with NYSDEC, E & E has directly contracted PEL for laboratory analytical services. PEL is a New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP) certified laboratory and has previously provided laboratory services for work conducted at the Site.

Samples will be transferred to the laboratory under chain-of-custody documentation via a laboratory-provided courier service or other laboratory-approved means. Delivery of sample containers, supplies, and return shipment of samples to the laboratory will be coordinated directly with the laboratory.

9 Investigation-Derived Waste

IDW anticipated to be generated during the investigation includes soil cuttings during drilling, purge water from well development and groundwater sampling, decontamination liquids, and expendable materials (e.g., PPE and sampling supplies). IDW will be placed into DOT-compliant 55-gallon steel drums, which will be sealed, labeled, and staged at the Site prior to off-site transportation and disposal. Solid and liquid IDW will be segregated. Expendable materials such as PPE that do not exhibit evidence of contamination may be disposed as municipal solid waste.

Brookside Environmental, Inc. (Brookside) has been subcontracted for IDW transportation and disposal services. IDW will be managed in accordance with applicable federal, state, and local requirements. IDW drums will be temporarily staged pending completion of waste characterization sampling in accordance with disposal facility requirements. Following characterization, appropriate waste codes will be assigned and transportation off-site by Brookside will be coordinated. The waste profile will identify NYSDEC as the generator of the IDW.

10 Site-Specific Health and Safety Plan

A site-specific health and safety plan (HASP) has been prepared for this fieldwork and is attached as Appendix B. All field personnel will be briefed on the HASP prior to performing work and will acknowledge their understanding and awareness of the HASP by signing the project-specific acknowledgment form. The HASP will be maintained on-site and available for review and reference during field activities. Field activities are anticipated to be conducted under Level D PPE, including safety toe boots, nitrile gloves, safety glasses, and high-visibility vests. During drilling, the work zone will be clearly defined and maintained in accordance with the approved traffic control plan, including the use of cones, barriers, and signage, and implementation of appropriate traffic control measures.

A site-specific Community Health and Safety Plan (CHSP), which includes a Community Air Monitoring Plan (CAMP), will be implemented during all subsurface investigation activities. The CHSP and CAMP are included in the HASP. During drilling and other ground-intrusive activities,

the work zone will be clearly defined using cones and caution tape, if applicable. CAMP stations equipped with a PID and a particulate monitor (e.g., DustTrak) will be positioned upwind and downwind of the active work area to monitor airborne VOCs and particulates in accordance with the CHSP/CAMP.

11 Reporting

The laboratory will provide "Category B" deliverables in accordance with Appendix 2B of NYSDEC DER-10. Laboratory deliverables will include a complete electronic analytical report (PDF) and a NYSDEC EQuIS electronic data deliverable (EDD). An E & E chemist will review the laboratory deliverables for completeness and accuracy and will validate the analytical data in accordance with Appendix 2B of DER-10, including preparation of data usability summary reports (DUSRs). The validated EDD will be updated with appropriate validator qualifiers and submitted electronically to NYSDEC.

Upon completion of subsurface investigation activities and data validation, E & E will prepare a Subsurface Investigation Report documenting the field activities and findings. The report will describe the field methods, sampling locations and depths, monitoring well construction details, and any deviations from this SAP. Soil boring logs will be prepared for each location. Analytical results will be summarized in tables and figures, and site maps will depict soil boring/well locations. The Subsurface Investigation Report will be submitted electronically to NYSDEC for review, with a final electronic version issued following receipt and incorporation of agency comments, as appropriate.

12 Schedule

Field activities for the WA26-6 subsurface investigation are anticipated to be completed by July 2026, with data validation and reporting to be completed during the third quarter of 2026.

References

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United States Geological Survey. 1990. *Bedrock and Engineering Geologic Maps of New York County and Parts of Kings and Queens Counties, New York, and Parts of Bergen and Hudson Counties, New Jersey,* Open-File Report 89-462, https://doi.org/10.3133/ofr89462.

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Woodard & Curran. Former Buick, Cleaners, and Gas Station Lot Supplemental Remedial Investigation Report. July 2022.

Table 1: Analytical Summary

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Buffalo, NY 14202

Table 1: Sampling and Analytical Summary, NYSDEC Site No. C360129A, Post Road Corridor White Plains Off-Site

Analytes	Method	Matrix	Container	Sample Quantity	Field Duplicates	Field Blanks	MS/ MSD	Trip Blanks	Total
Soil Sampling - Soil Boring (up to 3 depth intervals at 6 locations)									
TCL VOCs + 10	SW-846 8260D	SO	Terracore kit	18	1	1	1	3	24
Groundwater Sampling (6 locations)									
TCL VOCs + 10	SW-846 8260D	GW	40 mL VOA Vial (3)	8	1	1	1	1	12
Investigation Derived Waste - Soil									
TCLP RCRA-8 Metals	SW-846 1311/6010	IDW	8-oz Glass Jar (2)	2	0	0	0	0	2
Ignitability	SW-846 1010	IDW	8-oz Glass Jar (2)	2	0	0	0	0	2
PCBs	SW-846 8082A	IDW	8-oz Glass Jar (2)	2	0	0	0	0	2
Corrosivity	SW-846 9045D	IDW	8-oz Glass Jar (2)	2	0	0	0	0	2
VOCs	SW-846 8260D	IDW	5035 Terracore kit	2	0	0	0	0	2
Investigation Derived Waste - Groundwater									
Total RCRA-8 Metals	SW-846 6010D	IDW	1 L HDPE w/ HNO3 (1)	2	0	0	0	0	2
Ignitability	SW-846 1010	IDW	1 L Amber Glass (2)	2	0	0	0	0	2
PCBs	SW-846 8082A	IDW	1 L Amber Glass (2)	2	0	0	0	0	2
Corrosivity	SW-846 9040C	IDW	1 L Amber Glass (2)	2	0	0	0	0	2
VOCs	SW-846 8260D	IDW	40 mL VOA Vial w/ HCl (3)	2	0	0	0	0	2

Notes:

1. Detection limits must meet requirements of NYSDEC unrestricted soil cleanup objectives (Part 375-6.8)
2. All quantities and volumes are estimated.
3. Trip blanks are estimated and will be collected at the rate of one per cooler when collecting VOCs.

Key:

MS/MSD = laboratory matrix spike / matrix spike duplicate
TCL = Target Compound List
VOCs = volatile organic compounds
SO = soil
GW = groundwater
IDW = investigation derived waste
L = liter
mL = milliliter
TCLP = Toxicity Characteristic Leaching Procedure
RCRA = Reseource Conservation and Recovery Act
PCBs = polychlorinated biphenyls
HDPE = high density polyethylene

Figure 1: Project Location Map

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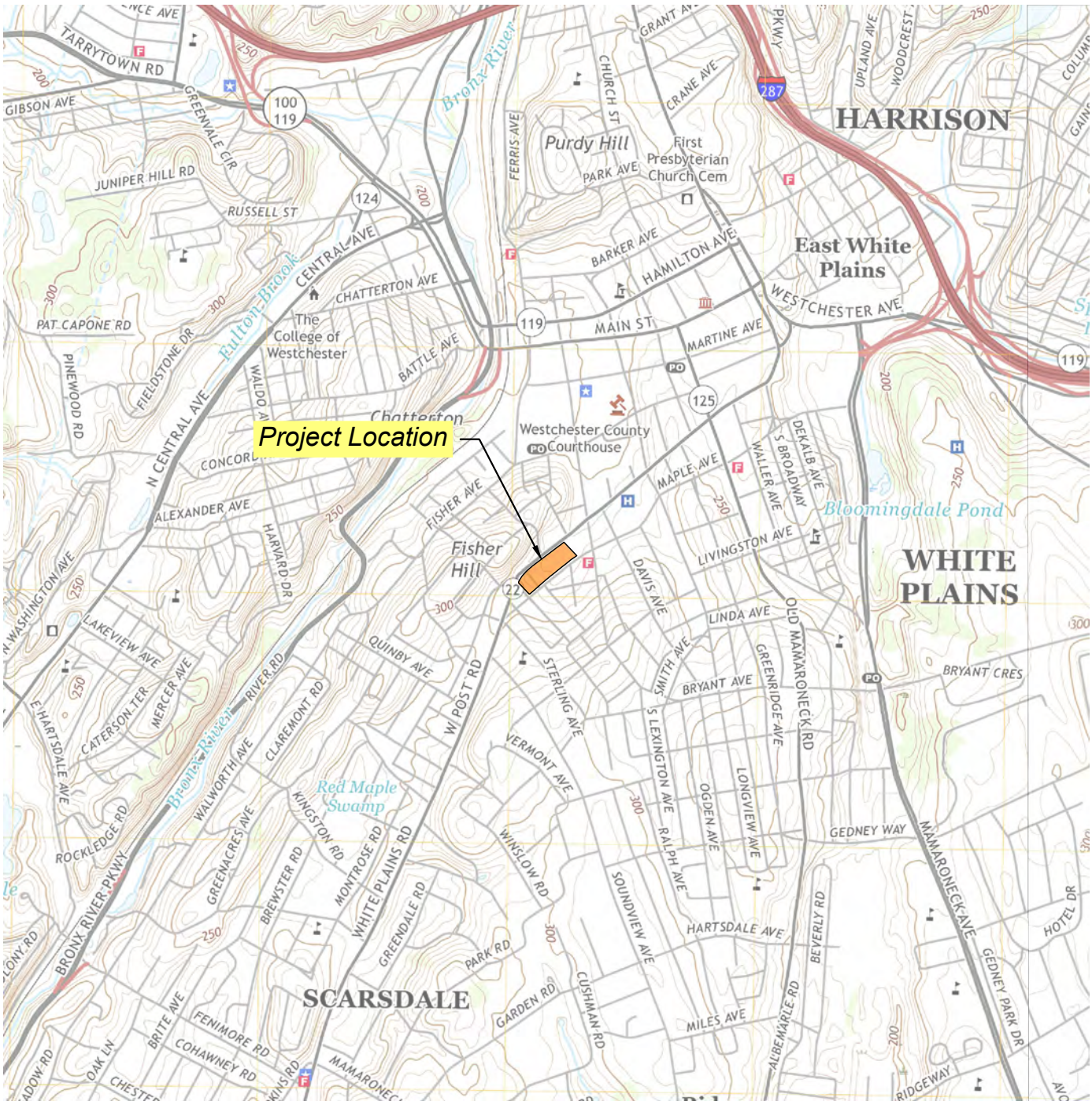
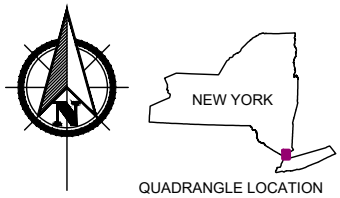


SOURCE: USGS TOPOGRAPHIC QUADRANGLE WHITE PLAINS, NEW YORK (2019) AND GLENVILLE, CONNECTICUT (2018).



LEGEND

BROWNFIELD CLEANUP PROGRAM SITE

0 2000

SCALE IN FEET

WSP USA Inc.
500 Summit Lake Drive
Suite 450
Valhalla, New York 10595
(212) 760-5635

Post Road Corridor Off-Site
NYSDEC Site No. C360129A
77 West Post Road
White Plains, New York

PROJECT LOCATION MAP

FIGURE 1

DWG Date: 01/23/2026
Checked: DM
Approved: DM
Drawn By: RAC
A

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Figure 2: Proposed Monitoring Well Locations Map

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LEGEND

PARCEL BOUNDARY

BROWNFIELD CLEANUP PROGRAM SITE

EXISTING MONITORING WELL LOCATION

RW-21 (10-20) MONITOR WELL ID / SCREENED INTERVAL

PROPOSED MONITORING WELL LOCATION

0 100

SCALE IN FEET

SOURCE: WESTCHESTER COUNTY NY GIS DATA.

WSP USA Inc.
500 Summit Lake Drive
Suite 450
Valhalla, New York 10595
(212) 760-5635

Post Road Corridor Off-Site
NYSDEC Site No. C360129A
77 West Post Road
White Plains, New York

PROPOSED MONITORING WELL LOCATIONS - JUNE 2026

FIGURE 2

Drawn By: RAC
Checked: DM
Approved: DM
DWG Date: 01/23/2026
A

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Appendix A: Community Air Monitoring Plan

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Community Health and Safety Plan
Post Road Corridor
Off-Site Investigation
NYSDEC Site No. C360129A
White Plains, Westchester County, NY

1.0 Community Air Monitoring Plan (CAMP)

This CAMP was prepared based on the New York State Department of Health (NYSDOH) Generic CAMP[1]. This plan requires real-time monitoring for volatile organic compounds (VOCs) and particulates at the downwind perimeter of each designated work area when certain activities are in progress at potentially 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, 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.

Reliance on the CAMP shall not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

A Special Requirements CAMP shall be implemented at the Site when ground intrusive or soil handling activity occurs within an occupied building or within 20 feet of a receptor (e.g., occupied buildings, bus stop, etc.). The standard CAMP is outlined in this Section and Sections 2 and 3 below. The additional requirements of a Special Requirements CAMP are outlined in Section 4.

Volatile Organic Compound Monitoring Plan
Periodic monitoring for VOCs will be required during non-intrusive activities such the collection of groundwater samples from 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, 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 and anticipated contaminant concentrations, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at contaminated wells along busy urban streets adjacent to a residence/business.

For intrusive activities such as drilling and direct push sampling, not located within 20 feet of potentially exposed populations or occupied structures, VOCs must be monitored at the

[1] New York State Department of Environmental Conservation (NYSDEC). 2010. DER-10, Technical Guidance for Site Investigation and Remediation, May 2010. Appendix 1A, Community Air Monitoring Plan (CAMP).

downwind perimeter of the immediate work area (i.e., the exclusion zone) at intervals of no more than 15 minutes. Upwind concentrations shall be measured at the start of each workday and periodically thereafter to establish background conditions. VOC monitoring shall be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment shall be calibrated at least daily.

VOC Response Levels:

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 a 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 shut down and mitigative measures implemented before work can continue.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations shall be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring shall 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 shall be equipped with an audible alarm or be continuously visually monitored to indicate exceedance of the action level. In addition, fugitive dust migration shall be visually assessed during all work activities.

Particulate Response Levels:

1. If the downwind PM-10 particulate level is **100 micrograms per cubic meter** ($\mu g/m^3$) greater than background (upwind perimeter) for a 15-minute period or if airborne dust is visually 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 $\mu g/m^3$** 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 $\mu g/m^3$** above the upwind level, work must be stopped, and a re-evaluation of activities initiated. Work can resume if dust suppression measures and

other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 $\mu g/m^3$ of the upwind level and in preventing visible dust migration.

2.0 Public Safety

Intrusive activities such as drilling and direct push sampling within the community will require the development of an exclusion zone at the perimeter of the work zone. The exclusion zone is meant to prevent pedestrians from entering the work zone and potentially being exposed to contaminants or physical safety hazards associated with the equipment used. The exclusion zone will be marked using caution tape and/or cones or similar high visibility barriers. When working on or immediately adjacent to a public road, the regulations listed in the NYS Manual of Uniform Traffic Control Devices (Title 17b, NYCRR) will be implemented. This includes the correct formation and placement of cones and "Road Work Ahead" signs to divert and warn oncoming traffic. Depending on the type of work and length of time needed, traffic controllers and observers may be required.

3.0 Responsibility

It shall be the responsibility of the Site Safety Officer to conduct monitoring at the downwind perimeter of the work zone as defined above and record all relevant data in the health and safety field notebook, which will be available for State (NYSDEC and NYSDOH) personnel to review. The Site Safety Officer shall also be responsible for visually monitoring the work zone for potential safety hazards and to prevent public intrusion in the work zone.

4.0 Special Requirements CAMP

In addition to the standard CAMP requirements per above the Special Requirements CAMP requires the following:

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 should be considered to prevent exposures related to the work activities and to control dust and odors. Consideration should 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 should 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 should 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 µg/m^3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 µg/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 should be pre-determined, as necessary, for each site.

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" would be 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, should 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.

Appendix B: Site-specific Health and Safety Plan

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NYSDEC SUBSURFACE INVESTIGATION 2026 POST ROAD CORRIDOR OFF-SITE SITE NO. C360129A WHITE PLAINS, NEW YORK

HEALTH AND SAFETY PLAN (REVISED)

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF ENVIRONMENTAL REMEDIATION
625 BROADWAY, 12TH FLOOR
ALBANY, NY 12233

NYSDEC WORK ASSIGNMENT NO.: D009807-26
E & E PROJECT NO.: EE1705007.0026
DATE: MAY 2025 (REVISED JUNE 2026)

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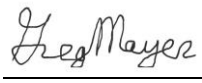

Gregory Mayer
Senior Consultant

REVIEWED BY:

Dave Morelli, PG
Project Manager, Hydrogeologist

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1 INTRODUCTION

Table 1: Site Location and Contact Information

Project No.:	EE1705007.0026
Site Name:	Post Road Corridor – Off-Site / Site No. C360129A
Street Address:	77 West Post Road
City:	White Plains
State/Country:	New York / USA
Site Contact:	Dave Morelli (Project Manager)
Phone Number:	(212) 760-5635
Start Date of Work:	June 15, 2026
End Date of Work:	July 15, 2026

1.1 ORGANIZATION STRUCTURE

Every E & E Health and Safety Plan (HASP) is organized to ensure that information regarding changes in site conditions, potential exposure to hazards and worker safety flows freely within the project team. Additionally, OSHA requires that a chain of command with lines of authority, responsibility, and communication is established for each project with a HASP. Therefore, a chain of command will be established that ensures that all site operations will be conducted safely. Each project will have a project/task manager (OSHA calls this the General Supervisor) who has the responsibility and authority to direct all site operations. Generally, this person is the project director who is ultimately responsible for the overall implementation of the project. The field work that will be covered by this short form HASP will be overseen or managed by a project or task manager. This individual is responsible for the proper implementation of the comprehensive work plan. The field project will have a site safety and health coordinator who has the responsibility and authority to implement the site HASP and verify compliance with the plan. Additionally, other personnel that are needed to conduct the proposed work will be assigned.

In all cases, the project director will ensure that the site work is staffed appropriately to safely and effectively implement the work plan. They will also ensure appropriate personal protective equipment (PPE) and monitoring equipment are provided to safely implement this HASP. The Site project/task manager will be responsible for the safe and proper implementation of the work plan. They will have the authority to expend company resources to ensure that PPE and other safety equipment are available and in good working order. They will communicate with the project director regarding implementation of the work plan. The Site Health and Safety Coordinator (SHSC) is responsible for the implementation of this HASP. The SHSC will communicate any issues with changing site conditions, upgrades in PPE, decontamination procedures and needs for monitoring equipment with the task manager. The SHSC will ensure that other workers assigned to the project are following the HASP. Subcontractors are responsible for developing and providing their own safety plans. The drilling subcontractor's site-specific Health and Safety Plan is presented as Appendix H.

It is expected that all other employees assigned to the project will follow the HASP and report any and all potential safety concerns to the SHSC.

1.2 PERSONNEL ASSIGNMENTS

All E & E field personnel that will be onsite will have the 40-hour Health and Safety training as required by OSHA (29 CFR 1910.120) and will be current with annual Health and Safety courses. All E & E field personnel assigned to this project are participants in a medical surveillance program as specified in 1910.120.

Certificates documenting the training for field personnel are available upon request.

Table 2: Project Personnel

Responsibility	Name
Project Manager	Dave Morelli
Task Manager	Ian Arturo
SHSC	Kevin Dunsmore, Senior Regional Health and Safety Manager, Northeast and Southeast
Alternate SHSC	Joseph Kapp, CIH, Industrial Hygiene and Hazmat Manager
Field Personnel	Gregory Mayer
Field Personnel	Rony John
Field Personnel	Aidan Kidd
Field Personnel	Mike Reiff
Field Personnel	Patrick Gaughan

2 SITE DESCRIPTIONS

2.1 SITE DESCRIPTION

Remedial Investigation activities will be conducted at multiple off-site properties and public rights-of-way near Brownfield Cleanup Program (BCP) Site No. C360129, known as Post Road Corridor, located at 77 West Post Road, White Plains, New York (the Site). All proposed drilling locations are on the off-site portion (referred to as Site No. C360129A), which includes local public rights-of-way and municipal parking lots. The C360129 BCP Site consists of empty lots from previously demolished structures. The site has historically contained dry cleaners, gas stations with underground storage tanks (USTs), automobile service facilities with USTs, above ground storage tanks (ASTs), hydraulic lifts, parking lots, and various commercial businesses and offices.

Environmental investigations conducted at the Site by others have indicated that indoor air and sub-slab vapor have been impacted by tetrachloroethene (PCE) and other chlorinated solvents. High concentrations of PCE were identified in an off-site monitoring well which prompted the off-site SSI investigation activities. A Site Layout showing the site and the proposed drilling and sampling locations are included as Appendix B.

2.2 SCOPE OF WORK

An E & E project geologist will coordinate with the property owners or representatives for access prior to all remedial investigation activities and the first site visit will include a safety briefing.

The number of samples will be designated ahead of the investigation. Quality Assurance/Quality Control (QA/QC) duplicate samples will be collected as needed. Appendix A contains a checklist of equipment and supplies that are needed for this work.

2.2.1 UTILITY CLEARANCE

The proposed work includes drilling boreholes for groundwater monitoring well installation. This intrusive work cannot begin at the site until all buried and overhead utilities in the public rights-of-way and on the site are located, marked, or cleared. The subcontractor (in this case, the drilling company) shall be responsible for both notifying the public utility locating authority and for mobilizing a private utility locator in advance of the investigation activities. The specific procedures for utility clearance are detailed in the WSP USA Earth & Environment and Energy Procedure Overhead and Underground Utilities (SA 313; Appendix D) and outlined below. The safe working distances for all subsurface activities are presented in SA313, included in Appendix D). Drilling locations within the specified minimum must be advanced using hand digging or soft digging methods to a depth of at least 5 feet. Note that the use of hand digging, or soft digging methods does

not replace the need for public and private utility locating services.

E & E personnel are also encouraged to identify a site contact (e.g., facility engineer, maintenance supervisor, or a plant manager) who may have specific knowledge about the utilities at the site. The contact may have direct knowledge of the plant layout or, in some cases, provide facility drawings outlining the location of buried utility lines. This information can be useful for facilities that are active and may have machinery, reinforced concrete floors, or other equipment that can interfere with the devices used by the private utility locator. The site contact is a valuable resource; however, the person and the facility drawings (or both) cannot replace the public and private utility locates. No intrusive work can be performed at the site before the legal dig date, all utilities on the list have been marked and visually verified, and the private utility locator has completed the sweep of the work area. It is not acceptable to rely solely on the site contact or facility drawings.

Any deviation from the public and private utility locates must be approved by the project manager and a District Business Leader with the further approval of the Chief Operating Officer, as detailed in SA313 (Appendix D).

UTILITY STRIKES AND DAMAGE

Damage to an underground or overhead utility is possible even if following all the guidance provided in the HASP and SA313 (Appendix D). E & E personnel, in the event of a strike, should:

- turn off the drilling or excavating equipment, move the equipment from the damaged line (if possible and it can be done safely) or abandon the equipment;
- avoid contact with escaping liquids, live wires, and open flames, and do not handle or view the ends of a fiber optic cable (this can result in eye damage;
- evacuate the area and establish a safe perimeter around the equipment and struck line; and
- notify the local emergency response number listed in in this HASP if the damaged utility has the potential to cause, or is causing, dangerous conditions.

E & E personnel should immediately notify the facility operator or site contact, and the utility operator (and the public utility authority) once onsite personnel are in a secure location. E & E personnel should also:

- send an alert or notification via the Integrated Safety Health, Environment, and Quality Management System (iSMS) and send an email to SafetyTeam@wsp.com;
- contact your immediate supervisor, human resources, and sector management in accordance with company policy.

Additional information about the utility clearance procedures is presented in SA313 (Appendix D).

2.2.2 MONITORING WELL INSTALLATION

The groundwater investigation will include the installation of six (6) groundwater monitoring wells, positioned in areas within the public rights-of-way along West Post Road and Rathbun Avenue. The proposed monitoring wells will be installed at the site by a New York-licensed drilling company using a vehicle-mounted drill rig equipped with 4.25-inch inside diameter (ID) hollow-stem augers (HSAs). The boreholes for the wells will be advanced from the ground surface to a depth of approximately 25 feet below ground surface (bgs). Continuous soil samples will be collected ahead of the HSAs using a 2-inch ID split-spoon sampler (or equivalent) to allow for soil classification, organic vapor screening (using a calibrated photoionization detector [PID] with a 10.6 electron volt [eV] lamp), and proper positioning of the well screens.

The boreholes will be converted to groundwater monitoring wells once the target depth has been achieved by installing 2-inch ID, flush-threaded 0.010-inch continuous-wrap polyvinyl chloride (PVC) screen fitted with enough 2-inch ID flush threaded blank PVC casing to reach the surface. The wells will be completed by installing an appropriately sized sand filter pack from the base of the borehole to a level approximately 2 feet above the top of the screened interval, which will be topped with a minimum of 2 feet of hydrated bentonite to form a seal. The remaining annular space will be backfilled with bentonite-cement grout with each well completed with a flush-mount protective curb box inside a concrete pad.

The newly installed monitoring wells will be developed 24 hours or later after installation of the well seal. The water column will be surged using dedicated development pump and surge blocks, as appropriate, until the purge water is relatively free of sediments. Groundwater generated during the monitoring well development activities will be contained in appropriately labeled Department of Transportation-compliant (DOT-compliant) 55-gallon steel drums. The drums will be staged onsite for

later offsite disposal in accordance with state and federal regulations.

2.2.3 GROUNDWATER SAMPLING

The wells will be gauged using an electronic water-level indicator. The depth-to-water measurements will be made to the nearest 0.01-foot using an electronic water level meter with the results recorded in the field notebook.

The purge and subsequent groundwater sampling of the monitoring wells will be conducted using submersible pumps and/or bailers to remove a minimum of three well volumes. The extracted groundwater will be monitored during the purge for temperature, specific conductance, dissolved oxygen (DO), pH, oxygen reduction potential (ORP), and turbidity using a calibrated water quality meter. Purging will continue until water quality parameters have stabilized (±10-percent for each parameter over the final three readings). Groundwater analytical samples will be collected using dedicated bailers once the purge has been completed.

The analytical samples, including those for QA/QC, will be placed in the laboratory-supplied bottlware, labeled, and packed in coolers with wet ice. The samples will be shipped via overnight express to an Environmental Laboratory Accreditation

Program-certified (ELAP-certified) analytical laboratory for analysis of VOCs by EPA Method 8260.

2.2.4 SOIL VAPOR INTRUSION INVESTIGATION

Soil vapor intrusion (SVI) investigation activities may be conducted at selected off-site properties within the Post Road Corridor off-site area (Site No. C360129A) to evaluate the potential presence of chlorinated volatile organic compound (CVOC) vapors in subsurface and indoor environments. These activities may include sub-slab soil vapor sampling and/or indoor air sampling at accessible structures.

SVI sampling will be performed using hand-held drilling equipment and low-flow sampling techniques designed to minimize disturbance and potential vapor release. Indoor air and sub-slab vapor samples will be collected using laboratory-supplied Summa canisters or equivalent media. All sampling activities will be conducted in accordance with applicable NYSDEC and NYSDOH guidance and in a manner intended to limit potential exposure to site personnel and building occupants.

Air monitoring will be conducted during SVI activities using a calibrated photoionization detector (PID) equipped with a 10.6 eV lamp. Monitoring will focus on the breathing zone and immediate work area to evaluate potential worker exposure to VOC vapors. PID readings at or above action levels identified in this Health and Safety Plan will require work stoppage and re-evaluation of site controls by the Site Health and Safety Coordinator.

SVI activities are anticipated to be performed under Level D personal protective equipment (PPE), as described in Section 4. No confined space entry is anticipated as part of the SVI investigation. Coordination with property owners or representatives will be completed prior to sampling to ensure safe access and work area control. Investigation-derived waste generated during SVI activities will be managed and disposed of in accordance with applicable state and federal requirements.

2.2.5 SUMP COVER INSTALLATION

Sump cover installation activities may be conducted at selected off-site structures to address open or inadequately sealed sump pits that may serve as potential vapor entry pathways. Prior to installation, accessible basements will be evaluated to identify sump type, condition, and site-specific health and safety hazards.

Sumps may include open pits, non-sealed covers, floor drain–connected sumps, or active sump pump systems. Basement conditions may present physical, electrical, and atmospheric hazards, including wet or uneven surfaces, low clearances, exposed utilities, and energized electrical equipment. These hazards will be addressed through pre-task evaluation, good housekeeping, adequate lighting, and maintaining safe distances from electrical components. Work will be performed using hand tools and low-impact methods; no excavation or confined space entry is anticipated.

Air monitoring will be conducted using a calibrated PID (10.6 eV lamp) to evaluate potential exposure to volatile organic compound vapors in the breathing zone. Elevated PID readings, strong odors, or adverse health symptoms will require work stoppage and re-evaluation by the Site Health and Safety Coordinator. Sump cover installation activities are anticipated to be conducted under Level D PPE, as described in Section 4. Coordination with property owners or occupants will be completed prior to work, and any investigation-derived waste will be managed in accordance with applicable regulations.

2.3 CHEMICALS OF CONCERN

Environmental investigations conducted by others at the Post Road Corridor site, a former dry cleaner facility, show the potential for off-site migration of CVOC vapors. PCE, trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride have been reported as chemicals of concern based on the results of those investigations. The relevant safety data sheets (SDSs) for these chemicals are presented in **Appendix F**.

3 HAZARD EVALULATION

This section outlines the potential hazards that workers may be exposed to during the onsite field activities associated with this project. To minimize exposure to various types of hazards, standard protocols will be followed at all times. All personnel will be familiar with the potential hazards as well as control measures to be followed to minimize those hazards.

All project tasks involve potential contact with contaminated soil and/or groundwater. The chemical, physical and environmental hazards are identical for each task due to the limited scope of this project. An evaluation and control table of physical and biological hazards is included as Appendix E.

3.1 CHEMICAL HAZARDS

Although no significant chemical hazards are anticipated, there is potential for CVOCs to be encountered during all phases/tasks of the field operations. Potentially impacted media may include soil and soil vapor.

The most common health hazards associated with CVOC exposure are irritation to the eyes, skin, nose, or respiratory system; dizziness; headache and nausea.

3.2 PHYSICAL HAZARDS

Various physical hazards may be encountered during the SVI field activities.

Slips, Trips and Falls: Working at the project may pose slip, trip and fall hazards due to wet surfaces, hoses or sandbags. Potential adverse health effects include falling at the same level or to a lower level and can result in minor injury or serious injury.

Overhead Hazards: During SVI sampling activities, beams, fixtures, and other objects can present overhead hazards, especially in basements with low ceilings. Care must be taken whenever overhead hazards exist, including avoiding areas with overhead hazards and wearing hard hats.

Falling Objects: Falling objects are a concern when overhead activities take place. Being struck by an object falling from as little as 10 – 20 feet can result in death or serious injury.

Manual Lifting: Manual lifting of objects is required during site operations. The lifting limit is 40 pounds or the worker's physical capability, whichever is less. Overstraining and/or failure to follow proper lifting techniques can result in back injuries and strains. Back injuries are a serious concern, as they are among the most common workplace injuries and often result in lost or restricted work time and long treatment and recovery periods.

Electric Hazards: Electric hazards exist from a number of sources including portable generators, shunts/shunt boxes, temporary electrical wiring, power tools and extension cords. Shocks, burns and electrocution can take place when proper procedures are not followed, or equipment is defective.

Noise: Noise is a potential hazard associated with the operation of construction machines and equipment. In addition to making communications more difficult, exposure to excessive noise levels can produce noise-induced hearing loss (both permanent and temporary). Excessive noise levels also increase stress levels and blood pressure.

Vehicle Traffic: Moving vehicles present an area of concern to field personnel. All personnel will be required to wear the appropriate safety vests onsite and be alert for operation and movement of motor vehicles. Onsite personnel must comply with any traffic control and safety measures employed. Daily safety meetings may include discussion of expected construction traffic patterns.

Sharp Objects: During the ground-intrusive activities, there is potential for contacting sharp debris (glass, tile, metal, etc.). Exposure to these hazards can result in cuts or abrasions from minor to severe.

Heavy Equipment: Heavy equipment and motor vehicle incidents are the number one cause of occupational fatalities, accounting for one in three deaths. Fifty (50) percent or more of vehicle safety incidents occur while backing up. Hazards include being struck by equipment/falling loads or caught in/between and can result in serious injury or death.

3.3 ENVIRONMENTAL AND BIOLOGICAL HAZARDS

Heat Stress: Heat stress may occur at any time work is being performed in hot environments. If the body's physiological processes fail to maintain a normal body temperature, a number of physical reactions can occur, with the possible effects of fatigue, irritability, anxiety and decreased concentration or dexterity. The effects can also be fatal.

Cold Stress: In a cold environment, body temperature is maintained by a shift in blood flow from the extremities to the core (chest and abdomen). Exposed skin and extremities will then cool rapidly and increase the risk of frostbite and hypothermia. Symptoms of frostbite include numbness, discolored and/or firm skin; and blisters may occur. Symptoms of hypothermia include when shivering stops, loss of coordination, confusion, disorientation; and, in extreme cases, inability to walk or stand, dilated pupils, slowed pulse or breathing rate and loss of consciousness.

Harmful Insects: The most common harmful insects encountered are ticks, mosquitoes, and bees/wasps/hornets. Ticks can transmit diseases including Lyme disease, while mosquitoes can transmit diseases including West Nile virus. Clothing can be treated with 0.5% permethrin, which lasts several washes and kills and repels ticks and mosquitoes. USEPA-registered insect repellants should be used and include but are not limited to repellents with active ingredients of DEET, picaridin, and oil of lemon eucalyptus (p-menthane-3,8-diol). When irritated, bees, wasps, and hornets can sting, causing pain and allergic reactions which can be life threatening. Care should be taken when moving debris or if a nest is spotted.

Harmful Animals: There are a variety of animals in the area, including mammals such as feral cats, racoons, and rats and reptiles such as snakes. Distance should be maintained upon spotting animals, especially if the animals exhibit signs of the rabies virus, such as unusually tame behavior or nocturnal animal activity during the day. Snakes can be encountered, including venomous snakes.

Bird and Animal Wastes: contain disease-causing micro-organisms. There is a potential to encounter animal waste, primarily pigeon droppings. The most serious health risks arise from disease organisms that grow in the nutrient-rich accumulations of bird droppings, feathers and debris under a roost — particularly if roosts have been active for years. Among the fungal diseases associated with bird droppings the two most common are histoplasmosis and cryptococcosis:

- *Histoplasmosis* is caused by a fungus (*Histoplasma capsulatum*). The disease is transmitted to humans by airborne fungus spores from soil contaminated by pigeon and starling droppings. Infection occurs when spores, carried by the air, are inhaled — especially after a roost has been disturbed. Most infections are mild and produce either no symptoms or a minor influenza-like illness.

- *Cryptococcis neoformans (C. neoformans)* is found worldwide. Its main habitats are debris around pigeon roosts and soil contaminated with decaying pigeon droppings. It is generally accepted that the organism enters the host by the respiratory route in the form of dehydrated yeast or as spores. Like histoplasmosis, most cryptococcosis infections are mild and occur without symptoms.

4 PERSONAL PROTECTIVE EQUIPMENT

NO CHANGES TO THE SPECIFIED LEVEL OF PROTECTION SHALL BE MADE WITHOUT THE APPROVAL OF THE SITE HEALTH AND SAFETY OFFICER AND/OR THE PROJECT GENERAL

SUPERVISOR/MANAGER.

It is anticipated that all or most work conducted by E & E personnel will not require respiratory protection. VOC vapor concentrations are expected to be below NIOSH occupational exposure limits (OELs) Particulate levels are expected to consist of nuisance dust only. Personnel will don disposable medical-grade dust filtering face mask as needed if visible dust enters the breathing zone.

The following Level D personal protective equipment (PPE) will be utilized by all onsite personnel for all project tasks.

Table 3: Personal Protective Equipment

Type	Level D PPE (list all required PPE)
Respiratory	None required
Clothing	Standard field clothing
Gloves	Disposable nitrile gloves
Boots	Safety-toe boots
Hearing protection	Ear plugs, as needed
Other PPE	Hard hat, safety glasses

5 MONITORING PROCEDURES

Table 4: Site Monitoring Equipment ("X" indicates required monitoring equipment)

X	Photoionization Detector (PID) 10.6 eV
	Flame Ionization Detector (FID; e.g., petroleum)
X	Particulate Monitor (PM; e.g., nuisance dust)
	Combustible Gas Indicator (CGI; combustibles, oxygen, carbon monoxide, hydrogen sulfide) as needed, if fossil fuel-powered equipment is used indoors.
	Chemical Name Colorimetric Tube (or similar)

Volatile Organic Compounds:

A PID will be used to screen the work area, specifically the breathing zone, for VOCs. Screening will be conducted periodically during the SVI activities, chemical inventory, and if atmospheric conditions change (decreased air flow, increased temperature). PID readings at or above 5 ppm (parts per million) in the breathing zone or the observance of any ill effects (dizziness, headache) will necessitate cessation of work and re-evaluation of the need for additional controls.

Particulate Matter (PM-10):

Real-time particulate monitors (e.g., DustTrak or equivalent) will be used to measure PM-10 concentrations at upwind and downwind perimeter locations during intrusive activities, with 15-minute average readings. If the downwind PM-10 level is 100 micrograms per cubic meter (µg/m³) greater than the upwind (background) level for a 15-minute period, or if visible dust is observed migrating beyond the work area, dust suppression measures will be implemented and work practices adjusted as necessary. If, after implementation of dust suppression, downwind PM-10 levels exceed 150 µg/m³ above background, work will be temporarily halted and reevaluated and will not resume until controls are shown to reduce downwind PM-10 to within 150 µg/m³ of upwind levels and prevent visible dust migration.

6 DECONTAMINATION PROCEDURES

E & E field personnel will be responsible for decontamination of equipment. Detergent and water will be used as the decontamination solution unless otherwise specified. No specialized decontamination procedures are expected.

All personnel, clothing, equipment and samples containers leaving the work area must be decontaminated to remove any harmful chemicals that may have adhered to them. Decontamination methods include either: 1) physically remove contaminants; 2) inactivate contaminants by chemical detoxification or disinfection/sterilization; or 3) remove contaminants by a combination of both physical and chemical means. In many cases, gross contamination can be removed by physical means involving dislodging/displacement, rinsing, wiping off and evaporation. Contaminants that can be removed by physical means include dust, vapors and volatile liquids. All reusable equipment will be decontaminated by rinsing in a bath of detergent and water. Monitoring equipment will be decontaminated by wiping with paper towels and water.

The effectiveness of the decontamination will be evaluated near the beginning of Site activities and will be modified if determined to be ineffective. All disposable PPE will be discarded following use. All used PPE to be discarded will be placed in an appropriate receptacle for disposal.

Equipment Decontamination Procedures will be conducted in accordance with E & E's Standard Operating Procedures

7 ONSITE CONTROLS

E & E personnel will be responsible for onsite control during monitoring well installation activities within the public rights-of-way along the Post Road Corridor. Intrusive work will be conducted outdoors using a vehicle-mounted drill rig and associated equipment, and will include boring advancement, monitoring well installation, well development, and groundwater purging and sampling. Refer to the site map and/or site figure(s) in Appendix B. Designed work zones will be determined around proposed drilling locations in the field. The drilling subcontractor shall be responsible for implementing a traffic control plan and providing additional personnel if necessary in order to establish a safe work/exclusion zone that is restricted to both vehicle and pedestrian traffic flow. The subcontractor traffic control plan is included as part of the subcontractor's site-specific Health and Safety Plan, included as Appendix H. Follow procedures in SOP ENV 3.2 Site Control Procedures for Potentially Contaminated Sites for work zone set-up. Prior to establishing ambient air and particulate monitoring locations, wind directions will be documented so that upwind and downwind positions can be appropriately selected relative to the work area and nearby receptors. During work activities, the following zones will be established:

- Work/Exclusion Zone (location in which no unauthorized person will be permitted): The work area around each sampling location.
- Contaminant Reduction Zone (CRZ) (location in which all decontamination procedures will be performed): A designated CRZ will be established near the drilling and SVI work areas; however, decontamination procedures are not anticipated beyond routine cleaning of drilling and sampling equipment associated with these activities.
- Support Zone (location in which no contaminated media is present where administrative tasks will be performed): Area beyond the sample location work areas.

8 STANDARD OPERATING PROCEDURES

- Standard Operating Procedures that are applicable to this project are presented in Appendix D and are included in the Field Activities Plan for NYSDEC Contract D009807.
- A daily safety meeting will be conducted for all E & E and subcontractor personnel and documented on the Daily Safety Meeting Record form (Appendix C) or on appropriate field forms. The information and data obtained from applicable site investigation and analysis will be addressed in the safety meetings and used to update this SHASP, as necessary.
- Whenever possible, use the buddy system.
- At least one E & E employee onsite must have a first aid kit onsite that includes, at a minimum, the following:
  - 1 Absorbent compress, 32 sq. in. (81.3 sq. cm.) with no side smaller than 4 in. (10 cm);
  - 16 Adhesive bandages, 1 in. x 3 in. (2.5 cm x 7.5 cm);
  - 1 Adhesive tape, 5 yd. (457.2 cm) total;
  - 10 Antiseptic, 0.5g (0.14 fl. oz.) applications;
  - 6 Burn treatment, 0.5 g (0.14 fl. oz.) applications;

  - 4 Sterile pads, 3 in. x 3 in. (7.5 x 7.5 cm); and
  - 1 Triangular bandage, 40 in. x 40 in. x 56 in. (101 cm x 101 cm x 142 cm).
- Practice good work practice controls: Do not sit down or kneel in contaminated areas; do not lay equipment on the ground where contaminated groundwater or soil may be present; and avoid unnecessary contact with onsite contaminated objects.
- Do not eat, drink or use tobacco products in the work area.
- Whenever possible, do not use contact lenses while onsite.
- Thoroughly wash hands and face before eating, drinking, etc.
- Keep copies of the HASP available.
- In the event PPE is ripped or torn, stop work and remove and replace PPE as soon as possible.
- In the event of direct skin contact with free-phase contamination (petroleum, solvents, etc.), immediately wash the affected area with soap and water.
- If contaminated media comes in contact with eyes flush with clean water for 15 minutes.
- Report all accidents, injuries, near misses and environmental releases as required by the WSP USA Health and Environmental Safety Program; including online filing at https://zeroharm.onepb.net/fieldforms

8.1 LONE WORKING

Employees should not be set out to work alone in the field whenever possible. This must be considered during the proposal phase of the project. Should lone working be required, the following must be adhered to:

- Section 10 includes provisions for communication prior to departure, during the work and upon completion of the task whether returning to the office or going to another location.
- Project managers must consider the level of competence of the individual being sent to perform the work. Under no circumstances shall interns be sent out to work alone. By signing the HASP, the project manager acknowledges that the appropriate staff is selected for all work especially for lone working conditions.

8.2 CONFINED SPACE ENTRY

No E & E employee may conduct **ANY TYPE** of confined space entry without compliant training and the implementation of an entry program. All non-permit required confined space entries **MUST BE** approved by the Site Health and Safety Coordinator or their designee before any entry attempt is made. Therefore, no attempt will be made to enter any type of confined space without approval.

No confined space entry anticipated under this scope of work. In the event confined space entry may be necessary, appropriate planning and safety measures will be established and approved by the Site Health and Safety Coordinator.

9 MEDICAL SURVEILLANCE

All employees, regardless of the exposure involved, are required to participate in the medical monitoring program established by E & E. OSHA regulations state that employees involved in certain activities that may expose them to hazardous materials at or above permissible exposure limits (PELs) or above the published exposure limit for greater than 30 days per year, or all employees who wear a respirator are required to participate in the monitoring program.

The purposes of the medical monitoring program are to identify any illness or condition that might be aggravated by exposure to hazardous materials or work conditions; to certify that each employee can use negative-pressure respirators as required by OSHA and withstand heat or cold stress; to ensure that employees are able to physically perform their assigned tasks and to establish and maintain a medical record to monitor for abnormalities that may be related to work exposure that could increase injury risk for the employee. E & E's medical monitoring program includes the following:

- a baseline physical examination;
- annual physical examination;
- a medical determination of fitness for duty, including work restrictions after any injury or illness that may affect employee safety; and
- a review of potential exposures to determine the need for specific biological and medical monitoring.

10 COMMUNICATION PROCEDURES

All onsite personnel will practice constant communication with other E & E personnel and facility personnel during active work. Generally, verbal and/or cellular telephone communication will be used while onsite.

10.1 LONE WORKING

No lone working will be permitted without adhering to the following specific contact procedures with the Project Manager:

- Prior to departure contact (face-to-face, phone, text message or email).
- During work contact (by phone, text message or email morning and mid-day).
- Daily upon completion of the task (by phone, text message or email morning and mid-day).
- When returned home (by phone, text message or email when arriving at home airport, office, or town/city).

10.2 EMERGENCY HAND SIGNALS

The following standard hand signals will be used in case injury or circumstance does not allow for verbal or other communication:

- Hand gripping throat = Out of air, can't breathe;
- Grip partner's wrist or both hands around waist = Leave area immediately;
- Hands on top of head = Need assistance;
- Thumbs up = Ok, I'm all right, I understand; and
- Thumbs down = No, negative.

11 EMERGENCY PROCEDURES

The following standard emergency procedures will be used by onsite personnel. First, E & E employees will review and become familiar with the emergency actions below for any active site. While onsite, the site health and safety coordinator shall be notified of any onsite emergency and shall be responsible for ensuring that the appropriate procedures are followed.

11.1 EMERGENCY ACTION PLAN (ACTIVE FACILITY)

If the site is an active facility, E & E will follow established onsite evacuation procedures.

Facility evacuation procedures have been reviewed (if applicable): _____

Verification initials (by a person assigned to the project): _____

(No review means no work can be conducted)

11.2 AIR RELEASE OR FIRE/EXPLOSION

On notification of an air release or a fire/explosion, all personnel will travel at a right angle to the upwind direction. The site Health and Safety Officer will then account for all personnel and notify the proper emergency agencies.

If the site Health and Safety Officer is not available, the task manager or appropriate field personnel will assume these responsibilities.

11.3 INJURY

In the event of a non-emergency injury, notify WorkCare (E & E's medical consultation service to assist employees with a non-life-threatening event) at 844-268-1852. WorkCare can help staff self-treat an injury or direct staff to a local medical facility that can treat the injury. Additionally, WorkCare will start the workers' compensation claims process. The WorkCare Flyer is included in **Appendix D**.

If onsite personnel require emergency medical treatment, and the buddy system is used, the following steps will be taken:

- evaluate the nature of the injury and obtain the onsite copy of this HASP;
- contact local emergency service (see Emergency Contact List in Section 13);
- decontaminate to the extent possible before administration of first aid; and
- stay with the injured person.

11.3.1 LONE WORKING

If onsite personnel are working alone, the following steps will be taken before beginning work each day:

- A cellular telephone MUST be kept with the employee at all times (before starting work, ensure that there is emergency service at a minimum).
- Inform an onsite contact (if they will be present throughout all active work activities) or senior member of E & E of your plans for the day and your expected active work schedule.

If an injury has occurred:

- Evaluate the injury and decide whether emergency services are required.
- Contact emergency services, if necessary, with cell phone.
- If emergency services are not necessary, attempt first aid alone or contact an onsite contact or E & E contact for assistance.

11.4 BASIC FIRST AID

- Skin Contact: Remove any contaminated clothing. Wash immediately with water for at least 15 minutes.
- Inhalation: Remove from contaminated atmosphere. Contact emergency services.
- Ingestion: Never induce vomiting on an unconscious person. Never induce vomiting when acids, alkalis, or petroleum products are suspected. Contact the poison control center.

11.5 PPE FAILURE

If any worker experiences a failure or alteration of protective equipment that affects the protection factor, that person their buddy shall immediately leave the work area. Reentry shall not be permitted until the equipment has been replaced or repaired.

12 OTHER SAFETY CONSIDERATIONS

12.1 ILLNESS

In order to protect E & E employees and contractors at the Site, E & E personnel will not mobilize to the site if they are feeling ill. General good hygiene practices must be utilized, such as frequent hand washing and using hand sanitizers with at least 60% alcohol between hand washings.

12.2 FLEET VEHICLES

If a Fleet Vehicle is involved in an accident, contact LeasePlan at (800) 323-6644 immediately. Obtain other driver information, license, insurance, license plate, VIN. Take photographs of the vehicles involved and any damage, as well as the adjacent area/roadway reflective of the incident. Contact your local office administrator/fleet manager for further assistance.

13 EMERGENCY CONTACT INFORMATION

Directions to the nearest emergency room, White Plains Hospital, are shown as **Appendix G**.

Table 5: Emergency Contact Information

Agency	Name	Address	Phone Number(s)
Ambulance Company	N/A	N/A	911
Hospital Emergency Room	White Plains Hospital	41 East Post Road White Plains, NY 10601	(914) 681-0600 or 911
Urgent Care	CityMD White Plains Urgent Care - Westchester	222 Mamaroneck Ave White Plains, NY 10605	(914) 401-4282
TriageNow Hotline for Workplace Injury	N/A	N/A	(877) 311-0038
Police	White Plains City Police Department	77 South Lexington Ave White Plains, NY 10601	(914) 422-6111 or 911
Fire Department	White Plains Fire Department, Station 1	225 Mamaroneck Ave White Plains, NY 10605	(914) 422-6361 or 911
Poison Control Center	New York City Regional Poison Control Center	455 1st Avenue #123 New York, NY 10016	(800) 222-1222 or (212) 689-9014

The emergency contact information presented above was verified by:

Greg Mayer

Signature

Gregory Mayer

Name

Senior Consultant

Title

June 2026

Date

E & E (WSP) Office Resources / Emergency Contacts:

E & E (WSP) Office, Buffalo, NY (Rick Watt) – (716) 395-2375 (office)

Dave Morelli, Project Manager – (212) 760-5635 (office)

Kevin Dunsmore, Senior Regional Health and Safety Manager – (856) 793-2005 (office)

Joseph Kapp, CIH, Industrial Hygiene and Hazmat Manager – (212) 760-5681 (office)

14 CERTIFICATIONS AND SIGNATURES

All site personnel MUST sign this page to acknowledge the requirements of this HASP.

Table 6: HASP Certifications

Name	Signature	Title	Date

APPENDIX A

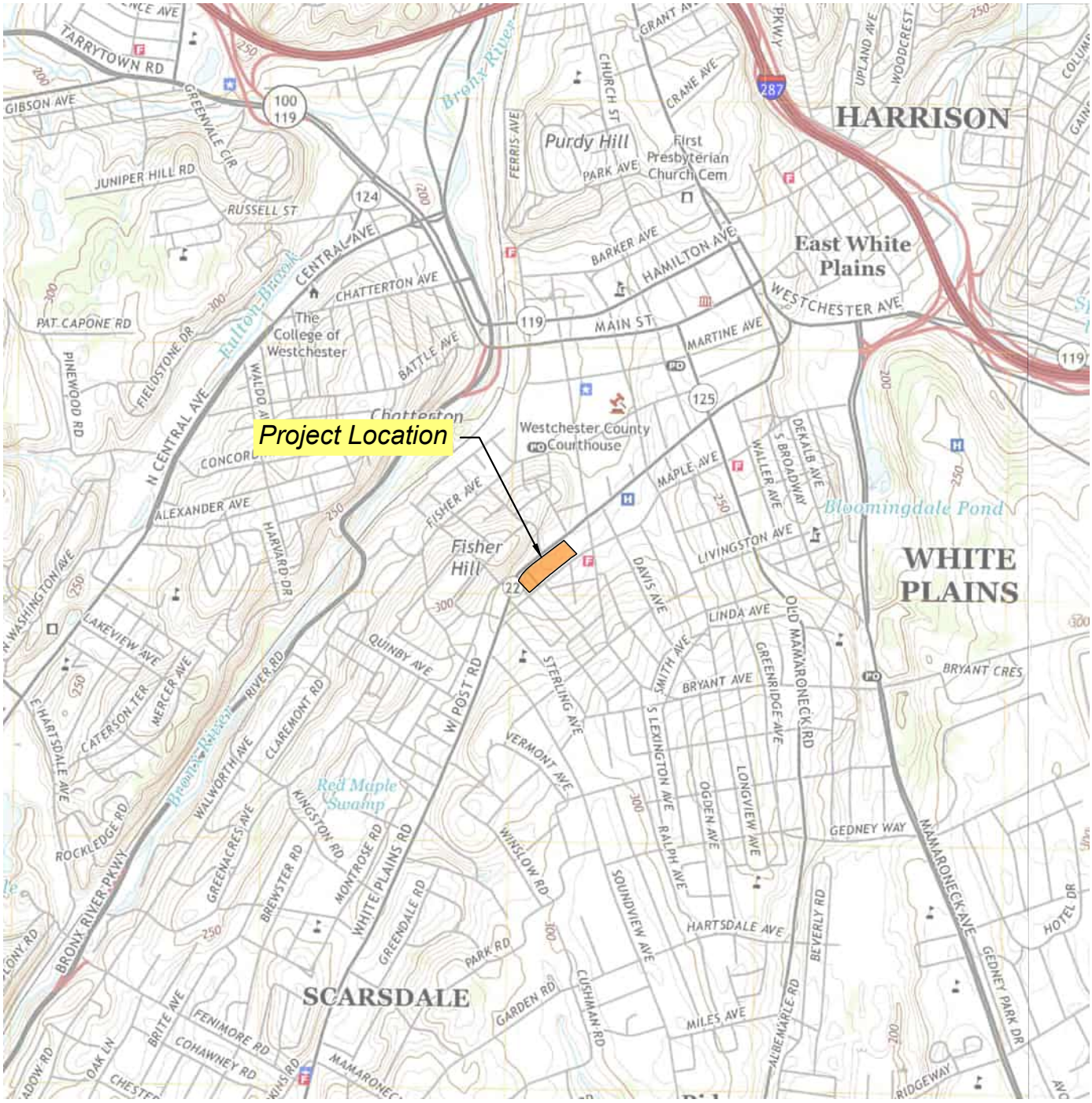
EQUIPMENT	Quant.
INSTRUMENTATION	
FID	
Thermal desorber	
O_2/explosimeter w/calibration kit	
Photovac tip	
PID (lamp: 10.6 eV)	1
Magnetometer	
Pipe locator	
Weather station	1
Colorimetric (e.g., Draeger) tube kit (tubes: _____)	
Brunton compass	
Real-time cyanide monitor	
Real-time H_2S monitor	
Heat stress monitor	
Noise equipment	
Personal sampling pumps and supplies	
MiniRae dust monitor	3
Mercury monitor	
Spare batteries (type: _____)	
RADIATION EQUIPMENT/SUPPLIES	
TLD badge for each field staff member	
Documentation forms	
Portable ratemeter	
Scaler/ratemeter	
NaI gamma probe: ☐ 1-in. ☐ 2-in. ☐ 3-in.	
Documentation forms	
GM pancake probe	
Tungsten-shielded GM probe	
Micro R meter	
Ion chamber	
Alert monitor	
Pocket dosimeter	

EQUIPMENT	Quant.
RADIATION EQUIPMENT/SUPPLIES (Cont.)	
Dosimeter charger	
Radiation warning tape	
Radiation decontamination supplies	
Spare batteries (type: _____)	
SAMPLING EQUIPMENT	
8-oz. bottles/Lab provided containers	
Half-gallon bottles	
VOA bottles	X
String	X
Hand bailers	
Thieving rods with bulbs	
Spoons	X
Knives	X
Filter paper	
Bottle labels	X
Summa Canister	
MISCELLANEOUS	
Pump	X
Surveyor's tape	X
100' Fiberglass tape	X
300' Nylon rope	
Nylon string	
Surveying flags	X
Camera	X
Film	
Bung wrench	
Soil auger	
Pick	
Shovel	
Catalytic heater	
MISCELLANEOUS (Cont.)	
Propane gas	
Banner tape	
Surveying meter stick	

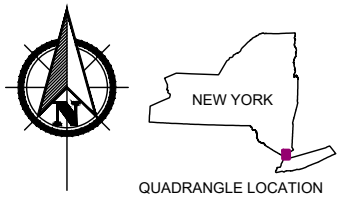
EQUIPMENT	Quant.
Chaining pins and ring	
Logbooks (1 large, _____ small)	X
Required SDSs	X
Intrinsically safe flashlight	
Potable water	X
Gatorade or equivalent	
Tables	X
Chairs	X
Weather radio	
Two-way radios	
Binoculars	
Megaphone	
Cooling vest	
EMERGENCY EQUIPMENT	
First aid kit	X
Stretcher	
Portable eye wash	X
Blood pressure monitor	
Fire blanket	
Fire extinguisher	X
Thermometer (medical)	
Spill kit (list contents:)	
DECONTAMINATION EQUIPMENT	
Wash tubs	
Buckets	X
Scrub brushes	X
Pressurized sprayer	
Spray bottle	X
Detergent (type: alconox)	X
DECONTAMINATION EQUIPMENT (Cont.)	
Solvent (type: _____)	
Plastic sheeting	X
Tarps and poles	
Trash bags	X
Trash cans	

EQUIPMENT	Quant.
Masking tape	
Duct tape	X
Paper towels	X
Face mask	
Face mask sanitizer	
Step ladders	
Distilled water	X
Barrier tape	
SHIPPING EQUIPMENT	
Coolers	X
Hazmat shipping kits	
Absorbent	
Shipping labels	X
DOT/IATA labels:	
Orientation arrows	
Excepted quantity mark	
Limited quantity mark	
Hazard Class(es)	
Strapping tape	X
Baggies	X
Custody seals	X
Chain-of-custody forms	X
FedEx airbill forms	X
Dangerous goods declaration(s)	
Permanent markers	X
Clear packing tape	X

APPENDIX B



SOURCE: USGS TOPOGRAPHIC QUADRANGLE WHITE PLAINS, NEW YORK (2019) AND GLENVILLE, CONNECTICUT (2018).



LEGEND

BROWNFIELD CLEANUP PROGRAM SITE

0 2000

SCALE IN FEET

WSP USA Inc.
500 Summit Lake Drive
Suite 450
Valhalla, New York 10595
(212) 760-5635

Post Road Corridor Off-Site
NYSDEC Site No. C360129A
77 West Post Road
White Plains, New York

PROJECT LOCATION MAP

FIGURE 1

DWG Date: 01/23/2026
Checked: DM
Approved: DM
Drawn By: RAC
A

O:\DWG\NYS DEC\Post Road Corridor\F1_USGS-SLM.dwg, 1, 1/23/2026 8:13:27 AM

LEGEND

PARCEL BOUNDARY

BROWNFIELD CLEANUP PROGRAM SITE

EXISTING MONITORING WELL LOCATION

RW-21 (10-20) MONITOR WELL ID SCREENED INTERVAL

PROPOSED MONITORING WELL LOCATION

0 100

SCALE IN FEET

SOURCE: WESTCHESTER COUNTY NY GIS DATA.

WSP USA Inc.
500 Summit Lake Drive
Suite 450
Valhalla, New York 10595
(212) 760-5635

Post Road Corridor Off-Site
NYSDEC Site No. C360129A
77 West Post Road
White Plains, New York

PROPOSED MONITORING WELL LOCATIONS - JANUARY 2026

FIGURE 2

Drawn By: RAC
Checked: DM
Approved: DM
DWG Date: 01/23/2026
A

O:\DWG\NYS DEC\Post Road Corridor\F2_PropMW dwg, 2, 1/23/2026 8:13:32 AM

APPENDIX C

DAILY SAFETY MEETING RECORD

Project Name:	Project Number:
Project Location (city/state):	
Date/time:	Weather:

DAILY ACTIVITIES:

MEETING TOPICS (see site-specific health and safety plan for details):

Hazards Discussed			Other Safety Topics
☐ Biological (insects, plants, etc.)	☐ Fire/explosion	☐ Railroads	☐ Buddy system
☐ Cold stress	☐ Hand tool usage	☐ Sunburn (skin/eyes)	☐ Communication
☐ Chemical hazards	☐ Heat stress	☐ Slips, trips, falls	☐ Decontamination procedures
☐ Compressed gas cylinders	☐ Heavy equipment (working near)	☐ Traffic (working near)	☐ Emergency procedures
☐ Confined space	☐ Heights	☐ Utility lines	☐ First aid
☐ Drilling/Geoprobe	☐ Infectious material	☐ Unoccupied buildings	☐ Hospital route
☐ Driving (general)	☐ Manual lifting	☐ Weather (storms, wind, lightning, etc.)	☐ Monitoring requirements
☐ Driving (off road)	☐ Noise	☐ Other:	☐ PPE requirements
☐ Drums/containers	☐ Overhead obstructions	☐ Other:	☐ Work zones
☐ Electrical (incl. extension cords)	☐ Power tools (electric & gas)	☐ Other:	☐ Other:
☐ Excavation/trenching	☐ Radiological	☐ Other:	☐ Other:

Note: First day on site should include topics from HASP. Subsequent days may include a subset of topics applicable to the day's activities.

SITE-SPECIFIC TRAINING /KEY SAFETY ELEMENTS DISCUSSED

Examples may include operation of specialized tools or equipment and team members' specific roles and responsibilities.

UPDATES/MODIFICATIONS*:

*This section should include hazards or conditions identified in the field that have changed since the site-specific health and safety plan was prepared. Updates in hazards and control measures, monitoring requirements, and PPE requirements must be included in a safety plan addendum. Approval of the addendum by a safety coordinator (OSC, RSC, CHSD) must be documented (signed addendum form and/or documented in logbook).

SAFETY MEETING ATTENDEES:

Name (printed)	Signature	Organization

Additional attendees shall sign the back of this form.

APPENDIX D

WSP USA Procedure

SA 313 Ground Disturbance - Utilities Damage Prevention

May 2026

HS-US-PRO-SA 313 Ground Disturbance - Utilities Damage Prevention

Revisions

Rev	Effective date	description of change	Issuing function	function Owner
Initial Issue	12/2022	Originally developed for Earth and Environment and Energy business lines, based on legacy Environment's Field Standard Operating Procedure 2 (Utility Locating).	Health & Safety	Ted Devens, SVP - US Corporate Safety Director
1	5/2026	Updated for use across business lines and aligned with current industry standards and business processes. Added WSP Ground Disturbance Permit requirement. Moved overhead utility hazards to Mobile and Heavy Equipment procedure.	HSEQ	Jennifer Gagnier, SVP HSEQ, WSP USA

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Appendix A – SA 313-01 WSP Ground Disturbance Permit- Utility Damage Prevention

Appendix B – SA 313-02 Site Reconciliation Checklist

Abbreviations and Definitions

Term	Description
811	The national “Call Before You Dig” system used to notify public utility owners/operators of planned excavation activities and request marking of underground utilities.
CGA	Common Ground Alliance, an industry organization that publishes best practices for underground utility damage prevention.
Daylighting	Controlled exposure of an underground utility using non-destructive excavation methods for positive identification purposes.
Ground Disturbance	Ground disturbance is any activity that penetrates, displaces, or drills through soil or surface material (including asphalt, concrete, pavement, or slabs), regardless of depth.
Hand Digging	Non-destructive manual excavation using non-powered, non-rotational, hand-held tools in a controlled manner with continuous visual control.
HSE	Health, Safety, and Environment
HSEQ	Health, Safety, Environment & Quality
iSMS	Integrated Safety, Health, Environment, & Quality Management System (WSP incident reporting tool)
MSHA	Mine Safety and Health Administration
Non-Destructive Excavation Methods	Controlled excavation methods used to safely expose underground utilities allowing visual confirmation before work continues. Examples: Vacuum excavation, air knife, hand digging.
OSHA	Occupational Safety and Health Administration
OSHMS	Occupational Safety and Health Management System
Positive Identification	Visual confirmation of the underground utility (location, alignment, depth, size).
PSP	Project Safety Plan (including Health and Safety Plan)
Tolerance Zone	A defined area surrounding a marked underground utility where only non-destructive methods are allowed because the exact location is uncertain.
Utility Locate	The process of identifying and marking underground utilities using public (811) and/or private locating services.
Zero Energy	A verified condition in which all hazardous energy sources (electrical, mechanical, hydraulic, pneumatic, thermal, chemical, or stored energy) have been isolated, controlled, or rendered safe prior to work.

Executive Summary

Ground disturbance activities present a risk of damaging underground utilities, which may result in serious injury, environmental harm, service disruption, or property damage. This procedure establishes requirements and controls to prevent utility damage during ground disturbance activities performed by or on behalf of WSP USA.

It defines minimum requirements for planning, utility locating, verification, non-destructive excavation, energy control, and stop-work actions when utility clearance is incomplete or uncertain.

Key requirements include:

- An approved WSP Ground Disturbance Permit.
- Identification, location, and verification of underground utilities prior to ground disturbance.
- Use of public 811 (a legal requirement) utility locating services.
- Use of private utility locating services, as applicable.
- Non-destructive excavation methods within tolerance zones and where positive identification is required.
- Immediate stop-work when required utility information is uncertain, conflicting, or incomplete.

Following these steps helps prevent utility strikes, protects personnel and the environment, and supports WSP USA's commitment to safety and operational excellence.

This procedure aligns with applicable regulatory requirements, including Occupational Safety and Health Administration (OSHA) standards, national 811 "Call Before You Dig", and Common Ground Alliance (CGA) best practices.

.

1. Introduction

Striking underground utilities, such as electrical, gas, chemical, telecommunication, and water lines, can occur during ground disturbance and various field activities if the appropriate controls are not implemented. Underground utilities, which include buried or below-grade pipelines, cables, conduits, ducts, and associated appurtenances, whether active or abandoned pose significant risks for equipment operators and nearby personnel. Additionally, such incidents can cause major environmental harm or financial loss, as well as damage to power transmission and operating equipment.

This procedure generally aligns with recognized industry standards and practices for ground disturbance and utility damage prevention and applicable regulatory requirements. It is not intended to supersede other applicable laws or client-specific requirements. Where regulatory or client requirements prescribe higher standards than those outlined in this procedure, those higher standards take precedence.

1.1 Purpose

The purpose of this procedure is to establish comprehensive requirements and controls for identifying, locating, and marking underground utilities that may pose a risk of contact or disturbance, prior to conducting any field activities. This approach helps prevent incidents that could lead to serious injury, environmental harm, significant financial loss, or property damage by providing employees with the necessary knowledge and preparation to address potential utility hazards before work begins.

1.2 Scope

This procedure applies to all WSP USA employees involved in ground disturbance activities, regardless of depth of disturbance.

.

2. Roles and Responsibilities

Roles and responsibilities of various personnel under WSP's Health, Safety, Environment, and Quality (HSEQ) Program are established in WSP's US Occupational Safety and Health Management System (OSHMS) procedure (SA 200). Additional responsibilities of key personnel are outlined in the following section.

2.1 Senior Vice President of Health, Safety, Environment & Quality (HSEQ) Executive

The Senior Vice President of Health, Safety, Environment & Quality (HSEQ) Executive is responsible for the development and implementation of this procedure including reviewing and approving updates or revisions to the procedure, as needed.

2.2 Project Managers and Site Supervisors

The Project Manager, with assistance from the Site Supervisor, is responsible for managing project health, safety, and environment (HSE) risks. This includes identifying hazards, implementing suitable controls, and confirming employees are competent to perform their role. Additional responsibilities include the following:

- Verify subcontractor responsibilities are established in agreements where subcontractors will be conducting the ground disturbance activities.
- Verify the site-specific Project Safety Plan (PSP) is developed and implemented.
- Verify utility locates are conducted, as required and site reconciliation has been performed.
- Communicate risks and controls, including the Emergency Response Plan, to workers on site.
- Approve the WSP Ground Disturbance Permit, as applicable.

2.3 Employees

Responsibilities for employees are as follows:

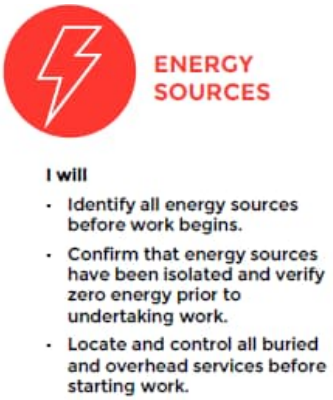
- Follow this procedure and site-specific requirements.
- Participate in site-specific pre-task tailgate meetings.
- Complete any required training relevant to ground disturbance activities.
- Wear the appropriate PPE for duties performed.

- Submit and review the approved WSP Ground Disturbance Permit, prior to activities, as applicable.
- Notify the Project Manager, Site Supervisor, or their designee, before proceeding with ground disturbance activities if utility clearances are not complete, sufficient information is not available, there are inconsistencies in the utility locates, or changes in location.

3. Ground Disturbance Controls

3.1 Planning and Critical Controls

Planning and critical controls for ground disturbance shall be addressed through the site-specific PSP, including applicable Life Saving Actions and the WSP Ground Disturbance Permit, as applicable. Prior to commencing any ground disturbance activities and/or in the event of any site or scope of work changes, employees and subcontractors shall conduct a safety tailgate meeting to discuss the risks and controls for the planned tasks.



3.1.1 WSP Ground Disturbance Permit

A project-specific WSP Ground Disturbance Permit shall be completed and approved prior to commencing any ground disturbance activity and WSP has responsibility for utility locating and/or verification. See Appendix A for the permit template. The Permit includes, but is not limited to the following:

- Emergency Response Plan.
- Utility clearance verification.
- Additional requirements.
- Designated section for signatures to document review and authorization. Approval may be granted by Project Manager or delegee (e.g., Site Supervisor).

The WSP Ground Disturbance Permit must be maintained as part of the site-specific PSP.

3.2 Underground Utility Locates

Any person undertaking ground disturbance activities shall, prior to commencing work, locate underground utilities.

3.2.1 Assignment of Responsibility

While the fundamental requirement is to identify underground utilities before work commences, the specific responsibilities and procedures may differ depending on the role of the excavator and the contractual arrangements. The following scenarios illustrate how these responsibilities may be assigned.

- When WSP is self-performing ground disturbance activities, WSP is responsible for completing the utility clearance activities and must follow procedures for utility locates, documentation, safety control, and emergency response.

- In situations where ground disturbance activities are being carried out by a WSP subcontractor or 3rd party where WSP is the Prime Contractor, WSP adheres to the terms specified in the client and subcontractor contract agreements, as applicable, as well as any relevant State-specific legal requirements regarding site responsibilities. Unless otherwise assigned, the excavator would be responsible for completing the utility clearance activities and must follow procedures for utility locates, documentation, safety control, emergency response, and means and methods. However, WSP retains accountability for planning, coordination, and verification of required controls as well as the management of the incident reporting and investigation, pending contractual requirements.
- In situations where ground disturbance activities are being carried out by a 3rd party and WSP is NOT considered the Prime Contractor, WSP is not responsible for completing the utility clearance activities, safety control, emergency response, incident reporting, or means or methods.

If there is any uncertainty or incomplete information regarding utility clearance, ground disturbance work must not proceed until the clearance activities have been verified, discrepancies resolved, and proper documentation is obtained.

3.2.2 Public Locates (811)

Public locates (811) are a key control in utility damage prevention and are required before ground disturbance to request marking of participating utility-owned facilities in the proposed work area.

Public utility 811 service providers will mark their underground lines within the public right-of-way up to the meter, connection point, or property line. It is common for meters or connection points to be inside the property line, so that segment is typically considered a public-owned utility and should be marked. However, cabling or piping (e.g., sewer laterals, storm drainage, private electric distribution) beyond the meter or connection point is often considered privately owned and not marked as part of the public locate service.

The excavator requests identification of the location of underground utilities at each site by notifying the utility owner/operator through the 811 “Call Before You Dig” center, unless otherwise specified by local regulations or contractual requirements. Excavation can typically begin 2-3 working days from the date of notice to the 811 center and markings are generally valid for 15 working days but can vary pending local requirements.

If the 811 center indicates that no utilities were notified for your request, this may mean that local utility owners/operators are not 811 members (e.g., small private cooperatives in rural areas) even though utilities may still be present. In these cases, contact the relevant non-member facility owners/operators directly, because 811 notifies only registered members.

If utility markings are destroyed or removed prior to the start or completion of excavation, immediately stop work and notify the appropriate utility company, utility protection service, or utility locating service.

Inform them that the markings are no longer visible. Work must not resume until the utilities have been properly re-marked.

A copy of the ticket or the ticket number and contacts must be recorded on the WSP Ground Disturbance Permit.

3.2.3 Private Locates

Private utility locating refers to the use of qualified personnel or 3rd party locating services to identify and mark underground utilities that may not be covered by public 811 markings (e.g., privately owned facilities) or where additional certainty is needed due to site conditions. Private locates are typically performed using appropriate locating technologies (e.g., electromagnetic locating, ground-penetrating radar, and/or other site-specific methods), followed by field marking/flagging and documentation of findings.

In addition to public utility 811 locates, private utility locating must be conducted whenever ground disturbance activities present an elevated risk such that reliance on public 811 markings alone may not provide sufficient confidence in utility location. Situations requiring private locating include, but are not limited to:

- Work in proximity to suspected utilities when the exact location is unclear.
- Areas with congested or complex subsurface conditions.
- Circumstances involving discrepancies, conflicting information, or uncertainty regarding utility locations exist.
- When otherwise required by client or site owner, or operator.

Where public 811 locates are not completed because coverage does not apply or the service is otherwise unavailable (e.g., privately owned or non-811 member facilities), private utility locating is required. However, an exception to additional private utility locating and issuance of a WSP Ground Disturbance Permit may be approved by the Project Manager only where a documented reasonable-care determination concludes that underground utilities are unlikely to be present, and all the following conditions are met:

- Ground disturbance is limited to hand-digging methods only.
- The determination includes a review of available information such as applicable requirements, utility records/as-builts, aerial imagery, land-use history, and site-specific field observations.
- The determination and supporting rationale are documented in the PSP.
- Work is immediately stopped and conditions are reassessed if site conditions change or unknown subsurface features are encountered.

This exception does not authorize mechanical excavation and does not supersede applicable regulatory requirements, client requirements, environmental controls, or other safety or permitting requirements.

3.2.4 Data Collection

- Identify a site contact with institutional knowledge (e.g., plant manager or facility engineer) to discuss potential underground utilities in the proposed ground disturbance area.
- Request historical utility data such as as-built drawings, fire insurance maps, engineering plans, and aerial photos.
- Locate existing or decommissioned underground storage tanks and piping and request relevant construction or engineering surveys.
- Assess potential encounters with underground assets from adjacent properties.
- Review the 811 ticket to identify potential utilities present at the excavation location.
- Identify if there are multiple owners, subdivided lots, easements, or rights-of-way that may require alternative utility locating methods and/or approvals.

3.2.5 Site Reconciliation

Site reconciliation is the process of verifying that utilities marked in the field are aligned with on-site plans and utility locate reports. This step is essential, even when utility clearance is performed by subcontractors. See Appendix B for a Site Reconciliation Checklist. If there are inconsistencies:

- Stop, contact the Project Manager and discuss the path forward.
- Contact utility companies to verify unmarked/located services, as needed.
- If feasible, conduct a second set of alternative private locates.
- Change the location of the ground disturbance area so it does not impact the known or suspected utilities, if possible (clear new area).
- Daylight utilities to confirm the location using non-destructive excavation methods.
- De-energize, lockout/tagout, and/or re-route any live utilities, as feasible.

Document the confirmation of verification on the WSP Ground Disturbance Permit.

3.2.6 Tolerance Zone

The tolerance zone is the area surrounding a marked or identified underground utility where excavation activities are restricted to prevent damage. Utility markings indicate the approximate location of underground facilities; therefore, additional precautions are required within the tolerance zone. The tolerance zone is comprised of the width of the utility plus 18 inches on either side of the outside edge of the underground utility on a horizontal plane, unless greater clearance is warranted. Where local regulations specify a greater tolerance zone width, those requirements shall be followed.

Within the tolerance zone:

- Mechanical excavation is prohibited until the utility has been exposed and positively identified.
- Utilities shall be exposed prior to commencing any destructive excavation within the tolerance zone using non-destructive methods, such as hand digging or vacuum excavation (daylighting).
- Excavation shall proceed carefully and incrementally to maintain continuous visual control of the utility and to ensure it remains supported.
- Exposed utilities must be protected, supported, or removed, as necessary in an open excavation.

Additional Requirements:

- Where multiple utilities are present, overlapping tolerance zones shall be treated as a single expanded tolerance zone.
- The tolerance zone applies regardless of assumed utility depth.
- The same tolerance zone principles shall be applied to private utility locates, even where 811 does not mark the facility.

3.2.7 Daylighting

Daylighting must be performed under the following circumstances, unless zero-energy conditions and client agreements are established that provide equivalent protection:

- When inspecting or repairing underground utilities.
- When ground disturbing activities will occur within the tolerance zone of a marked or suspected utility.
- When confirming utility alignment, depth, or size.
- When working in areas with a high density of underground utilities (e.g., oil and gas facilities, electrical substations, industrial sites, or urban areas).
- When there is reason to believe that underground utilities may be present but were not identified during locating activities.
- When required to meet client, utility owner, site owner, or site operator daylighting requirements, including minimum separation distances within the ground disturbance area.

3.2.8 Achieving Zero-Energy Conditions

When utilities are present in the work area, achieving zero-energy conditions is recommended whenever possible. This involves verifying that all sources of energy, such as electrical, gas, steam, or pressurized systems are completely de-energized, isolated, flushed/purged/depressurized (as needed), and confirmed safe prior to beginning any ground disturbance activities. Verification must include lockout/tagout procedures and testing for the absence of energy, with authorization obtained before proceeding.

3.2.9 Concrete/Asphalt Coring

When coring through asphalt, concrete, or slabs, additional precautions are required:

- Complete utility locating and verification using methods suitable for the surface, site, and risk.
- Check proposed coring sites for signs of shallow or embedded utilities, such as signage, valves, markers, meters, vaults, basins, equipment, lighting, EV chargers, camera poles, or conduit.
- Look for repairs or changes in pavement indicating prior disturbance.
- Review drawings/as-builts for possible embedded utilities and slab type.
- Controlling Energy
  - If electrical, gas, steam, or pressurized piping may be present, do not start coring until confirmed zero-energy conditions or approved controls are in place, with authorization to proceed.
  - Isolate, block, blank, and purge lines with hazardous gases or chemicals where possible.
- Coring and Verifying
  - Do not core post-tension slabs without structural engineer and owner approval.
  - Control depth, stop before subsurface, and verify before proceeding.
  - Assess other hazards like dust (silica), chemicals, ergonomics, and noise during coring.

3.2.10 Backfilling

- Protect exposed utilities from damage or displacement during backfilling.
- Use suitable backfill material free of debris, coiled wire, or materials that could damage utilities or interfere with the accuracy of future locates.
- Place and compact backfill in a controlled manner to prevent voids, settlement, or shifting of utilities.
- Restore surfaces and site conditions in accordance with applicable requirements.

3.3 Stop Work

Employees involved in ground disturbance activities have the authority to stop work when conditions are unsafe or inconsistent with this procedure. Work must be stopped immediately if any of the following occur:

- Utility locations and supporting information are uncertain, conflicting, or incomplete.
- Utility markings are no longer visible.
- An unmarked or unexpected utility or asset is encountered.

- Required permits, approvals, or utility clearances are not in place.
- Daylighting or verification requirements cannot be met.
- Zero-energy conditions cannot be achieved or maintained where required.
- A utility is contacted or damaged, including contact with utility bedding material or red concrete, indicating the work may be within the tolerance zone of a utility.
- Site conditions change such that the work can no longer be performed safely.

Work may resume once discrepancies are resolved and authorization is provided by the Project Manager or Site Supervisor.

4. Emergency Response

- Before field activities, review the procedures in the Emergency Response Plan and confirm the location and operation of emergency shut-off devices and emergency response equipment.
- During ground disturbance, if any indication of an unknown or unverified utility is encountered:
  - Stop work.
  - Notify the Project Manager and/or Site Supervisor and determine how to proceed before continuing.
- If an underground utility is contacted or damaged:
  - Stop work.
  - Immediately notify:
    - 9-1-1 for emergencies (e.g., gas emissions, liquid discharge, discharge of electricity).
    - 811.
    - The utility owner/operator.
    - The Project Manager and/or Site Supervisor.
  - Shut off applicable valves and switches, if you are trained and authorized and it can be done safely.
  - Evacuate personnel from the area (preferably upwind from a suspected release) and establish a safe perimeter.
  - Avoid contact with utility or any liquid, vapor, or gas that may be emitted.
  - If a fiber optic cable is damaged, do not handle or look into the cable, as serious eye damage may occur. Please note that the light in fiber optic cables is not visible to the human eye.
  - If an electrical line is damaged, always treat the lines as energized. To minimize the risk from ground potential differences, keep your legs together and either shuffle or jump away from the area. Operators must remain inside the equipment cab unless the equipment is on fire or there is an immediate threat to personal safety. If they must evacuate equipment, they should jump from the equipment with feet together and then shuffle or jump away for the area.
  - Allow the utility operators to conduct the damage condition assessment.
- Report incident in the iSMS and participate in the investigation of the incident, as requested.

Upon confirmation of safe work conditions by the utility operator, work may resume upon authorization by the Project Manager, Site-Safety Supervisor, and/or emergency personnel.

5. Training

Employees conducting ground disturbance activities are required to be trained in the hazards and risks of ground disturbance, with training that should at a minimum cover this procedure and inform them of hazards and safety controls. Competency shall be evaluated through observation of practical field skills and knowledge of work history. Additional training may be required based on local regulation or client specific requirements.

6. Recordkeeping

Record Identification	Storage/Protection Location	Record Media Type	Minimum Retention Period	Disposition of record after minimum retention period
WSP Ground Disturbance Permit	Follow Project Delivery practices	Electronic/Other	5 years	Archive
Training	Horizon/other following applicable business practices	Electronic/Other	5 years	Archive

7. REFERENCES

SA documents are available on the WSP Occupational Safety and Health Program page on Canopy here.

- SA 200 Occupational Safety and Health
- SA 203 Incident Investigation and Reporting
- SA 204 Project Safety Plans
- SA 310 Mobile and Heavy Equipment
- MSHA: 30 CFR 56.7003 Drill Area Inspection
- OSHA: 29 CFR 1926 Subpart P – Excavations
- 811 “Call Before You Dig” https://811beforeyoudig.com/
- Common Ground Alliance (CGA), Best Practices for Underground Safety and Damage Prevention

7.1 FORMS

- WSP Ground Disturbance Permit – Utility Damage Prevention
- Site Reconciliation Checklist

1

Forms

Appendix A – SA 313-01 WSP Ground Disturbance Permit- Utility Damage Prevention

SA 313-01 WSP Ground Disturbance Permit – Utility Damage Prevention

Completed by:		Date:
PROJECT INFORMATION		
Date(s) of Work:	Project Name and Number:	Client Name:
Project Manager:	Site Supervisor(s):	Site Location:
EMERGENCY RESPONSE PLAN		
Stop Work and follow the project's Emergency Response Plan. -Evacuate the area -Notify 811, 911, utility owner/operator, Project Manager, and /or Site Supervisor, as applicable -Do not resume work until authorized -Enter incident into iSMS		Additional Instructions:
GROUND DISTURBANCE INFORMATION		
Excavation Dates (start/end):	Excavator (company name):	Responsible party for notifying 811 Call Before you Dig:
Disturbance Description (depth, size, method, location) (attach site map):		Location ID(s) (e.g., bore hole ID):
Hazards/Special Conditions:		
UTILITY CLEARANCE		
811 Call Before You Dig/One Call ticket? ☐ Yes ☐ No	Ticket # and date (attach ticket):	Identified underground utilities:
Private locates conducted? ☐ Yes ☐ No	Company (attach report)?	Identified underground utilities:
Will daylighting be conducted? ☐ Yes ☐ No	Zero-Energy Conditions Confirmed? ☐ Yes ☐ No	Site Reconciliation completed? ☐ Yes ☐ No
Describe in detail or attach map of identified underground utilities and describe any noted discrepancies:		
For identified utilities, indicate the Tolerance Zone:	Other special instructions:	

PERMIT REVIEW AND APPROVAL		
Approved by (Project Manager or delegee):	**Status:** ☐ Approved ☐ Not Approved	**Date:**
Comments:		

Notes: For projects where WSP has responsibility for utility locating and/or utility verification, a project-specific Ground Disturbance Permit shall be completed and approved by the Project Manager of delegee.

Appendix B – SA 313-02 Site Reconciliation Checklist

SA 313-02 Site Reconciliation Checklist

This checklist is used to verify alignment between utility locate information, field markings, plans, and site conditions prior to and during ground disturbance activities, in accordance with SA 313 Ground Disturbance – Utilities Damage Prevention.

PROJECT INFORMATION	
Project Name and Number:	Client Name:
Completed by:	Date Completed:

Pre-Field Review (Office / Planning)

☐ Scope of work and limits of ground disturbance clearly defined

☐ Public 811 ticket obtained and valid for the work area

☐ 811 ticket number and expiration date documented

☐ Private utility locating completed where required

☐ As-built drawings, site plans, surveys, and historical utility records reviewed

☐ Land-use history reviewed for evidence of buried infrastructure

☐ Client / site owner utility requirements reviewed (if applicable)

☐ Documented reasonable-care determination for private locate exception (See Section 3.2.3 of SA 313 Ground Disturbance – Utilities Damage Prevention Procedure)

Field Verification – Utility Markings

☐ Utility markings visible, legible, and within the defined work area

☐ Utility markings consistent with 811 color codes

☐ Markings match locate reports and plans

☐ No missing, faded, or disturbed markings observed

☐ Public utilities marked to meter/connection/property line

☐ Private utilities identified and marked where required

☐ Survey/proposed construction markings differentiated from utilities

☐ Overhead and adjacent utilities evaluated

Site Conditions & Visual Indicators

☐ Valves, meters, vaults, pedestals, handholes identified

☐ Pavement patches or prior excavations evaluated

☐ Potential abandoned or undocumented utilities considered

☐ Adjacent property utilities assessed

☐ Congested subsurface conditions identified

☐ Environmental/geotechnical features reviewed

Reconciliation of Conflicts or Gaps

☐ Field markings align with plans and locate reports

☐ Discrepancies identified and documented

☐ Utility owners/operators contacted as needed

☐ Additional private locating completed if required

☐ Work area adjusted to avoid utilities where feasible

☐ Daylighting performed where required

☐ Zero-energy conditions verified where applicable

Authorization to Proceed

☐ Utility locations verified and reconciled

☐ Tolerance zones established and communicated

☐ Required controls in place

☐ Team briefed on utility locations and stop-work criteria

☐ Emergency response plan reviewed

☐ Ground Disturbance Permit completed and approved

Stop-Work Triggers

☐ Uncertain, conflicting or uncertain utility information

☐ Utility markings no longer visible

☐ Unmarked or unexpected utility encountered

☐ Required permits, approvals, or utility clearances are not in place

☐ Daylighting or verification requirements cannot be met

☐ Zero-energy conditions cannot be achieved or maintained where required

☐ Change in scope, location, or method

☐ Utility contact, strike, or near-miss

Notes / Comments

For projects where WSP has responsibility for utility locating and/or utility verification, a project-specific Ground Disturbance Permit shall be completed and approved by the Project Manager of delegee.

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STANDARD OPERATING PROCEDURE

SAMPLE HANDLING, PACKING, AND SHIPPING

SOP NUMBER: ENV 3.16

REVISION DATE: 2/28/2018 **SCHEDULED REVIEW DATE: 2/28/2023**

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1 Scope and Application

This Standard Operating Procedure (SOP) describes the handling, packing[1], marking, labeling, and shipping procedures routinely used by E & E field personnel to ship samples from the field to off-site laboratories. Shipping includes transport by air, motor vehicle, or rail.

Samples collected of the following matrices typically would be classified as nonhazardous samples (commonly called "environmental samples"):

- Drinking water, groundwater, and surface water;
- Soil and sediment;
- Air;
- Treated municipal and industrial effluent; or
- Biological specimens (e.g., non-pathogenic plant or animal tissue).

Samples collected from drums, storage tanks, impoundments, and lagoons; from known or suspected contaminated areas; and of leachate may potentially need to be classified as hazardous samples.

This SOP does not address sample collection, which is addressed in other E & E SOPs, and assumes that properly collected, filtered (as applicable), preserved, and labeled samples are presented for shipment.

This SOP also does not address the specific procedures for packing, marking, labeling, documenting, and shipping hazardous samples as United States Department of Transportation (DOT) hazardous materials or International Air Transport Association (IATA) dangerous goods, and directs the reader to E & E's Hazardous Materials/Dangerous Goods Shipping Manual for those steps. The project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, and site-specific health and safety plan (SHASP) will address the types and degrees of contamination anticipated and also might address certain handling and shipping procedures.

This SOP is intended for use by personnel who have knowledge, training, and experience in the procedures described herein.

E & E SOP DOC 2.1, Field Activity Logbooks, also would typically apply to sample handling, packing, and shipping.

2 Definitions and Acronyms

APHIS	Animal and Plant Health Inspection Service
^{o}C	degrees Celsius
CLP	Contract Laboratory Program
COC	Chain of custody

[1] Although some common vernacular might be to "package" samples, the term "pack" samples is used in this SOP: 1) for alignment with the reference SOPs used to develop this SOP, and 2) to prevent confusion with the definitions in hazmat transport regulations for "packaging," which is the receptacle used to contain a hazardous material, and "package," which is the packaging plus its contents.

DOT	(United States) Department of Transportation
DQO	Data quality objective
EPA	(United States) Environmental Protection Agency
IATA	International Air Transport Association
QA/QC	Quality assurance/quality control
RHTC	Regional Hazmat Transportation Coordinator
SHASP	Site-specific health and safety plan
SOP	Standard operating procedure
USDA	United States Department of Agriculture
VOA	Volatile organic analysis

3 Procedure Summary

Properly preserved, containerized, and labeled samples provided by field personnel are maintained under secure custody during sample handling, packing, and shipping. Samples presented for shipment are sealed in plastic bags and secured in a plastic-lined cooler. Double-bagged ice is added to the cooler for samples requiring cold preservation. A chain-of-custody (COC) form is completed in full, carefully cross-checked with the samples in the cooler, and enclosed in the cooler. Shipping papers are completed and attached to the cooler, which is custody-sealed and taped closed. The E & E project manager and designated analytical laboratory are notified daily of impending shipments.

4 Cautions

Cautions related to health and safety are discussed in Section 8.

In order to ship hazardous samples, E & E personnel must have received training consistent with the requirements in Title 49 of the Code of Federal Regulations Part 172 (49 CFR 172) Subpart H. If the samples will be shipped by air, E & E personnel also must have received training consistent with Section 1.5 of the IATA Dangerous Goods Regulations. E & E provides this training to applicable employees. The training includes instruction in the use of E & E's on-line Hazardous Materials/Dangerous Goods Shipping Manual and the role of E & E Regional Hazmat Transportation Coordinators (RHTCs), who provide technical support for hazardous sample shipping. This SOP does not specifically address the requirements to properly pack and ship samples that are a hazardous material/dangerous good.

Soil samples from foreign countries, United States (U.S.) territories (i.e., Puerto Rico, U.S. Virgin Islands, and North Mariana Islands), Hawaii, and certain parts of the U.S. fall under federal quarantine as authorized under 7 CFR 301 and are regulated by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS). Some areas in the U.S. also are under state or local agricultural quarantine. Soils from these regulated areas may contain bacteria, viruses, fungi, nematodes, invertebrates, or seeds of undesirable plant species that could be harmful to U.S. agriculture or natural resources. The movement of these soils within the continental U.S. is regulated under 7 CFR 330.300, which may impose additional special handling, packing, and shipping requirements. Although the general packing for environmental samples likely will suffice, APHIS may have additional requirements, such as for the use of specialized electronic barcoded shipping labels. The project team should refer to the

USDA APHIS and analytical laboratory requirements before handling, packing, and shipping such samples.

International shipping requirements will apply to samples shipped to or from foreign countries and are not addressed by this SOP.

5 Equipment and Supplies

Project planning documents will provide direction on specific equipment and supplies. The following equipment and supplies are commonly used to handle, pack, and ship samples that are presented for shipment:

- Filtered (as necessary), preserved, containerized, and labeled samples, prepared by the field team;
- Coolers, custody seals, and COC documentation forms (typically provided by the laboratory);
- Electrical tape, clear tape, duct tape, and fiber-reinforced packing tape (strapping tape);
- Resealable plastic bags, typically 1-gallon and 2-gallon sizes; freezer-style is preferable because they are thicker;
- Large plastic bags or drum liners, to line coolers;
- Shock-absorbing packing material (e.g., foam block, bubble wrap);
- Packaged ice (commercially available, typically in sizes such as 7-pound and 20-pound bags); and
- Shipping documentation, consisting of an air waybill (air transport) or bill of lading (ground transport).

6 Procedure

6.1 Prior to Field Activity

The following activities are performed prior to field mobilization.

1. Team personnel will assemble and stage equipment and supplies needed to handle, pack, and ship samples;
2. Temperature blanks (typically tap water-filled 40-milliliter volatile organic analysis [VOA] vials or other containers specified in the sampling and analysis plan) will be prepared for use in the field;
3. The project manager or designee will determine the best mode of transportation and verify available locations and pickup/delivery schedules; and
4. The project manager or designee will coordinate with the assigned analytical laboratory regarding schedule and availability to receive and log in the shipped samples. Laboratory receipt of samples on a weekend or holiday will require additional coordination with the laboratory.

6.2 Sample Custody

Collected samples must be either in the custody of responsible personnel or sealed and secured if samples are being stored or transported. Samples are considered to be secure if they are in a locked area with controlled access or when being transported by approved field personnel, a commercial carrier (such as FedEx or UPS), or an approved courier.

A COC form is used to document who has custody of a sample, when, and any exchange of sample custody between the field, shipper/transporter, and laboratory. The COC form also documents sample information and analysis requirements. The final signed COC form becomes the permanent record for sample collection, requested analyses, and custody for each collected sample.

A custody seal is a specialized adhesive label or tape that is used to seal sample containers and the shipment packaging, which for samples is typically a cooler. Custody seals must be affixed such that the seal will be visibly broken if the containers or cooler are opened or tampered with. An intact custody seal means that the samples and their shipping container have not been accessed during storage or shipping. When the laboratory logs in the samples, they will report the condition of the custody seals on the COC or otherwise in the laboratory analytical report.

6.3 Determining Whether Samples are Hazardous

Trained and competent field personnel (see Section 4) will determine if the samples could be considered to contain hazardous materials (dangerous goods) according to U.S. DOT and/or IATA regulations. If so, the samples will be packed, marked, labeled, documented, and shipped in accordance with those regulations. E & E's online Hazardous Materials/Dangerous Goods Shipping Manual provides guidance concerning shipping hazardous samples, and E & E's RHTCs should be consulted during the process.

Types of samples that likely would be classified as hazardous materials/dangerous goods include:

- Samples collected from waste lagoons, drums, tanks, heavily stained soils, and groundwater contaminated with a non-aqueous phase liquid;
- Known or suspected polychlorinated biphenyl- or dioxin-containing samples;
- Samples preserved with methanol, such as from using a Terra Core™ kit (although such samples can be shipped as an excepted quantity of hazardous material, which has some less rigorous shipping requirements); and
- Some biological specimen samples, such as those known or suspected to contain an infectious agent.

Water samples preserved with acids or bases typically will not be considered hazardous materials/dangerous goods. (The containers of acid or base preservatives themselves would be a hazardous material/dangerous good.)

6.4 Environmental Sample Packing

It is E & E's intent to pack samples securely to prevent damage and leakage during shipment. This is to prevent the loss of samples and the expenditure of funds to re-obtain the samples or for potential emergency response to a leaking package or spill. Liquid samples are particularly vulnerable. Even if a package is classified and transported as a nonhazardous material, transporters (carriers) are not able to know the difference between a package leaking distilled

water and a package leaking a hazardous chemical and may react to a spill in an emergency fashion, potentially causing expense to E & E or its clients for the cleanup of the sample material. Therefore, samples are packed in plastic bags with the use of shock-absorbent/cushioning material to help prevent leaking of samples both inside and outside the transport package.

Environmental samples will be packed securely whether the samples are shipped via commercial carrier or courier. Environmental samples are usually shipped in 80-quart, solid outer-shell plastic or metal coolers, although other size coolers may be used if they meet project needs. Disposable, pressed Styrofoam™ coolers must not be used to store or ship samples.

Initial Steps

1. Remove non-applicable labels from the cooler.
2. Seal the cooler drain hole with duct tape or equivalent both inside and outside the cooler to prevent leakage.
3. Assemble the containerized samples that will be shipped in the cooler.
4. Ensure that the sample containers are clean, dry, and labeled (wipe container with a paper towel if the container is not clean or dry).
5. Verify that sample container caps/lids are tight.
6. Apply a custody seal over the cap/lid and then secure the custody seal and cap/lid to the container using fiber-reinforced tape, electrical tape, or equivalent. Do not obscure the sample label with the custody seal or tape.
7. Ensure that each container is fully documented on the COC form. COC forms may be completed electronically or by hand depending on project requirements. E.g., EPA Contract Laboratory Program (CLP) sampling/analysis may require electronically generated and completed COC forms.
8. Place each sample container into a resealable plastic bag.
9. Place at least 1 inch of inert shock-absorbent material (e.g., bubble wrap) in the bottom of the cooler.
10. Line the cooler with a heavy-duty plastic trash bag or drum liner.
11. For samples requiring cold preservation:
    a. Maintain the samples on ice during sample handling and packing.
    b. Fill resealable plastic bags with ice and enclose each bag in a second resealable plastic bag such that the ice is double-bagged. These bags of ice will be needed for the cooler.

Securing Sample Containers in the Cooler

1. The sample containers themselves will typically be secured inside the cooler using one of the following methods intended to prevent container damage or breakage.
    a. Pre-cut foam block insert:
        i. Place the foam block insert (with holes cut for the sample containers) inside the plastic bag.
        ii. Place the containers upright in the holes in the foam block.

b. Bubble wrap or equivalent:

   i. Surround each sample container (including the bottom) with bubble wrap, taping the wrap securely around the container; or place the container in a bubble bag. (Some personnel opt to surround the sample container with bubble wrap before placing the sample container in its resealable bag.)

   ii. Place the containers upright in the plastic bag.

   iii. Fill void spaces with additional bubble wrap or other shock absorbent.

c. Loose material that provides shock absorption and liquid absorption (e.g., small animal bedding material made from recycled paper/wood waste):

   i. Place at least 1 inch of the absorbent material in the bottom of the plastic bag lining the cooler.

   ii. Place each sample container upright inside the plastic bag, maintaining about 3 inches between containers.

   iii. Fill the void spaces around the containers with absorbent to at least half the height of the largest container.

2. For liquid samples packed by methods 1a or 1b above, void spaces in the plastic-lined cooler additionally can be filled with non-combustible, absorbent packing material to absorb any sample liquid should breakage or leakage occur and breach the plastic bags containing the individual samples. Vermiculite or light-weight cat litter should not be used for this purpose because they are dusty, staticky, and difficult to remove from the sample containers and cooler. The animal bedding material described in method 1c above is a suitable material for this purpose, as is cellulose wadding and super-absorbent packets. The use of liquid absorbent is not strictly required, and the consequences of sample container leakage are largely mitigated by following the other steps in this section (e.g., the use of multiple layers of plastic bags).

3. If the samples require cold preservation, fill void spaces with double-bagged ice. The ice should be sufficient to maintain the temperature of the samples to about 4 degrees Celsius (°C), ±2 °C, and also not freeze the samples. Additional ice likely will be needed in warmer climates, during warmer times of the year, and if the samples will not be immediately checked in by the laboratory (such as during weekends or holidays). Samples that do not arrive at the laboratory at the proper temperature might need to be re-collected if analysis of those samples would result in qualified data. Analysis of improperly preserved samples and/or re-collection of samples will result in additional expense to E & E and its client that is far greater than shipping the additional sample coolers that might be needed to accommodate a sufficient quantity of ice.

4. Place a temperature blank inside a resealable plastic bag and place the blank inside the cooler.

5. Close and seal the plastic bag lining the cooler and affix a custody seal. This custody seal is an additional layer of custody security in case the cooler is opened and inspected by the U.S. Transportation Security Administration or by customs for international shipments, or the outer custody seals on the cooler fail.

Final Steps

1. Complete and sign the COC form, maintain the required copies, place it in a resealable plastic bag or pouch, and tape the bag/pouch to the inside of the cooler lid.

2. Close the cooler. Place custody seals in two locations along the top of the cooler such that the cooler cannot be opened without breaking the seals. Do not place the custody seals on the hinged side of the cooler lid.
3. Secure the cooler with strapping tape or equivalent over the hinges, over the custody seals, and and around the entire cooler.

6.5 Marking, Labeling, and Shipping

Marking, labeling, and shipping will be performed in accordance with the requirements of the carrier (e.g., Federal Express) or courier that will be used.

Each cooler of environmental (nonhazardous) samples will be marked with an address label showing the name and address of the sender and recipient. "This Side Up" labels will be applied to at least two sides of the cooler.

Shipping documentation will consist of an airbill for air transport or a bill of lading for ground transport, which will be affixed to the lid of the cooler. A hazardous materials/dangerous goods shipper's declaration is not used when shipping environmental (nonhazardous) samples.

The field team will notify the E & E project manager and the recipient laboratory daily of impending shipments. The E & E project manager will notify E & E's client if required. The field team or project manager will follow up daily using shipper tracking numbers and review of laboratory log-in documentation to ensure that each shipment of samples has been received as scheduled and logged in immediately upon receipt, and that samples requiring cold preservation have been placed in cold storage upon receipt at the laboratory.

7 Quality Assurance/Quality Control

The program/project manager will identify personnel for the field team who have knowledge, training, and experience in the sample handling, packing, and shipping activities to be conducted.

Prior to initiating field work, the project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, SHASP) will be reviewed by team personnel to understand the procedures that have been specified to result in samples that will meet project data quality objectives (DQOs). Project planning documents will define the quality assurance/quality control (QA/QC) procedures necessary to meet project DQOs. QA/QC steps important to sample handling, packing, and shipping have been incorporated into the procedures in Section 6 and include steps such as the following:

- Maintaining samples under secure custody;
- Completely and accurately filling out COC forms and diligently checking the samples in the cooler against the samples listed on the COC form;
- Using sufficient ice to maintain appropriate sample temperatures during the shipping of samples requiring cold preservation;
- Coordinating with the recipient laboratory regarding scheduled sample shipments; and
- Following up with the laboratory to ensure that samples have been received as scheduled and logged in, and that samples requiring cold preservation have been placed in cold storage upon receipt at the laboratory.

8 Health and Safety

Prior to entering the field, personnel will acknowledge in writing that they have read and understand the SHASP, which will be in compliance with the Corporate Health and Safety Program.

Unique hazards associated with sample handling, packing, and shipping include handling containerized samples that have been preserved with acids, bases, or other chemicals, and the ergonomic hazards of lifting heavy coolers of samples. Exposure to these hazards will be controlled by following the SHASP and the hazard control measures and safe work practices it prescribes, such as wearing gloves and using safe lifting practices.

9 Special Project Requirements

Project-specific requirements will be included with the project planning documents. Programs such as the EPA CLP may have additional, specific proceedures for handling, packing, and shipping samples.

10 References

United States Environmental Protection Agency (EPA). 2014. *Sampler's Guide. Contract Laboratory Program Guidance for Field Samplers.* OSWER 9200.2-147. EPA-540-R-014-013. Office of Superfund Remediation and Technology Innovation. October 2014.

_____. 2015. Packing, Marking, Labeling and Shipping of Environmental and Waste Samples. SESDPROC-2009-R3. EPA Region 4. Science and Ecosystem Support division. February 4, 2015. Athens, Georgia.

_____. 2015. Sample Packing and Shipping. Scientific Engineering, Response and Analytical Services (SERAS) SOP Number 2004. Revision 1.0. June 25, 2015. Edison, New Jersey.

END OF SOP

ecology and environment, inc.

STANDARD OPERATING PROCEDURE

FIELD ACTIVITY LOGBOOKS

SOP NUMBER: DOC 2.1

REVISION DATE: 6/30/2017 **SCHEDULED REVIEW DATE: 6/30/2022**

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1 Scope and Application

Proper documentation of field activities is a critical component of any field effort. This Standard Operating Procedure (SOP) establishes procedures for initiating, entering information/data into, reviewing, and maintaining/storing hard-copy field logbooks for E & E field activities. Field activities may range from simple reconnaissance to complex sampling programs. Such activities may include visual or other observations, *in situ* or *ex situ* field measurements (monitoring), biological surveys, or sample collection, as well as meetings and consultations with E & E clients, subcontractors, or other stakeholders.

Field logbooks are most commonly used for projects involving sampling, monitoring, or surveying but are also used for field activities such as a scoping site visit or oversight/ observation of engineering or construction contractors. A logbook is required to be maintained unless an approved project plan specifically eliminates the requirement. The SOP for documenting E & E activities outside of an E & E office that do not include the field activities discussed in the SOP herein is E & E SOP DOC 2.7 (Activities Log).

Field logbook documentation may be supplemented by other records (e.g., site safety forms, data collection forms, electronic data, or geotechnical logbooks). Information and data to be recorded on such forms or logbooks are addressed in the applicable SOPs.

Field observations, measurements, and samples have value to data users only to the degree that the observation, measurement, or sample is representative of a specified environment, setting, or process. Field logbooks address representativeness by documenting:

- Identification of the subject of the observation, measurement, or sampling;
- Selection of an observation, measurement, or sampling location and time that represents that subject;
- Compliance with or deviation from the work plan, sampling and analysis plan, quality assurance project plan, or other project or program plans; and
- Sufficient documentation of how the observation, measurement, or sample represents the same subject as other observations, measurements, or samples from the vicinity.

Complete, accurate, and precise logbook entries provide a legally defensible record of field activities, quality control (QC), decisions and their rationale, approved changes to planned activities, and meetings and communications. Well-written logbooks allow individuals not involved with a project to independently reconstruct the salient field activities at a later date.

This SOP is intended for use by personnel who have knowledge, training, and experience in the field activities being conducted.

2 Definitions and Acronyms

DI	Deionized
Field	Locations (sites) outside the controlled environment of an office or laboratory
Field observation	Qualitative and/or quantitative remark/statement regarding sensory inputs noted in the field

Field measurement	Quantitative determination of physical, chemical, biological, geological, or radiological properties of a matrix by measurement made in the field
Field sampling	Process of obtaining a representative portion of an environmental matrix suitable for laboratory or field measurement or analysis
E & E	Ecology and Environment, Inc.
EPA	(U.S.) Environmental Protection Agency
GPS	Global positioning system
ID	Identification
IDW	Investigation-derived waste
PM	Project manager
QA	Quality assurance
QC	Quality control
SOP	Standard operating procedure

3 Procedure Summary

E & E's Quality Management Plan gives the E & E project manager (PM) the authority to directly implement the project work activities necessary to meet technical and quality objectives. Project implementation requires, among other things, that the PM hold a kickoff meeting with appropriate team members to discuss work requirements, QC requirements and results, individual responsibilities, plans and schedules, work progress, and reporting requirements.

Prior to field activity, the PM identifies field personnel, a field team leader, and team members responsible for documenting field activities. Since there may be multiple activities with unique logbooks, there may be multiple team members responsible for documenting field activities.

The individual responsible for documenting field activities or other designated author should briefly summarize in the logbook the field activities that are planned to be conducted.

Visual or other observations, *in situ* or *ex situ* field measurements (including instrument and equipment calibrations), surveying, and sample collection information should be recorded in real time as fieldwork is conducted. Meetings, including electronic communications, with E & E, client, subcontractor, regulatory, or other personnel should be recorded. Compliance with or deviation from the work plan, sampling and analysis plan, quality assurance project plan, or other project or program plans should be documented, together with authorization for such deviations.

The field team leader and/or PM should review logbook entries on a routine basis.

4 Cautions

Logbook entry must be a priority and not left to "later." Contemporaneous documentation is important to achieve complete, accurate, and precise reporting.

Field logbooks become part of the permanent record for projects/programs and, thus, should include factual material, not opinions. Language used in logbooks should be objective and factual. Pertinent personal observations may be included, but must be clearly identified as such.

If multiple logbooks are used, a project logbook should be used to maintain control of all other logbooks.

Do not leave blank line(s) between logbook entries. Cross out blank spaces with a single line, and sign and date the cross out.

Initials should not be used in place of signatures unless specifically allowed by client requirements. Logbooks are considered evidentiary files and full signatures are required under judicial review guidelines (see EPA NEIC Policy, EPA 1991). If initials are used, a table of signatures and initials for project personnel should be recorded in the logbook.

5 Equipment and Supplies

Logbooks must be bound with consecutively numbered pages.

Entries should be made using indelible ink (preferably black).

6 Procedure

6.1 General Requirements

- Logbooks will be assigned by the PM to the field team leader. Additional logbooks may be assigned to other personnel (e.g., health and safety monitors). The PM is responsible for tracking field event logbooks.
- A separate field logbook must be maintained for each project.
- Logbook entries must be legible.
- The first entry for each day will be made on a new, previously blank page.
- No pages may be removed for any reason, even if mutilated or illegible. If a page or portion of a page is accidentally skipped during fieldwork, it should be crossed out, signed, and dated.
- Entries should be made in chronological order. Observations that cannot be recorded during field activities should be recorded as soon as possible. If logbook entries are made after field activities, the time of the activity/observation and the time that it is recorded should be noted.
- The time of each entry should be noted. It is customary to record time using a 24-hour clock.
- If corrections are necessary, they must be made by drawing a single line through the original entry in such a manner that it can still be read. Do not erase or render an incorrect notation illegible. The corrected entry should be written beside the incorrect entry, and the correction initialed and dated. Corrected errors may require a footnote explaining the correction.
- Each logbook page used during the day should be signed and dated at the bottom of each page at the end of each day (if more than one person makes entries into the logbook, each person should sign and date next to his or her entries). Signatures should be written along a single diagonal line drawn across the blank portion of any partially filled page following the last entry of the day.

- If multiple personnel are anticipated to make entries in a logbook, then a table of printed names, signatures, and initials should be recorded in the logbook.
- The field team leader should review logbook entries on a daily basis, or more frequently if appropriate. The PM should review the logbook on a weekly basis and at the close of fieldwork.
- At the completion of the field activity, the logbook must be returned to the PM to include with the project files.

6.2 Format

The following instructions provide a general format for recording a field event in a field activity logbook:

- Title Page

  The logbook title page should contain the following items:

  - Site name,
  - Site identification (ID) number,
  - Location,
  - Project name and number,
  - Start/finish date (may be completed at the end of the project), and
  - Book ___ of ___ (may be completed at the end of the project).

- First Page (for each day in the field)

  The following items should appear on the first page of the logbook prior to daily field activity entries (can be completed prior to entry into the field):

  - Date (at top of page),
  - Project name and number (at top of page),
  - Key project contact names and contact information (e.g., phone numbers),
  - General summary of proposed work (reference work plan and other documents, as appropriate), and
  - Team members and duties.

- Successive Pages (for each day in the field)

  In addition to specific activity entries and observations (refer to the remainder of Section 6 below), the following items should appear on every logbook page:

  - Date, project name, and project number at the top of each page,
  - Signature and date at the bottom of each page (if more than one person makes entries into the logbook, each person should sign and date next to his or her entries), and
  - Strikethroughs of any unused lines.

- Last Page (of project logbook entries)
    - The last page should indicate if work is continuing in subsequent logbooks or if the project is complete.

6.3 Logbook Information

Field logbook entries will contain a variety of information based on the field activities conducted (e.g., observing, monitoring, surveying, or sampling) and project requirements. In general, information recorded on field forms or electronic data does not need to be recorded in the logbook. Information also can be recorded on the first day of the field event and then noted on a daily basis whether there were any changes. The following information will generally need to be recorded, as applicable:

- Daily health and safety meetings:
    - Time conducted,
    - Leader,
    - Attendees, and
    - Summary of content.
- Outline of field activities to be performed that day.
- Arrival and departure times of E & E project personnel.
- Arrival and departure times of non-E & E personnel.
- Record of phone calls and/or other contacts (e.g., meetings, conversations, written or electronic communications) with individuals at the site, including names and affiliations.
- A site sketch identifying the site layout, features, and points of interest (with global positioning system [GPS] coordinates, as appropriate). A north arrow and rough scale should be included.
- Physical description of the site (expand on site sketch as necessary to provide a clear "picture" of the site).
- Pertinent field observations and reconnaissance methodology used to gather observations.
- Brief description of oversight procedures. Oversight activities may include:
    - Contractor activities, including operating times,
    - Contractor progress,
    - Contractor deviations from governing documents, and
    - General housekeeping and safety.
- Weather conditions, updated as necessary on successive pages if weather conditions change throughout the field day.
- Documentation of photographs, including:
    - Make and model of the camera,

    - Description of the photograph (noting specific items of interest), including the date and time,
    - Photograph number,
    - Direction or view angle of the photograph, and
    - Name of the photographer.
- Description of monitoring procedures and results.
- Information on monitoring equipment used (e.g., GPS, air monitoring, field screening):
    - Model and serial numbers,
    - Equipment preparation/calibration procedures, date and time, and results if not recorded on separate form, and
    - Field maintenance and/or repairs.
- Description of biological survey conducted (e.g., species survey, wetland survey) and results.
- Sample collection procedures and reference to applicable work plan section or SOP:
    - A sketch of individual sampling locations if no GPS coordinates are available.
    - Pre-sampling activities, such as:
        - Groundwater well purging and the number of volumes purged before sample collection, and
        - Associated data and results (e.g., well purging pH, conductivity, temperature data).
    - Sample information and observations:
        - Sample number, station location ID, programmatic ID, and/or location, including relationship to permanent reference points,
        - Names of samplers,
        - Sample description, sample depth interval, sample time, sample date, and any field screening results,
        - Sample matrix and number of aliquots if the sample is a composite,
        - Soil/sediment characteristics (e.g., grain size, plasticity, color, cohesiveness, moisture content),
        - Water quality parameters (e.g., pH, temperature, conductivity, turbidity) and water characteristics (e.g., color and odor),
        - Characteristics of biological specimens,
        - Container and preservatives used, recipient laboratory including contact information, and requested analyses, and
        - Any preservative added in the field including preservative type, lot number, and expiration date.
    - Quality assurance (QA)/quality control(QC) samples:
        - For trip blanks, indicate the source of the blanks,

        - For equipment rinsate samples, note the equipment from which the rinsate sample is collected and the source of the deioinized (DI) water, and
        - Field duplicates or replicates and a description of how the duplicate was sub-sampled.
    - Equipment and personnel decontamination procedures.
    - Shipping paper (airbill) numbers and chain-of-custody form numbers.

6.4 Work Plan Changes/Deviation

Deviation from the work plan, sampling and analysis plan, quality assurance project plan, health and safety plan, or other project or program plans should be documented, together with authorization for any deviations. Deviations (who, what, where, when, why, and how [the rationale for the change]) from the plans and the circumstances necessitating such changes should be recorded. No work plan changes or deviations may be acted upon without documented authorization from the PM.

6.5 Investigation-Derived Waste

Disposition of non-hazardous versus potentially hazardous investigation-derived waste (IDW) should be delineated in the field planning documents. The following information should be included in the logbook:

- Nature and disposition of non-hazardous wastes;
- The type and number of containers of potentially hazardous IDW generated (each drum or container should be numbered and its contents noted);
- Information relevant to characterizing IDW;
- Disposition of IDW (left on site or removed from site);
- IDW sample information should be recorded the same as other samples; and
- The type of paperwork that accompanied the waste/sample shipment (e.g., manifest).

6.6 Data Collection Forms

Certain phases of fieldwork may require the use of separate project-specific data collection forms, such as sample collection, equipment calibration, wetland survey, or daily summary forms. Use of such forms and the types of information recorded should be noted in the logbook. Information recorded on data entry forms does not need to be repeated in the logbook, but can be summarized and should be appropriately referenced for easy access.

7 Quality Assurance/Quality Control

As discussed in this SOP, important QA/QC measures for maintaining field activity logbooks include the following:

- Logbook entries should be made in real time (and not retroactively) and using indelible ink;
- On a daily basis, the individual responsible for documenting field activities should briefly summarize in the logbook the field activities that are planned to be conducted;

- Key daily activities should be recorded in the logbook;
- Logbook pages should be signed and dated as they are completed;
- Deviation from the work plan, sampling and analysis plan, quality assurance project plan, or other project or program plans should be documented, together with authorization for such deviations;
- The field team leader should review logbook entries on a daily basis, or more frequently if appropriate. The PM should review the logbook on a weekly basis and at the close of fieldwork; and
- Logbooks may be audited by quality assurance personnel from E & E or a client.

8 Special Project Requirements

Project-specific requirements will be included with the project planning documents.

9 References

United States Environmental Protection Agency (EPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.* Interim Final. EPA/540/G-89/004, October 1988.

_____. 1991. *Guidance on Oversight of Potentially Responsible Party Remedial Investigations and Feasibility Studies.* Final. EPA/540/G-91/010a.

_____. 1991. *Guidance for Performing Preliminary Assessments Under CERCLA*. EPA/540/G-91/013. September 1991.

_____. 1991. *NEIC Policies and Procedures Manual.* EPA 330/9-78-001-R. May 1978, revised August 1991.

_____. 1992. *Guidance for Performing Site Inspections Under CERCLA.* Interim Final. EPA/540-R-92-021. September 1992.

END OF SOP

ecology and environment, inc.

STANDARD OPERATING PROCEDURE

ACTIVITIES LOG

SOP NUMBER: DOC 2.7

DATE: 7/15/2013 **SCHEDULED REVIEW DATE: 7/15/2014**

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1 Scope and Application

Proper documentation of E & E activities conducted outside an E & E office is a critical component of any project. This Standard Operating Procedure (SOP) establishes procedures for initiating, entering information into, reviewing, and maintaining/storing hard copy logs for E & E activities outside of an E & E office environment and does not involve field survey or sampling. The standard operating procedure for documenting monitoring (e.g., oversight or observation of engineering or construction contractors) and sampling field activities is presented in E & E SOP DOC 2.1 (Field Activity Logbooks).

E & E activities may include: compliance management, providing advice, guidance, or communications support; as well as meetings and consultations with E & E clients, sub-contractors or other stakeholders.

Activities log documentation may be supplemented by other records (e.g., daily or weekly memoranda or reports).

Complete, precise and accurate log entries provide a legally defensible record of: activities; decisions, meetings and communications. Well written logs allow individuals not involved with a project to independently reconstruct the salient activities at a later date.

This E & E Activities Log SOP is intended for use by personnel who have knowledge, training and experience in the activities being conducted.

2 Definitions and Acronyms

E & E	Ecology and Environment, Inc.
PM	Project Manager
QA	Quality assurance
QC	Quality control
SOP	Standard operating procedure

3 Procedure Summary

E & E's Quality Management Plan requires the project manager (PM) direct implementation of project work activities to meet technical and quality objectives. Project implementation requires the PM hold a kickoff meeting with appropriate team members to discuss work requirements, QC requirements and results, individual responsibilities, plans and schedules, work progress, and reporting requirements.

Prior to activity, the PM identifies personnel; designates a team leader and team members responsible for documenting activities. Since there may be multiple activities with unique logs, there may be multiple team members responsible for documenting activities.

Prior to beginning an activity, the duties and responsibilities as defined by the project work plan must be accurately documented in the log and **dated** and **signed by the PM**.

Activities (and information) must be recorded in real-time as each is conducted. Meetings, including electronic communications, with E & E, client, sub-contractor, regulatory, or other personnel are to be recorded. Any requested deviation from the project work plan must be

recorded and immediately brought to the attention of the team leader (if in place) and the PM. Only PM directed deviations are to be recognized for which PM authorization must be received and documented in the log.

The team leader should review log entries on a daily basis or more frequently, if appropriate. The PM should review the logs on a weekly basis and at the close of the activity. Logs may be audited by quality assurance personnel from E & E or a client.

At the completion of the assignment or as each log becomes full; logs must be submitted to the PM who in turn is responsible for storing/archiving applicable logs in the project file.

4 Cautions

Log entry must be a priority and not left to "later." Contemporaneous documentation is critical to complete, accurate and precise reporting.

Activities logs become part of the permanent record for projects/programs and, thus, should include factual material, not opinions. Language used in logs should be objective and factual. Pertinent personal observations may be included, but must be clearly identified as such.

If multiple logs are used, a project log should be used to maintain control of all other logs.

Do not leave blank line(s) between log entries. Cross out blank spaces with a single line, sign and date the cross out.

Initials should not be used in place of signatures unless specifically allowed by client requirements. Logs are considered evidentiary files and full signatures are required under judicial review guidelines (See EPA NEIC Policy 1991). If initials are used, a table of signatures and initials for project personnel should be recorded in the log.

5 Equipment and Supplies

Logs must be bound with consecutively numbered pages.

Entries should be made using indelible ink (preferably black).

6 Procedure

The following general procedure will be followed:

- Logs will be assigned by the PM to the team leader. Additional logs may be assigned to other personnel. The PM is responsible for tracking activities logs.
- A separate activities log must be maintained for each project.
- Log entries must be legible.
- The first entry for each day will be made on a new, previously blank page.
- No pages may be removed for any reason, even if mutilated or illegible. If a page or portion of a page is accidentally skipped during an activity, it should be crossed out, signed, and dated.
- Entries should be made in chronological order. Observations that cannot be recorded during activities should be recorded as soon as possible. If log entries are made after activities, the time of the activity/observation and the time that it is recorded should be noted.

- The time of each entry should be noted. It is customary to record time using a 24-hour clock.
- If corrections are necessary, they must be made by drawing a **single line** through the original entry in such a manner that it can still be read. Do not erase or render an incorrect notation illegible. The corrected entry should be written beside the incorrect entry, and the correction **initialed** and **dated**. Corrected errors may require a footnote explaining the correction.
- Each log page used during the day should be signed and dated at the bottom of each page at the end of each day (if more than one person makes entries into the log, each person should sign and date next to his or her entries). Signatures should be written along a single diagonal line drawn across the blank portion of any partially filled page following the last entry of the day.
- If multiple personnel are anticipated to make entries in a log, then a table of printed names, signatures and initials should be recorded in the log.
- At the completion of the activity, the log must be returned to the PM to include with the project files.

6.1 Format

The following instructions provide a general format and identify information to be recorded in Activities Logs:

- Title Page

The log title page should contain the following items:

  - Site name;
  - Site identification (ID) number; if applicable;
  - Location;
  - Project Name and Number;
  - Start/finish date (may be completed at the end of the project);
  - Log of . (may be completed at the end of the project); and,
  - Work Plan Duties and Responsibility Summary with **PM sign-off**.

- First Page (to be completed prior to initiating the activity)

The following items should appear on the first page of the log prior to daily activity entries:

  - Date (at top of page);
  - Project Name and Number (at top of page);
  - Key project contact names and contact information (e.g., phone numbers);
  - General summary of proposed work (reference work plan and other documents, as appropriate); and,
  - Team members and duties.

- Successive Pages (for each day of the activity)

In addition to specific activity entries and observations (refer to sections 6.2, 6.3, and 6.4 below); the following items should appear on every log page:

  - Date, project name and project number at the top of each page:
  - Signature and date at the bottom of each page (if more than one person makes entries into the log, each person should sign and date next to his or her entries); and,
  - Strikethroughs of any unused lines.
- Last Page (of project log entries)
  - The last page should indicate if work is continuing in subsequent logs or if the project is complete.

6.2 Log Information

Activities log procedures for E & E personnel conducting activities outside an E&E office are presented below.

Activities log entries will contain a variety of information based on the activities being conducted (e.g., providing advice, guidance, or communications support). The specific type of information recorded in the log will depend on the project requirements. In general, information recorded on forms or electronic media do not need to be recorded in the log.

- Logs should accurately and impartially reflect the activities performed by E & E personnel;
- Meetings
  - Purpose;
  - Attendees;
  - Summary of discussion; and,
  - Actions to be taken by whom and when;
- Telephone calls and/or other contacts/interactions (depending on the subject, include the information identified under meetings);
- Documents (hard copy and electronic) received or delivered; and the deliverer or recipient name and affiliation; and,
- Arrival and departure times of E & E project personnel.

6.3 Work Plan Changes/Deviation

Deviation from project or program plans should be highlighted together with authorization for any deviations. Deviations (who, what, where, when, why, and how [change rationale]) from the plans and the circumstances necessitating such changes should be recorded. **No work plan changes or deviations will be acted upon without documented authorization from the PM.**

6.4 Information Collection Forms

Some activities may require the use of separate project-specific information collection forms, such as daily summary records. Use of such forms and the types of information recorded should be noted in log. Information recorded on forms does not need to be repeated in the log but summarized and appropriately referenced for easy access.

7 Quality Assurance/Quality Control

Deviation from project or program plans should be highlighted together with documented authorization from the PM for any deviations.

Prior to activity, among other responsibilities, the PM should identify knowledgeable, trained, and experienced personnel; designate a team leader; and an individual responsible for documenting activities. Since there may be multiple activities with unique logs, there may be multiple individuals responsible for documenting activities.

Prior to project mobilization, the PM should lead a kickoff meeting with appropriate team members to discuss work requirements, QC requirements and results, individual responsibilities, plans and schedules, work progress, and reporting requirements.

Prior to initiating activities, the individual responsible for documenting activities or other designated author should briefly summarize the activities being conducted in the log, which the PM must then sign off on.

The team leader should review log entries on a daily basis or more frequently if appropriate. The PM should review the logs on a weekly basis and at the close of the activity. Logs may be audited by quality assurance personnel from E & E or a client.

The PM is responsible for storing/archiving applicable logs in the project file.

8 Special Project Requirements

Project or program-specific requirements that modify this procedure should be entered in this section and included with the project planning documents.

9 References

The following list sources of technical information on activities logs.

United States Environmental Protection Agency (EPA). 1991. *NEIC Policies and Procedures Manual*, U.S. EPA, EPA 33019-78-001-R, August 1991

END OF SOP

ecology and environment, inc.

STANDARD OPERATING PROCEDURE

SITE CONTROL PROCEDURES FOR POTENTIALLY CONTAMINATED SITES

SOP NUMBER: ENV 3.2

REVISION DATE: 11/30/2017 **SCHEDULED REVIEW DATE: 11/30/2022**

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1 Scope and Application

This Standard Operating Procedure (SOP) describes the routine procedures used by E & E field personnel for initially entering and exiting potentially contaminated sites, as well as certain other site control measures. Safe and proper entry, egress, and site control require a careful and coordinated team effort and completion of project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, and site-specific health and safety plan [SHASP]). The reasons for entering a potentially contaminated site may range from simple reconnaissance to complex sampling programs, and may include visual or other observations, *in situ* or *ex situ* field measurements (monitoring), emergency response, engineering and engineering oversight, or sample/data collection (biological, chemical, geological, radiological, or physical).

This SOP addresses entry and egress of contaminated sites containing hazardous, toxic, dangerous, or similar materials, substances, and wastes and is especially pertinent to the first-time entry of a new or unknown site, when the potential hazards are not yet fully defined. This SOP does not specifically address confined space entry, drum opening activities, or entry to sites suspected to be contaminated by biohazards (e.g., medical waste or biological agents such as anthrax), explosives, or fissile radioactive materials. These are not considered to be routine operations and may require specialized procedures.

Because entry to a contaminated site for the first time can carry with it health and safety considerations associated with unknown contaminants, hazards, and site conditions, this SOP touches on more health and safety-related information than normally would be addressed in a procedural SOP. E & E's Corporate Health and Safety Program (CHSP) defines corporate polices and procedures for key elements of E & E's health and safety program, including medical surveillance, training requirements, and the selection of appropriate personal protective equipment (PPE). The SHASP developed for the work, and the CHSP with which the SHASP must be compliant, constitute the safety documentation for the work activity. This SOP is not a substitute for that safety documentation.

This SOP is intended for use by E & E personnel who have knowledge, training, and experience in the field activities being conducted.

Other E & E SOPs that would typically also apply to site entry, egress, and control include the following:

- DOC 2.1, Field Activity Logbooks;
- ENV 3.15, Sampling and Field Equipment Decontamination;
- ENV 3.16, Environmental Sample Handling, Packaging, and Shipping;
- ENV 3.26, Handling Investigation-Derived Wastes;
- ENV 3.27, Procedure for Routine GPS Operation; and
- Various sampling and data collection SOPs.

2 Acronyms

ALARA	As low as reasonably achievable
CFR	Code of Federal Regulations

CGI	Combustible gas indicator
CHSD	Corporate Health and Safety Director
CHSP	Corporate Health and Safety Program
CRZ	Contamination reduction zone
dBA	Decibels as measured using the A-weighted network
DQO	Data quality objective
E & E	Ecology and Environment, Inc.
EPA	(United States) Environmental Protection Agency
FID	Flame ionization detector
FTL	Field team leader
ICAO	International Civilian Aviation Organization
LEL	Lower explosive limit
mR/hr	Milliroentgens per hour
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PDS	Personnel decontamination station
PID	Photoionization detector
PM	Project manager
PPE	Personal protective equipment
PPM	Parts per million
QA/QC	Quality assurance/quality control
SCBA	Self-contained breathing apparatus
SHASP	Site-specific health and safety plan
SOP	Standard operating procedure
SSO	Site safety officer
USCG	United States Coast Guard

3 Procedure Summary

This SOP discusses procedures for establishing control for activities at potentially contaminated sites. It addresses background research and site categorization, work zones, the roles of field team members, communications, ambient monitoring and characterization equipment, site entry and egress, and personnel decontamination. Site-specific procedures and responsibilities are described in project planning documents.

4 Cautions

Even with diligent research, site entry, egress, and control may include incomplete understanding of current site conditions or unexpected changes in site conditions. Planning documents are living documents and need to be updated to reflect changing site conditions. E & E field personnel are expected to advise other field personnel of safety concerns as they are encountered. Cautions related to health and safety are further discussed in Section 8.

Before site entry, written permission to access and conduct activities within the property that contains the site must be obtained. Permission may be granted by the property owner or appropriate judicial authorities. Documentation of permission, in the form of a court order or written authorization, should be available for disclosure at the site during the field activities.

The decontamination of PPE will generate one or more waste streams, some of which could be potentially hazardous waste. All wastes will be handled in accordance with E & E SOP ENV 3.26, Handling Investigation-Derived Wastes, as well as project planning documents.

Agents used to decontaminate PPE and personnel, such as soaps and detergents, can be potentially damaging over time to reusable protective apparel such as gloves, hard hats, respirators, and reusable protective suits and aprons, as well as to skin. Care should be taken to ensure that the decontamination process is compatible with the PPE being decontaminated. In accordance with the CHSP, PPE should be inspected before each use to ensure its integrity.

5 Equipment and Supplies

Project planning documents will provide direction on specific equipment and supplies. The following equipment and supplies are commonly used for site entry, egress, and control for a broad-scale field investigation:

- PPE;
- Work area markers/delineators (e.g., traffic cones, barricade tape, stakes, flagging);
- Communication equipment (e.g., cellular telephones, two-way radios);
- Ambient monitoring and characterization equipment; and
- PPE decontamination supplies:
  - Plastic sheeting for ground cover,
  - Galvanized steel or similar wash basins,
  - Plastic buckets (5-gallon),
  - Long-handled brushes,
  - Spray/squeeze bottles,
  - Tables and chairs,
  - Paper towels,
  - Trash bags,
  - Non-phosphate detergent (e.g., Alconox™ or Liquinox™) or other specified decontamination agent,
  - Deionized water (e.g., American Society for Testing and Materials Type II),
  - Potable water, and
  - Waste collection drums.

6 Procedure

6.1 Site Categorization Based on Background Research

Background research occurs during project planning and is inherently linked to developing the work plan and SHASP. Data may be available from multiple sources, e.g., client records; environmental and property data clearinghouses (such as EDR®); aerial photographs; federal, state, or local agency files; national or regional databases; and the internet. Background reviews commonly look at historical land use, materials used or disposed of, data and information from previous investigations, past site conditions, litigation-related documentation, and the present activity at and condition of the site.

As necessary, a site can be classified into one of three categories (Site Categories I, II, or III) for the purposes of determining appropriate levels of personal and respiratory protection and the level of caution for initial site entry. In brief, the four levels of personal protection are:

- Level D: No chemical-protective clothing or respiratory protection;
- Level C: Chemical-protective clothing plus air-purifying respirator;
- Level B: Higher level of chemical-protective clothing plus positive-pressure self-contained breathing apparatus (SCBA); and
- Level A: Fully encapsulating protective suit plus SCBA.

Requirements for each level of protection are described in the CHSP. In accordance with the CHSP, a minimum of Level B protection is required when site respiratory and/or dermal hazards have not been identified.

Site Category I

For a Category I site, E & E personnel may enter the site and conduct site activities using Level D protection if the following conditions exist at the site:

- Background research indicates that no hazardous substances are present at the site that could present a potential respiratory hazard;
- A perimeter reconnaissance is conducted;
- Work activities are limited to non-intrusive activities such as visual inspection and non-invasive sampling, and do not include entering uncharacterized areas, structures, trenches, pits, basements, or excavations;
- Containers (e.g., drums, impoundments, tanks, etc.) of unknown or known hazardous substances are not present;
- There are no unknown or known odors of hazardous substances;
- There are no visible vapor clouds;
- The site has good natural air circulation; and
- Neither dead animals nor dead/stressed vegetation are visible.

Site Category II

A Category II site is an active investigation/remediation/construction site with workers present from other agencies or companies. E & E will determine the adequacy of existing site safety procedures based on a review of the following:

- Site history;
- Chemical and other hazards, including locations, affected media, quantities, and extent of contamination;
- Physical hazards;
- Ambient monitoring instrumentation, results, and action levels;
- Applicable industry standards (consulting with outside experts as necessary);
- Sitewide general health and safety procedures; and
- The site's ongoing health and safety program.

If the review process indicates that the existing protection procedures meet E & E corporate health and safety standards, field personnel may enter the site in the same level of protection as the other site personnel and the facility's ongoing health and safety program may be used as the basis for E & E's SHASP. If the review process indicates that a higher level of protection is required, these findings will first be discussed with the site owner/operator and other competent authorities, including the E & E Corporate Health and Safety Director (CHSD).

Site Category III

A Category III site has unknown or potentially uncontrolled contamination present, e.g., such as what might be encountered during an emergency response to a hazardous materials incident under E & E's START contracts with the United States Environmental Protection Agency (EPA). In addition to the background review discussed for Site Categories I and II, E & E will evaluate:

- The potential for a respiratory hazard;
- Whether appropriate real-time monitoring instruments are available for the hazards identified;
- The need for Level A versus Level B entry (assuming that entry using a Level C air-purifying respirator has been determined to not be adequate for the conditions); and
- The need for splash protection during initial entry.

E & E maintains Level A and Level B capabilities in selected offices. Level A work requires special training and is conducted rarely enough that it must be approved by the CHSD.

6.2 Work Zone Setup

Procedures for identifying work zones, access control points, and routes for traversing hazardous areas are described below. Actual layout of the zones, distances between zones, access points, and travel routes will vary depending on the weather, terrain, location, types of contaminants, operational areas, and boundaries of the site. Project planning documents, a site map or sketch, direct observations, and real-time ambient monitoring by field personnel will help inform these decisions.

Figure 6-1 shows a typical work zone arrangement for hazardous site work. Organizing work zones as shown on Figure 6-1 minimizes the potential for overexposure and protects the public by restricting the dispersion of hazardous substances outside the site. Figure 6-2 presents an alternative work zone setup where the exclusion zone is limited to the interior of a building. Work zones can be delineated and marked using barrier tape, rope, traffic cones, wooden stakes, signage, and similar methods. The basic types of work zones are described below.

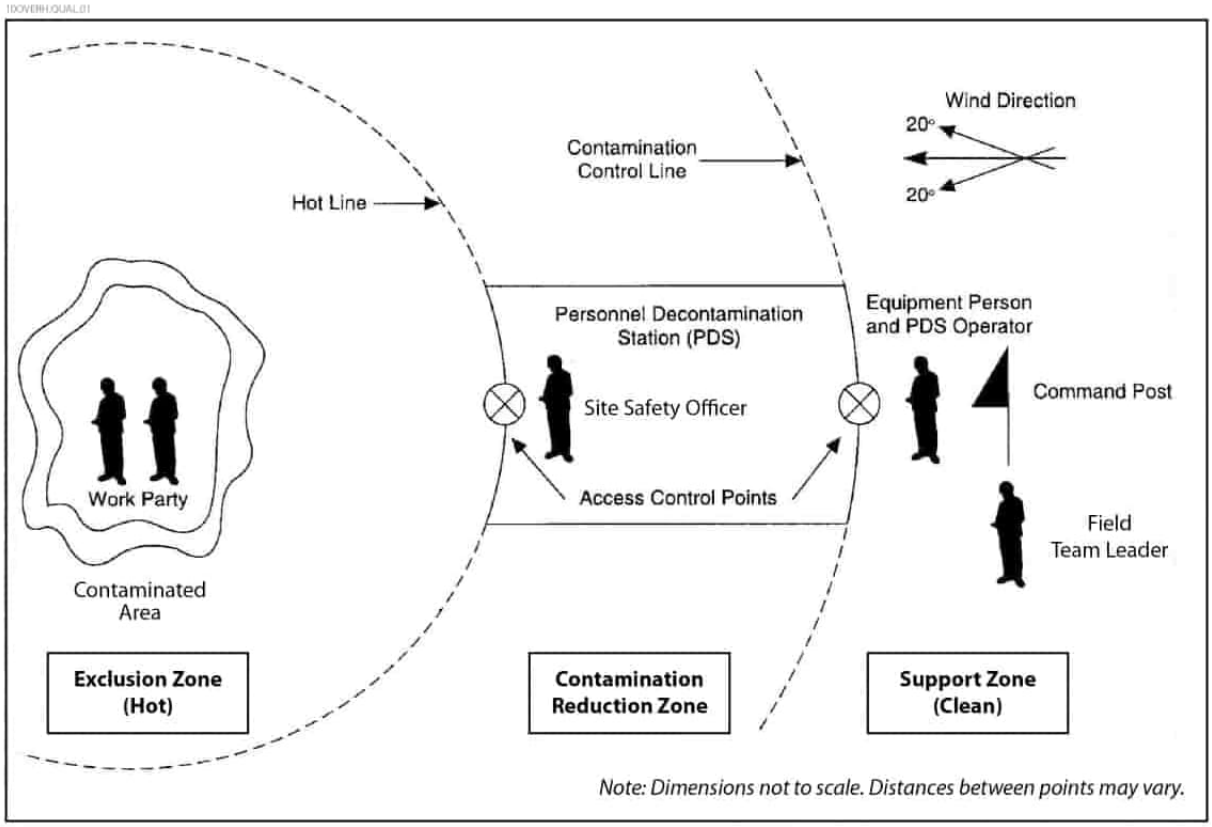

Figure 6-1 Conceptual Work Zone Setup for Potentially Contaminated Site

6.2.1 Exclusion Zone

The exclusion zone—also known as the hot zone, contamination zone, or exclusion area—is the area of known or suspected contamination. It is the area where site work activities are performed, such as characterization, sampling, and cleanup. The exclusion zone may be subdivided based on the known or suspected types or degrees of contamination/hazard, incompatible material or waste streams, and the activities to be performed.

The outer boundary of the exclusion zone is the hot line. The hot line is marked and established based on considerations such as:

- Visual survey of the area;
- Location of:
  - hazardous/toxic substances,
  - drainage, leachate, and spills, and
  - visible staining;
- Data from the initial site survey for:
  - oxygen deficiency or enrichment,
  - combustible gases,
  - organic and inorganic gases, particulates, or vapors, and
  - ionizing radiation;

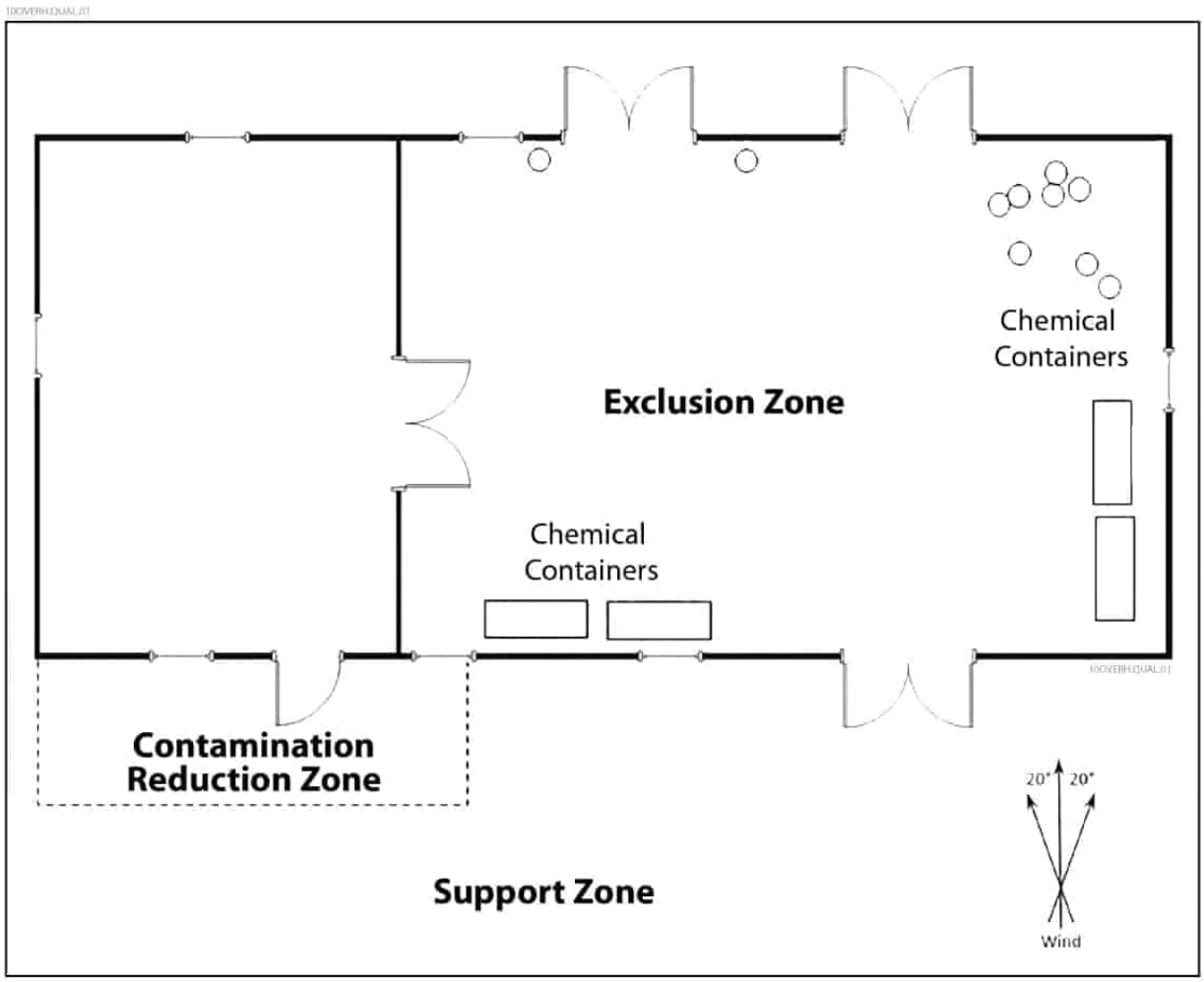

Figure 6-2 Conceptual Work Zone Setup for Potentially Contaminated Building

- The results of soil, water, or other matrix sampling;
- The distances needed to prevent an explosion or fire from affecting personnel outside the exclusion zone;
- The physical area required to safely conduct field activities; and
- Meteorological conditions and the potential for contaminants to be carried from the area by wind.

The hot line is modified as necessary as more information about the site becomes available or if conditions change. An access control point on the hot line is established through which work party personnel enter and exit the exclusion zone. Only properly protected personnel who have met all of the site safety requirements may cross the hot line, via the access control point, into the exclusion zone.

6.2.2 Contamination Reduction Zone

The contamination reduction zone—also known as the CRZ, warm zone, decontamination zone, or contamination reduction area—is the transition area between the contaminated area (exclusion zone) and the clean area (support zone). The contamination reduction zone lies between the hot line and the contamination control line. The contamination reduction zone is established to reduce the probability that the support zone could be affected by contaminants or other site hazards. The contamination control line separates the contamination reduction zone from the support zone. Access control points on the hot line and contamination control line control access to the contamination reduction zone from the exclusion zone and the support zone.

The contamination reduction zone is typically designed to facilitate:

- Personnel decontamination (at a personnel decontamination station [PDS]) and equipment decontamination;
- Equipment resupply and management, e.g., air tank changes, PPE changes, monitoring instrument maintenance and recalibration, sampling equipment and supply management, and tool management;
- Sample packaging for on-site or off-site laboratories;
- Temporary rest for the work party, potentially including wash and toilet facilities, benches/chairs, potable liquids, and protection from the weather;
- The collection and management of decontamination fluids and wastes; and
- Emergency response support: transport for injured personnel (e.g., stretcher), first aid equipment (e.g., bandages, blankets, eye wash), and containment equipment (e.g., spill absorbent, fire extinguisher).

6.2.3 Support Zone

The support zone—also known as the clean zone, cold zone, or support area—is established in a clean area. It houses the command post and administrative and other support functions required for field activities. The support zone is located based on considerations such as:

- Accessibility (e.g., security, level terrain, ease of entry and egress for vehicles);
- Resource availability (e.g., power and transportation);
- Visibility (line-of-sight with the activities in the exclusion and contamination reduction zones);
- Wind direction (upwind if possible or at least cross-wind of the exclusion zone);
- Distance (as far as practicable from the exclusion zone); and
- Visibility by the general public (as out of view from the general public as possible).

The support zone may encompass multiple facilities and activities, as follows:

- Command Post
  - Supervision of field personnel and activities,
  - Maintenance of communications, including telephone numbers and emergency lines of communication,
  - Recordkeeping, including:

        - accident reports
        - chain-of-custody records
        - daily logbooks
        - site entry/exit logs
        - manifest directories and orders
        - medical records
        - personnel training records
        - site inventories
        - site safety and evacuation route maps
        - current SHASP and planning documents
    - Interfacing with the public, including site owners/operators, government agencies and contractors, local politicians, medical personnel, media, and others,
    - Monitoring work schedules and weather changes,
    - Sample shipment,
    - Maintenance of site security, and
    - Sanitary facilities;

- First Aid
    - First aid administration,
    - Response to medical emergencies, and
    - Medical monitoring activities;

- Equipment and Supply Management
    - Supply, maintenance, and repair of communications, respiratory, and sampling equipment,
    - Maintenance and repair of vehicles,
    - Replacement of expendable supplies, and
    - Storage of monitoring equipment and supplies; and

- Field Laboratory (if applicable)

6.3 Field Personnel Organization

Only qualified personnel with knowledge, training, and experience in the field activities being conducted, and who have read and understand the project planning documents, may participate in field activities. Movement of field personnel between zones is restricted to access points and minimized to prevent potential contaminant dispersal. The number of personnel required is a function of project data quality objectives (DQOs), site-specific conditions, and the activities identified in the project planning documents. The project manager (PM) and site safety officer (SSO) will make specific field assignments based on their evaluation of potential site hazards, tasks, and site-specific safety considerations. Functionally, the following personnel typically will be present:

- Command and control personnel – field team leader (FTL), on-site manager, or supervisor;
- SSO;
- PDS operator, located in the contamination reduction zone; and
- Work party – at a minimum, two personnel to perform field activities.

These personnel roles are further described below. A typical five-member team is shown on Figure 6-1. The names of field personnel should be written on hard hats, coveralls/outer PPE, and respirators.

6.3.1 Command and Control Personnel

Command and control of field activities is exercised from the command post in the support zone, which is staffed by an FTL, an on-site manager, a command post supervisor, or equivalent, and additional support personnel as required. In an emergency response situation, this role is assigned to the incident commander.

6.3.2 Site Safety Officer

The SSO is responsible for implementing the SHASP and verifying compliance with applicable health and safety procedures. The SSO traditionally is positioned in the contamination reduction zone, near the hot line, where s/he can monitor work party activities in the exclusion zone. The SSO monitors internal communications, maintains line-of-sight with the work party, and checks site security and work party safety (e.g., fatigue, air time remaining on SCBA, and heat stress). The SSO supports the PDS operator when the work party is in the contamination reduction zone. The SSO wears PPE no more than one level below the work party and keeps full exclusion zone PPE at the ready in order to rapidly enter the exclusion zone when necessary.

6.3.3 PDS Operator

The PDS operator works in the contamination reduction zone to process work parties and equipment into the exclusion zone and assist with the decontamination of personnel and equipment returning from the exclusion zone. The PDS operator typically wears PPE no more than one level lower than the work party and facilitates the activities conducted in the contamination reduction zone.

6.3.4 Work Party

The work party performs the field activities described in the project planning documents, such as initial site entry, reconnaissance, monitoring, sampling, emergency response, engineering, or engineering oversight. To maintain the buddy system, the work party typically includes at least two personnel unless there is clear line of sight with the SSO, FTL, or other personnel and prior approval has been obtained for one team member to work in the exclusion zone. The intent of the buddy system is that each member of the work party is observed by at least one other member of the work party to facilitate rapid assistance to team members in the event of an emergency.

6.4 Communications

6.4.1 General Communications

On-site communications among work party, PDS, safety, and command and control personnel are typically accomplished through the use of cellular telephones or portable two-way radios. Hand signals, agreed upon by field personnel before entering the field, and dry-erase whiteboards also can be used if the phone or radio systems fail or otherwise become unavailable.

6.4.2 Radio Communications

Field personnel should adhere to the following radio communication guidelines:

- Each transmission should be initiated by identifying the party being reached, followed by identification of the initiator, followed by a pause for acknowledgment (e.g., "Command post, this is Jane Smith, over.").
- Each word must be pronounced clearly using plain and direct language. The International Civilian Aviation Organization (ICAO) phonetic alphabet (e.g., alpha, bravo, charlie) may be used to avoid miscommunication.
- Each message should end with "over."
- The term "out" indicates that the complete transmission is ended and no return transmission is expected.

6.4.3 Alerting Means for Emergencies

The SHASP will address:

- The audible emergency or evacuation signals to be used on site to alert team members to the existence of an on-site emergency. A hand-held air horn, vehicle horn, cell phones, and/or shouting are routinely used for this purpose.
- The identification of and contact information for local emergency services (e.g., fire, police, hospital, and emergency medical services).
- The notifications required to be made in the event of an emergency (e.g., E & E management, client, and applicable regulatory authorities).

6.5 Ambient Monitoring and Characterization Equipment

Ambient monitoring of site conditions is conducted during initial site entry and periodically thereafter as work activities are conducted. This monitoring is primarily performed for health and safety purposes, although monitoring also provides information useful for decision making for the investigation and cleanup of the site. The requirements for ambient monitoring are included in the project work plan and SHASP.

E & E personnel will not operate ambient monitoring instrumentation without having received adequate training in the operation of the instrument, interpretation of the readings, and the limitations of each instrument. Although some basic instruction is provided to E & E employees as part of initial and refresher health and safety training, personnel responsible for conducting ambient monitoring should refresh their training as part of site-specific pre-planning and preparation. Ambient monitoring instrumentation will have been calibrated according to the prescribed frequency (which varies by instrument) and field-checked daily before use.

Table 6-1 lists some typical ambient monitoring instruments and health and safety action levels. The instruments and action levels specified in the SHASP will take precedence over the information in Table 6-1.

Table 6-1 Typical Ambient Monitoring Instruments and Action Levels

Instrument	Health and Safety Action Level
Photoionization Detector (PID) (e.g., TVA 1000, MiniRAE 3000, or other multiple gas monitor) Flame Ionization Detector (FID) (e.g., TVA 1000)	**Unknown Vapors** Background to 1 part per million (ppm): Level D 1 to 5 ppm above background: Level C 5 to 500 ppm above background: Level B > 500 ppm above background: Level A
Oxygen Detector	< 19.5% or > 22.0%: Evacuate area; eliminate ignition sources; reassess conditions. 19.5 to 22.0%: Continue work in accordance with action levels for other instruments.
Combustible Gas Indicator (CGI) (e.g., MSA or RAE Systems multiple gas monitor with CGI)	≤ 10% Lower Explosive Limit (LEL): Continue work in accordance with action levels for other instruments; monitor continuously for combustible atmospheres. > 10% LEL: Evacuate area; eliminate ignition sources; reassess conditions.
Particulate (Dust) Monitor	Evaluate health and safety measures when dust levels exceed 2.5 milligrams per cubic meter.
Hydrogen Cyanide/Hydrogen Sulfide Monitor (e.g., Monitox)	≥4 ppm: Leave area and consult with SSO.
Other Analyte-specific Monitor/Indicator	Site-specific.
Air Monitor/Sampler – Breathing Zone	Site-specific.
Air Monitor/Sampler – Perimeter	Site-specific.
Noise Dosimeter	≤85 decibels as measured using the A-weighted network (dBA): Use hearing protection if exposure will be sustained throughout work shift. >85 dBA: Use hearing protection. >120 dBA: Leave area and consult with safety personnel.
Radiation Alert Monitor (e.g., Rad-mini or RAM-4)	< 0.1 milliroentgens per hour (mR/hr): Continue work in accordance with action levels for other instruments. ≥0.1 mR/hr: Evacuate area; reassess work plan and contact radiation safety specialist.
Micro R Meter or Ion Chamber	<2 mR/hr: Continue work in accordance with action levels for other instruments. 2 to 5 mR/hr: In conjunction with a radiation safety specialist, continue work and perform stay-time calculations to ensure compliance with dose limits and as low as reasonably achievable (ALARA) policy. >5 mR/hr: Evacuate area to reassess work plan and evaluate options to maintain personnel exposures ALARA and within dose limits.
Radiation Survey Ratemeter/Scaler with External Detectors (e.g., pancake Geiger-Mueller probe)	>Approximately 2 to 3 times background: Consider area to be radioactive. Consider item to be radioactively contaminated and to require decontamination for unrestricted use. Other site-specific levels as warranted.

6.6 Initial Site Entry

Initial entry helps define current site conditions and hazards and provides data used to evaluate the need for modifications to the planning documents, especially the SHASP. While maintaining communication with the SSO, the work party uses ambient monitoring and other instruments identified in the planning documents, especially the SHASP, to evaluate site hazards.

Key actions for initial entry into a potentially contaminated site typically include:

- **Actions in the Support Zone:**
  - Brief the work party,
  - Check equipment,
  - Don protective clothing,
  - Verify evacuation routes,
  - Collect instrument background readings,
  - Check lines of communication, and
  - Monitor the weather.
- **Actions in the Contamination Reduction Zone:**
  - Sign the exclusion zone entry/exit log,
  - Perform final check of communications and equipment, and
  - Enter exclusion zone via access control point.
- **Actions in the Exclusion Zone:**
  - Maintain safe distances from unsafe areas,
  - Follow prearranged, task-specific routes,
  - Complete only assigned tasks,
  - Maintain buddy system,
  - Maintain contact with the SSO,
  - Conduct ambient monitoring, allowing time for instruments to respond; take appropriate action if action levels are exceeded,
  - Photo-document site conditions,
  - Prepare or modify sketches of the work area,
  - Identify potential locations for sample/data collection, and
  - Record observations and data in a field logbook and/or digital devices.

6.7 Subsequent Entries into the Exclusion Zone

Subsequent entry into the exclusion zone is guided by the information gathered during previous entries and how the information affects DQOs. Health and safety protocols for subsequent entries will be modified as necessary consistent with information gained from prior exclusion zone entries. Subsequent entry activities may include:

- Completing unfinished tasks from initial entry;
- Collecting additional samples as determined by initial analytical or field screening results;
- Verifying previous observations;
- Collecting additional information based on the results of the initial site entry; and

- Contaminant stabilization activities (e.g., absorbent boom deployment, closing open containers, or minor containment).

6.8 Egress

The procedure for egress from the exclusion zone includes timing work activities to correspond with safety limitations, e.g., exiting the exclusion zone prior to the need to replace an SCBA (i.e., before an SCBA End of Service Time Indicator alarm indicates that only 20% to 25% of the total recommended air pressure remains in the tank). Work parties exit following the buddy system.

Planning includes carrying sufficient equipment and supplies to avoid multiple trips in and out of the exclusion zone where possible.

6.9 Personnel Decontamination Station Operation

6.9.1 PDS Design and Setup

A site-specific decontamination procedure will be developed, communicated to workers, and implemented before workers or equipment enter areas on site where the potential exists for exposure to hazardous substances. The site-specific protocol and the procedures in this SOP have been developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

The PDS is set up within the contamination reduction zone. At the PDS, personnel returning from the exclusion zone are decontaminated before re-entry into the clean support zone (see Figure 6-1). (Decontamination of items and equipment is addressed in SOP ENV 3.15, Sampling and Field Equipment Decontamination.)

The size and layout of the PDS will be described in the planning documents and will be based on the type of contaminant, the work activities to be conducted, health and safety considerations, and project DQOs. Contamination avoidance is the most effective decontamination procedure. The PDS will be located in an area that will minimize the exposure of uncontaminated personnel and equipment to contaminated personnel and equipment.

The scope and layout of the PDS will be affected by the relative use of reusable PPE (which will require decontamination) versus disposable PPE (which will require disposal as either a contaminated or noncontaminated waste). The project planning documents will specify what types of PPE and decontamination will be used for the project, which will evaluate factors such as the contaminants involved, safety, and cost (of PPE, decontamination, and waste disposal). Reusable PPE is required to be decontaminated, cleaned, laundered, maintained, or replaced as needed to maintain its effectiveness. Disposable PPE is typically used when practicable. Wet decontamination, involving the use of water and decontamination wash and rinse steps, is used to clean reusable PPE. Dry decontamination consists of limited decontamination and the removal and disposal of disposable PPE. Figure 6-3 shows a complex layout for a Level B PDS involving predominantly wet decontamination, which is discussed further in Section 6.9.2.1.

Ergonomic layout of the PDS allows work party personnel crossing the marked access point from the hot zone to move efficiently and systematically into the contamination reduction zone and between decontamination stations within the PDS. Clearly labeled signs with arrows, ropes, and/or markers delineating the proper avenue for decontamination and the boundaries of the PDS typically would be used and should be visible to personnel in their working level (Level A, B, or C). In addition to labels and markers, the PDS operator may provide verbal instruction or escort and assist workers as they exit the exclusion zone and move through the PDS.

Drop cloths, plastic sheeting, tubs, decontamination implements (e.g., long-handled brushes), and garbage cans are staged throughout the PDS, and lined/diked catchment systems might be required to direct and collect decontamination fluids. Tables, chairs, and other non-disposable furniture within the PDS are protected with plastic sheeting and decontaminated prior to removal from the contamination reduction zone. Environmental and personal monitoring equipment are also similarly protected from contamination while being held in the PDS (e.g., stored in clear plastic bags).

The PDS operator typically wears PPE no more than one level lower than the personnel entering the PDS from the exclusion zone. For example, if the work party level of protection is B, then the PDS operator should be in Level C or higher. After removal, disposable PPE should be rendered useless by cutting or tearing to prevent the inadvertent or intentional reuse of contaminated PPE.

Decontamination processes will be monitored by the PDS operator and SSO to determine their effectiveness and correct any deficiencies found. Unauthorized workers may not remove protective clothing or equipment from the PDS.

6.9.2 PDS Steps/Stations

The functions of typical PDS steps and stations are briefly described below for wet decontamination and dry decontamination.

6.9.2.1 Wet Decontamination

A wet decontamination PDS may range from a boot wash to multiple stations with wash solutions and water rinse steps. Figure 6-3 shows a complex layout for a Level B PDS involving predominantly wet decontamination. This type of PDS layout is very involved and would be used when it is necessary to reduce contamination on PPE throughout the decontamination process (for the safety of the PDS operator and the work party) and also because multiple items of reusable PPE have been worn (including outer gloves, safety boots, and respirator face mask). This layout will be modified as needed to accommodate project needs.

The scope and layout of the PDS, as well as the decontamination agents to be used, will be defined in the project planning documents. A common agent used to decontaminate PPE is a detergent such as Alconox®. Additional consultation with E & E health and safety staff is recommended to determine appropriate agents to decontaminate PPE for unique, high chemical hazard, or complex activity sites. In general, wash and rinse solution volumes should be minimized to the extent practicable to reduce waste characterization and disposal costs. A description of key steps and stations is provided below.

- **Equipment Drop and Sample Decontamination**: The equipment drop is situated in the exclusion zone near the hot line. Equipment that will be used again in the exclusion zone is segregated from equipment that is being removed from the exclusion zone. Containerized samples (and reusable sampling implements) will be decontaminated at a station established near the hot line.
- **Boot Cover and Outer Glove Wash/Rinse and Removal**: Boot covers and outer gloves (such as heavy neoprene or nitrile gloves; not surgical-type inner gloves) typically will be decontaminated and removed in the exclusion zone because those are the PPE items likely to be the most contaminated. For excessive contamination on water-resistant outer garments, the boot cover wash/rinse station can alternatively function as a gross decontamination station where the worker stands in large tubs to have dirt and

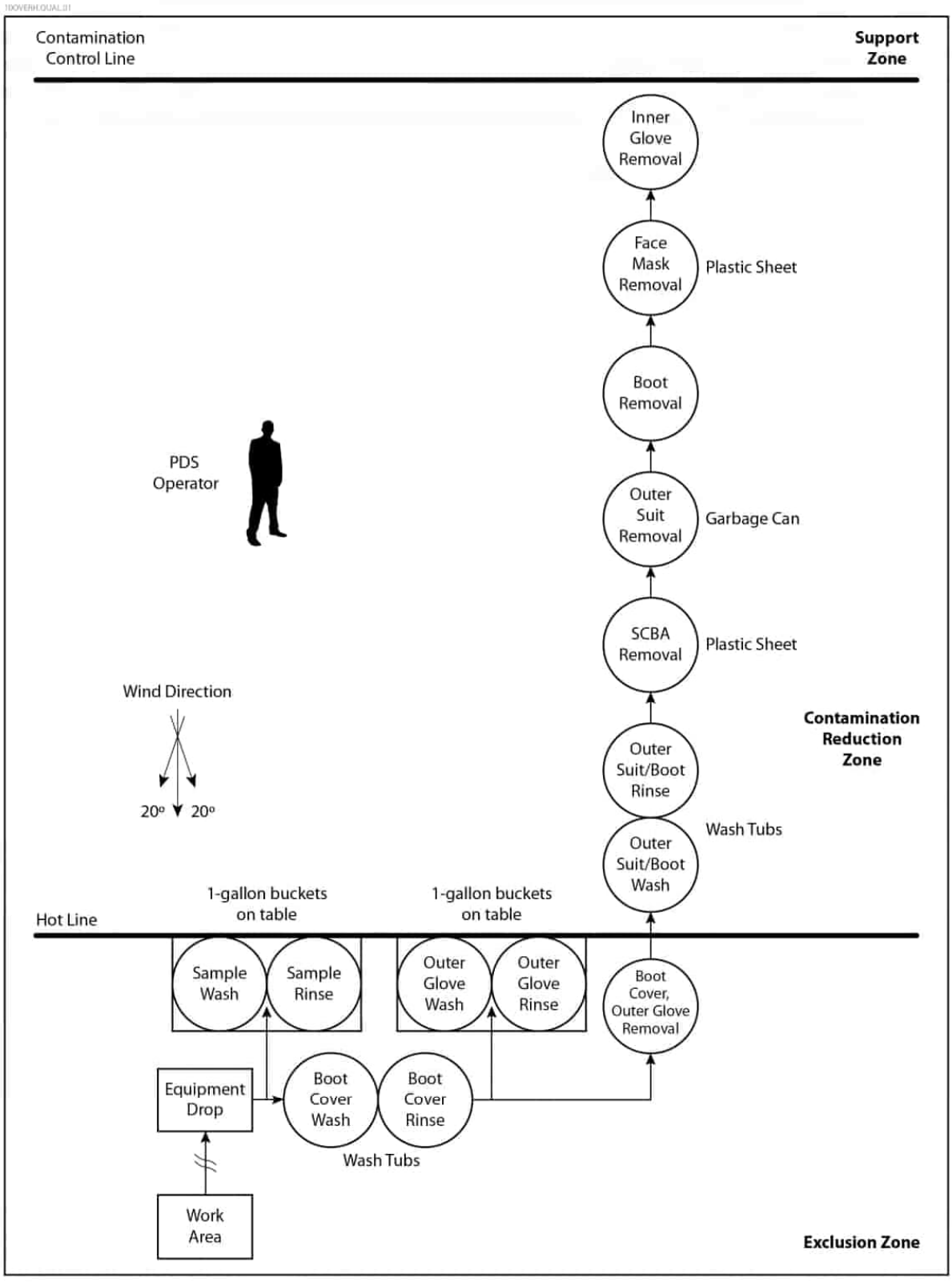

Figure 6-3 Complex PDS Layout for Level B Protection

contamination gently hosed off or removed with long-handled brushes. While at the boot cover and outer glove wash/rinse/removal stations, which are near the hot line, PDS personnel working from the PDS can replace an SCBA cylinder and the individual could return to the exclusionzone (depending on the level of contamination on the PPE, the SCBA cylinder can even be replaced without the work party member going through the boot cover and outer glove wash). PDS personnel also can resupply the work party in this general area. However, PDS personnel will not cross the hot line into the exclusion zone.

- **Outer Suit and Boot Wash/Rinse and Removal**: As needed, the outer chemical-protective suit and boots (such as neoprene boots) will be decontaminated next, followed by SCBA tank assembly removal and then outer suit removal. It is important that personal footwear and inner gloves do not become contaminated during the removal of outer PPE. The SCBA face mask will remain on the individual at this point. The SCBA tank assembly will be decontaminated or receive maintenance to be placed back into service for further work activities in the exclusion zone.
- **Face Mask and Inner Glove Removal**: The secondary (outer) inner gloves will be removed, then the face mask, and then the primary inner gloves. The face mask will be segregated for decontamination in the PDS before the face mask leaves the contamination reduction zone. In some cases, the face mask is bagged in a clean plastic bag and removed from the site for washing at the end of the day by the wearer.

After leaving the contamination reduction zone, field personnel will wash their hands and face with soap and water at the earliest opportunity. In the absence of sanitary facilities or a wash station at the job site, wet towelettes can be used. The use of hand sanitizer is not a substitute for washing with running water or wet towelettes.

If showers are used for decontamination, they will meet the requirements of 29 CFR 1910.141. If temperature conditions prevent the effective use of water, then other effective means for cleansing will be provided and used. In the unlikely event that commercial laundries or cleaning establishments are used to decontaminate protective clothing or equipment, they will be informed of the potentially harmful effects of exposure to hazardous substances.

6.9.2.2 Dry Decontamination

Similar to wet decontamination, a dry decontamination PDS may range from a single station, where all of the steps for dry decontamination are completed, to multiple stations. A dry decontamination PDS would tend to be used when low levels of contamination are expected on reusable PPE or when predominantly disposable PPE is planned to be used for the work. The level of protection will determine the number of stations needed, the layout will be modified to accommodate project needs, and the scope and layout of the PDS will be defined in the project planning documents.

Although a figure is not provided, a dry decontamination PDS is a scaled-down version of the wet decontamination PDS shown on Figure 6-3, and typically would consist of equipment drop, outer PPE removal, and inner PPE removal stations. For dry decontamination, some stations may be consolidated and wash/rinse steps involving the generation of spent decontamination fluids are eliminated. Dry decontamination can involve the limited and controlled use of moist towelettes, paper towels dampened with water, and other damp methods.

6.9.3 Emergency Decontamination

For an emergency involving the work party, such as a medical emergency, site emergency, or breach of protective clothing, routine work activities will be suspended and the work party will proceed to the contamination reduction zone. Decisions regarding the extent of decontamination in an emergency will be made on a case-by-case basis and will be based on factors such as the:

- Nature and severity of the emergency;
- Nature of the site-specific contamination; and
- Availability of outside emergency services.

In some emergencies, the time should not be taken for the affected worker to be fully processed through the PDS and only gross decontamination (or perhaps no decontamination at all) should be performed before the emergency is addressed. The procedure for emergency gross decontamination after an individual leaves the exclusion zone includes immediate removal of gross contamination and removal of outer layers of protection, while limiting contamination of the work party and PDS operator to the extent practicable. In some cases, deluging the affected work party member with large volumes of water may be the appropriate next step, while in other cases the removal of the outer layers of protection may be sufficient before rendering first aid or otherwise addressing the emergency. Appropriate techniques should be included in the SHASP and discussed before the initial site entry is performed. E & E field staff are first aid/cardiopulmonary resuscitation-trained and should follow their training. Initially, the scene should be checked for safety to determine what has happened, how many people are involved, and whether it is safe to approach the victim.

Although not necessarily an emergency, workers whose non-impermeable clothing becomes wetted with hazardous substances will immediately remove that clothing and proceed to shower, and the affected clothing will be disposed of or decontaminated before it is removed from the work zone.

6.9.4 Special Considerations for Radioactive Decontamination

Personnel decontamination on sites containing radioactive material typically follows dry decontamination methods in order to minimize the generation of radioactively contaminated decontamination fluids, which might be costly and complicated to dispose of. When liquid decontamination agents are specified for radioactive site investigations, commercial preparations are available that contain special chelating or binding agents that are often better than Alconox® at removing radioactive materials.

6.9.5 PDS Closure

When it is time to close and dismantle the PDS, equipment, furniture, and items used to operate the PDS are evaluated for the potential to be contaminated, and then are decontaminated as appropriate in accordance with SOP ENV 3.15, Sampling and Field Equipment Decontamination. Reusable items that have been decontaminated are moved to the support zone. Solid wastes generated at the PDS such as used PPE, expendables, and decontamination supplies are double-bagged and/or drummed according to the project planning documents. Spent decontamination solutions typically are drummed pending analysis and disposal. Once all items within the PDS have been decontaminated and moved to the support zone, containerized, or otherwise directed to their proper disposition, protective ground coverings are rolled or folded (starting from the hot line) and double-bagged for proper

disposal. The PDS operator and command/control personnel will ensure that wastes generated from personnel decontamination are collected and containerized for proper disposal in accordance with SOP ENV 3.26, Handling Investigation-Derived Wastes.

7 Quality Assurance/Quality Control

The program/project manager will identify personnel for the field team who have knowledge, training, and experience in the field activities being conducted. Field personnel will be assigned responsibilities for implementing the procedures in this SOP. The program/project manager should also identify additional personnel, as necessary, to complete ancillary procedures (e.g., field logbook documentation, sample management, sample shipment, and waste disposal).

Prior to initiating field work, the project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, and SHASP) will be reviewed by field personnel to understand the planned site entry, egress, and control activities. Project planning documents will define the quality assurance/quality control (QA/QC) procedures necessary to meet project DQOs.

8 Health and Safety

Prior to entering the field, E & E field personnel will acknowledge in writing that they have read and understand the SHASP.

Unique hazards associated with entry onto a site for the first time include conditions that are not consistent with historical background documents or project planning documents, such as undisclosed or unknown chemical, toxicological, radiological, or pathogenic hazards; undisclosed or unforeseen physical hazards (e.g., unsound structures, deep holes/pits in the ground, unsafe infrastructure); and difficult terrain.

Exposure to site hazards will be controlled by following the SHASP and the hazard control measures and safe work practices it prescribes. The SHASP is required to be compliant with E & E's CHSP. The SHASP will identify the nearest medical assistance. In accordance with E & E standard practice, a daily safety meeting will be conducted for all on-site personnel prior to work activities and will address the specific hazards and hazard control measures applicable to that day's work. The daily safety meeting will be documented on E & E's Daily Safety Meeting Record form or in the field logbook.

9 Special Project Requirements

Project-specific requirements will be included with the project planning documents.

10 References

Martin, William F. and Michael Gochfeld. 2000. *Protecting Personnel at Hazardous Waste Sites.* Third Edition.

National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), United States Coast Guard (USCG), and United States Environmental Protection Agency (EPA). 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. October 1985.

Occupational Safety and Health Administration (OSHA). *Occupational Safety and Health Standards.* U.S. Department of Labor. Title 29 of Code of Federal Regulations, Part 1910.

United States Environmental Protection Agency (EPA). *Standard Operating Safety Guides.* Publication 9285.1-03. June 1992. Washington, DC.

END OF SOP

ecology and environment, inc.

STANDARD OPERATING PROCEDURE

GROUNDWATER WELL SAMPLING

SOP NUMBER: ENV 3.7

REVISION DATE: 9/30/2018 **SCHEDULED REVIEW DATE: 9/30/2023**

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1 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures used by E & E for collecting representative water samples from groundwater wells, the most common example being a groundwater monitoring well. Every effort is typically made to ensure that each sample is representative of the water zone of interest, such as the saturated zone. This SOP also addresses some procedures that can be used to purge and sample plumbed groundwater wells such as domestic drinking water, public drinking water supply, and irrigation wells that contain a downhole well pump. Analysis of groundwater samples may be used to determine pollutant concentrations and their potential risk to public health, welfare, or the environment; extent of contaminants; or compliance with remedial standards.

This SOP addresses routine sample collection activities consisting of well purging; field measurement of water quality parameters; and collection of samples for off-site laboratory analysis of chemical, biological, radiological, or physical parameters. Specific sampling procedures may vary depending on the data quality objectives (DQOs) and regulatory requirements identified in project planning documents.

This groundwater well sampling SOP is intended for use by personnel who have knowledge, training and experience in the field sampling activities being conducted.

Other E & E SOPs that would typically also apply to groundwater well sampling include the following:

- DOC 2.1, Field Activity Logbooks;
- ENV 3.15, Sampling and Field Equipment Decontamination;
- ENV 3.16, Environmental Sample Handling, Packing, and Shipping;
- ENV 3.26, Handling Investigation-Derived Wastes; and
- GEO 4.15, Measuring Water Level and Well Depth.

2 Definitions and Acronyms

C	Celsius
DQO	Data quality objective
DO	Dissolved oxygen
E & E	Ecology and Environment, Inc.
EPA	(United States) Environmental Protection Agency
HDPE	High-density polyethylene
LDPE	Low-density polyethylene
µm	micrometer
mg/L	milligrams per liter
mL/min	milliliters per minute
mV	millivolt
NTU	Nephelometric turbidity unit

ORP	Oxidation-reduction potential
%	percent
PCB	Polychlorinated biphenyl
PFAS	Per- or polyfluoroalkyl substance
PFC	Perfluorinated compound
PTFE	Polytetrafluoroethylene (or Teflon™)
PVC	Polyvinyl chloride
QA	Quality assurance
QC	Quality control
SHASP	Site-specific health and safety plan
SOP	Standard operating procedure
SVOC	Semivolatile organic compound
VOA	Volatile organic analysis
VOC	Volatile organic compound

3 Procedure Summary

This SOP addresses purging and sampling methods primarily for groundwater monitoring wells. It also includes some procedures applicable to purging and sampling of plumbed groundwater wells such as domestic drinking water, public drinking water supply, and irrigation wells that contain a downhole well pump.

A primary goal of groundwater sampling is to provide data that are representative of actual aquifer conditions. Because standing water in a well casing may not be representative of aquifer conditions, that standing water and other near-well groundwater is typically purged (evacuated) from the well prior to sampling. The water level in the well is measured prior to, and frequently during, purging and sampling to determine the amount of standing water, location of the water with respect to the well screen, and drawdown and recovery rates. Water quality parameters such as pH, temperature, specific conductance, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity are typically monitored throughout purging to help determine when standing, stagnant water has been removed from the well and fresher aquifer water is available for sampling.

Groundwater wells are typically purged and sampled using a manual bailer or pumps such as a submersible pump, bladder pump, or peristaltic pump. In some cases, low-flow purging and sampling procedures will be specified when it is necessary to collect samples under conditions that are most reflective of ambient flow conditions and with as little hydraulic stress as possible at the well-aquifer interface. If dedicated or disposable equipment is not used, purging and sampling equipment will be decontaminated before use at a groundwater well location.

4 Cautions

4.1 Sampling

Cautions related to health and safety are discussed in Section 8.

Standard measures, such as the use of disposable gloves, should be used to avoid cross-contamination of samples between sample locations.

4.2 Special Considerations for Sampling for PFASs

When collecting samples for analysis of per- and polyfluoroalkyl substances (PFASs), it should be noted that common consumer products and commonly used environmental sampling equipment contain PFASs or PFAS derivatives that have the potential to cross-contaminate the samples, resulting in potential false positives for the PFAS analytes. Table 4-1 lists some common items and materials used during field efforts and sample collection that could contain PFASs, and acceptable non-PFAS substitutes to use. (Note: "PFAS" is the currently recognized term by the United States Environmental Protection Agency [EPA], the Centers for Disease Control and Prevention, and others for the class of chemical compounds addressed herein. PFASs might also be referred to as perfluorinated compounds [PFCs], although PFCs are a subset of PFASs.)

Table 4-1 Item and Material Guidance for Sampling for PFASs

Item/Material Type	Items/Materials to Avoid	Allowable Items/Materials
Pumps, tubing, connectors, and samplers	PTFE, Teflon™, and other fluoropolymer-containing materials[1] (including thread seal tapes and pastes); LDPE HydraSleeves	Peristaltic pump or stainless steel submersible pump HDPE or silicone tubing (LDPE[2] as a last resort) HDPE HydraSleeves Acetate items
Decontamination agents	Decon 90® (contains fluoro-surfactants); water from unknown sources	Alconox® or Liquinox® soap; PFAS-free water
Sample containers and packaging supplies	LDPE[2] or glass[3] bottles; PTFE-lined or Teflon™-lined caps; chemical ice packs (Blue Ice®), aluminum foil	Laboratory-provided, HDPE, or polypropylene[4] sample bottles; unlined HDPE or polypropylene[4] screw caps; regular ice made from PFAS-free water and contained in plastic (polyethylene) bags; standard Coleman® coolers are HDPE
Field documentation	Waterproof/treated paper or field books; plastic clipboards; Sharpies®; markers; adhesive paper products (such as Post-it® notes)	Plain paper; Masonite or metal clipboard; pens
Clothing, boots	Clothing or boots made of or with Gore-Tex™ or other synthetic water-resistant, waterproof, or stain-resistant materials; fabric softener-treated clothing; new clothing; Tyvek® material	Synthetic or cotton material; previously laundered clothing (preferably previously washed greater than six times) without the use of fabric softeners; polyurethane or PVC safety boots; powderless nitrile gloves; polyurethane or wax-coated rain gear
Personal care products	Cosmetics; moisturizers; hand cream; dental floss; most sunscreens; most insect repellants; and other related products	Avoid most personal care products the day of sampling; use PFAS-free or natural sunscreens and insect repellents (DEET is OK)

Table 4-1 Item and Material Guidance for Sampling for PFASs

Item/Material Type	Items/Materials to Avoid	Allowable Items/Materials
Food	Pre-packaged food; fast food wrappers and containers; candy wrappers; aluminum foil	Home-prepared foods (consumed only in a designated rest area); bottled water or hydration drinks

[1] In cases where Teflon™-containing materials are unavoidable, ensure that adequate purging is performed prior to sampling (e.g., in-well pumps) and that rinsate blanks are collected prior to sampling.

[2] Although LDPE is allowed by some agencies during sample collection, it is not recommended that samples be stored in LDPE sample containers.

[3] Glass is to be avoided due to potential analyte loss from PFAS adsorption on the glass, not due to potential cross-contamination from glass.

[4] Some laboratories recommend HDPE only and do not support the use of polypropylene bottles. Polypropylene bottles are allowed by EPA Method 537, for instance, because the method contains steps to recover PFASs that might have adsorbed to the inside of the container. Not all analytical methods, however, contain such steps.

Key:
DEET = N,N-Diethyl-m-toluamide
HDPE = High-density polyethylene
LDPE = Low-density polyethylene
PFAS = Polyfluoroalkyl substance
PTFE = Polytetrafluoroethylene (Teflon™)
PVC = Polyvinyl chloride

In addition to following the item/material guidance in Table 4-1, the following guidance should be followed to the extent practicable when sampling for PFASs:

- Wash hands before the sampling effort, even though gloves will be worn, to prevent the inadvertent transfer of PFASs to sampling supplies;
- Collect the samples for PFAS analysis prior to collecting samples for other parameters;
- Filter water samples with non-glass and non-PFAS-containing filters (glass fibers can potentially adsorb PFASs);
- Keep sampling supplies for PFAS sampling separate from other sampling supplies;
- Keep samples collected for PFAS analysis separate from other samples; and
- Include field blanks (such as trip blanks and/or equipment blanks) in the sampling protocol to check for potential cross-contamination from PFASs from non-field sources during sample transport and handling, as well as from equipment used during sampling.

5 Equipment and Supplies

The following is a general list of equipment and supplies. A detailed list of equipment and supplies will be prepared based on the project planning documents. In general, the use of dedicated or disposable equipment is preferred, to reduce the potential for cross-contamination between sampling locations, but equipment may be reused after thorough decontamination between sample locations.

- Water level indicator (e.g., electric sounder, steel tape, transducer, reflection sounder, airline, etc.) capable of measuring to 0.01-foot accuracy.

- Oil/water interface indicator.
- Keys or combinations for well cap locks.
- Organic vapor analyzer (e.g., photoionization detector).
- Specific purging/sampling equipment as applicable:
  - Bailers:
    - Reusable or disposable bailers of appropriate size and construction material.
    - Nylon or polypropylene line, enough to dedicate to each well.
    - Aluminum foil (to wrap clean bailers if not using disposable bailers).
  - Submersible Pump:
    - Submersible pump, preferably constructed of stainless steel or Teflon™.
    - Flow controller as applicable.
    - Safety cable (e.g., nylon or polypropylene line).
    - Flow meter with gate valve.
  - Bladder Pump:
    - Non-gas-contact bladder pump, preferably constructed of stainless steel or Teflon™.
    - Flow controller as applicable.
    - Spare bladders, typically polyethylene or Teflon™.
    - Compressor or compressed gas.
  - Suction Pump (Peristaltic Pump):
    - Suction pump.
    - Silastic (silicone) tubing of appropriate size and length for use in pump.
    - Flow meter with gate valve.
  - Low-Flow Purging/Sampling:
    - Pump (see above for options).
    - Transparent flow-through cell.
- Water discharge tubing for use with pumps, enough to dedicate to each well, and connectors (hose barbs, connectors, nipples, ferrules, etc.).
- Multi-parameter water quality measurement instrument suitable for measuring pH, temperature, specific conductance, ORP, and DO. If low-flow procedures and a flow-through cell are used, the water quality probes and flow-through cell may come together as a set.
- Turbidity meter.
- Water quality measurement calibration standards.
- Power for pumps: generator, gasoline, battery, and power cables.
- Chargers for any battery-operated equipment.
- Timepiece (preferably with a stopwatch function).
- Calculator.
- 5-gallon buckets (graduated), for purge water.

- Tools (pipe wrenches, wire strippers, electrical tape, tubing connectors, Teflon™ tape, box cutters, scissors, sharp knife, etc.).
- Associated equipment and supplies (e.g., meter stick or tape measure, aluminum foil, plastic sheeting, disposable gloves, sample containers, sample preservatives, field logbook, sampling log or field data sheets, sample custody and documentation supplies, decontamination supplies, sample packing/shipping supplies, safety supplies, and waste handling supplies).

6 Procedure

6.1 General Purging and Sampling Considerations

Groundwater sampling methods and equipment will be specified in project planning documents and will have been selected based on factors such as:

- Analytes of interest;
- Analytical volumes needed;
- The need for portable vs. dedicated equipment;
- Characteristics of the well being sampled, such as type, diameter, and depth to water;
- The need and availability of a power source for a sampling pump;
- Ease of decontamination;
- Project-specific regulations and requirements; and
- Cost.

In general, purging and sampling equipment must be constructed of materials that cannot interfere with the parameters being analyzed for. For example, some sample collection devices have parts constructed of plastic or rubber that cannot be used for sampling for volatile organic compounds (VOCs) and extractable organic parameters. Samplers constructed of glass, stainless steel, polyvinyl chloride (PVC), polytetrafluoroethylene (PTFE), or Teflon™ typically should be used, depending on the types of analyses to be performed (e.g., samples to be analyzed for metals should not be collected in metallic containers). Submersible and bladder pumps, which are inserted into the well, ideally should be constructed of stainless steel or Teflon™, and pumps ideally should have an adjustable and variable flow rate.

The water discharge tubing used with pumps should preferably be Teflon™ or Teflon™-lined polyethylene tubing when sampling is to include VOCs, semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and certain inorganics. If tubing constructed of other materials is used, adequate information must be provided to show that the materials do not leach contaminants or cause interference to the analytical procedures to be used. PVC, polypropylene, or polyethylene tubing typically is acceptable when collecting samples for metal and other inorganics analyses.

The use of pumps, tubing, and equipment dedicated to an individual well is ideal when possible. Non-dedicated and non-disposable purging and sampling equipment requires decontamination prior to each sample location. When non-dedicated or non-disposable groundwater purging and sampling equipment is used, purging and sampling should be conducted moving from least contaminated well to most contaminated well. As well, decontamination of non-dedicated and

non-disposable equipment will be minimized if purging and sampling are completed for an individual well before moving to the next well.

Power sources such as gas-powered generators must be positioned downwind of the well during purging and sampling to prevent contamination of the well or sampled groundwater with chemical constituents in gasoline. Gas-powered equipment and containers of spare fuel should not be stored near supplies used to purge and sample wells.

Plastic sheeting is typically placed on the ground around the well to provide a clean place to stage and use purging and sampling equipment.

In addition to using a field logbook, groundwater purging and sampling are often documented on standardized forms such as a sampling log or field data sheets, which may be project-specific. Standardized forms are also available in many state and federal guidance documents.

6.2 Well Observations and Sampling Preparation

6.2.1 Water Quality Meter Calibration

1. Calibrate the multi-parameter water quality meter and turbidity meter on a daily basis, before use, in accordance with manufacturers' instructions and project planning documents. If the calibration results are out of range, repeat the calibration so that acceptable results are obtained or remove the instrument from service and obtain a replacement.
2. In some cases, an additional mid-day calibration is advised, especially if readings are observed to drift during the day or otherwise be unreliable or suspect.

6.2.2 Monitoring Wells

1. Start at the least-contaminated well.
2. Note the location of the well, date, and time in the field logbook or sampling log.
3. Remove the locking well cap.
4. Remove the well cap covering the well riser. Listen for indications of pressure or vacuum when opening the well riser cap.
5. If required, test the headspace in the well interior casing for the presence of organic vapors using an organic vapor analyzer or equivalent.
6. Measure water level (depth to water) and total depth of the well using appropriate reference points and procedural steps in E & E SOP GEO 4.15, Measuring Water Level and Well Depth. If possible, measure water levels in neighboring wells before any individual well is disturbed by purging and sampling, which could affect certain neighboring wells.
7. If free-phase product is expected in the well, measure depth to product and depth to water with an oil/water interface meter.
8. Measure the diameter of the well and calculate the volume of water in the well as follows:

$$V = \pi r^2 h$$

Where:

V = Static well volume
π = Mathematical constant, 3.14159
r = Inside radius of well casing
h = Height of water in well (depth of well – depth to water)

Ensure that the units of all measures are the same (e.g., feet). Other volume measurements may be derived from cubic feet using the following conversions:

1 cubic foot = 7.48052 gallons,
28.3168 liters,
0.02832 cubic meter, and
1,728 cubic inches.

A commonly used alternative short-cut version of the same equation is:

$$V = Tr^2(0.163)$$

Where:

V = Static well volume, in gallons
T = Height of water in well, in feet (depth of well – depth to water)
r = Inside radius of well casing, in inches
0.163 = Conversion constant for converting casing radius in inches to feet, and converting cubic feet to gallons

9. Determine the required volume of groundwater to be removed from the well, e.g., three well volumes or as indicated in the project planning documents.

6.2.3 Plumbed Well Systems

1. Visually assess the well system, from the well to the nearest tap.
2. Large-volume well systems (e.g., industrial and public supply wells) operate at high pressure and care must be taken when opening a large-diameter tap. Most large-volume well systems have a small-diameter tap near the well head to reduce pressure for sample collection.
3. Plan to purge/sample from as close to the well head as possible, before water treatment or softening systems, if present.
4. Avoid removing installed pumping systems to purge/sample the well directly because this may disturb the well, loosen rust, or cause other changes or damage.
5. Remove any filters, aerators, screens, washers, or hoses from the faucet prior to purging/sampling, with the permission of the well owner, and document any plumbing features that could affect the water sample.

6.3 Purging

6.3.1 Purging Considerations

Groundwater wells are typically purged prior to sampling to ensure that the sampled groundwater is representative of actual aquifer conditions. The amount of purging performed on a well prior to sample collection depends on the intent of the monitoring program, constituents to

be analyzed, hydrogeologic conditions, and produced water management requirements. Programs in which overall quality determinations of water resources are involved may require long purging periods to obtain a sample that is representative of the groundwater.

Traditionally, three to five well casing volumes of water are removed. For sites with deep wells or many wells, this can generate a large volume of groundwater that will require proper handling and disposal if potentially contaminated. In addition, the amount of time to purge multiple casing volumes can be significant for sites with deep wells or many wells.

Monitoring for defining a contaminant plume requires a representative sample of a small volume of the aquifer. These circumstances require that the well be pumped enough to remove the stagnant water, but not enough to induce flow from other areas.

Non-representative samples can result from excessive pumping of a well. For example, excessive pumping can cause stratification of certain contaminants in the groundwater formation, or dilute or increase contaminant concentrations from what is normal.

Water quality parameters are typically measured and recorded at regular intervals during purging. The data may be used to compute water table or aquifer transmissivity and other hydraulic characteristics, as well as determine or confirm when water quality has stabilized and purging can be considered to be complete. In some cases, wells may simply be purged of a specified number of well volumes without confirmation of water quality stability.

Low-flow purging focuses on pumping a well from the well screen at a flow rate below the recharge capacity of the formation. The specific rate of pumping is generally aquifer-dependent and typically less than 500 milliliters per minute (ml/min). By purging at low-flow rates, only the groundwater that enters through the well screen is theoretically purged from the well. Because stagnant water located above the pump intake in the well casing is not drawn into the pump, the full casing volume (or multiple casing volumes) would not have to be purged from the well prior to sampling. The low-flow purging approach can reduce the volume of water generated during purging and the time spent performing the task.

6.3.2 Water Quality Measurements

Water quality parameters are measured during purging to determine when water quality has stabilized and the water available for sampling is from the formation. The parameters are generally considered to have stabilized, and purging is considered to be complete, when at least three successive measurements are within specified guideline values. Some common stability criteria are:

- **pH**: +/- 0.1 standard unit;
- **Temperature**: +/- 3 percent (%);
- **Specific Conductance**: +/- 3%;
- **Oxidation-Reduction Potential (ORP)**: +/-10 millivolts (mV);
- **Dissolved Oxygen (DO)**: +/- 10% for values greater than 0.5 milligrams per liter (mg/L); if three successive DO measurements are less than 0.5 mg/L, consider the parameter stabilized; and
- **Turbidity**: +/- 10% for values greater than 5 nephelometric turbidity units (NTUs); if three successive turbidity measurements are less than 5 NTU, consider the parameter stabilized.

In many cases, if all parameters other than turbidity have stabilized and turbidity is ≤50 NTUs, purging is considered complete and groundwater samples may be collected. If all parameters other than turbidity have stabilized and turbidity does not expeditiously reduce to ≤50 NTUs, purging is typically considered to be complete, and separate filtered and unfiltered samples may be required for metals and other analyses.

Water quality will be measured and recorded at pre-determined intervals specified in project planning documents. A typical interval is one-quarter of a well volume.

Project-specific requirements for water quality stability may be different from the above and will be followed.

6.3.3 Purging Wells Using Various Equipment

Each of the procedures below assumes that purging will be conducted until stable and acceptable water quality parameter values are achieved; information such as water level, pumping rate, drawdown rate, and water quality measurements is recorded in the field logbook or sampling log; and the proper purge volume is removed in accordance with project planning documents. These steps are not repeated below.

6.3.3.1 Bailer

1. Attach the bailer line to the bailer and lower the bailer slowly (trying not to agitate the water) until it is completely submerged.
2. Pull the bailer out of the well, ensuring that the line falls onto the plastic sheeting.
3. Empty the bailer into a graduated 5-gallon bucket.
4. Repeat until the required purge volume has been removed.
5. When the 5-gallon bucket is full, empty it into a 55-gallon drum or otherwise discharge the contents of the bucket as specified in project planning documents.

6.3.3.2 Submersible Pump

1. Assemble the pump, water discharge tubing, power source, and safety cable.
2. Lower the pump and assembly into the well to a point at least a few feet below the water level and above the bottom of the well. The midpoint is often used. Measure the new initial water level.
3. Begin purging at a low pumping rate, and increase the rate until water discharge occurs. Using a flow meter or a bucket and a stopwatch, determine the flow rate and calculate the time required to remove the required volume of water from the well.
4. Collect the purge water in graduated 5-gallon buckets, in 55-gallon drums, or as indicated in the project planning documents.
5. Lower the pump by stages until it is just above the screen, and continue to purge until the required volume of water has been removed from the well. Measure the water level as necessary to monitor drawdown rate and well recovery. In cases where the well will not yield water at a sufficient recharge rate, pump the well dry and allow it to recover.

6.3.3.3 Bladder Pump

1. Assemble the pump, water discharge tubing, compressor/control box, and power source.

2. Adjust the flow rate as needed to allow smooth intake and discharge cycles.
3. Lower the pump and assembly into the well to a point at least a few feet below the water level and above the bottom of the well. The midpoint is often used. Measure the new initial water level.
4. Refer to the remaining procedural steps for a submersible pump (see above).

6.3.3.4 Suction Pump (Peristaltic Pump)

1. Assemble the pump, tubing, and power source.
2. Lower the sample tubing into the well to a point at least a few feet below the water level and above the bottom of the well. The midpoint is often used. The pump stays outside of the well.
3. Refer to the remaining procedural steps for a submersible pump (see above).

6.3.3.5 Low-Flow Purging

The objectives of low-flow purging and sampling are to collect samples under conditions that are representative of ambient flow conditions in the subsurface and with as little hydraulic stress as possible at the well-aquifer interface. Some key steps related to low-flow purging are included below. Refer to EPA SOP EQASOP-GW 001, Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, for the complete procedure.

1. Assemble the pump, tubing, flow-through cell, and power source. Wells with low recharge rates may require the use of pumps that can attain low pumping rates, such as bladder or peristaltic pumps. Be advised that EPA and other agencies may not favor the use of a peristaltic pump when collecting sample that will be analyzed for pH and volatile constituents, because use of a peristaltic pump may cause pH modifications or degassing of the sample.
2. Lower the pump and assembly into the well to a suitable pump intake depth (often based on the location of the well screen), which also ideally should be at least a few feet above the bottom of the well. Measure the new initial water level.
3. Begin purging at a low pumping rate, and increase the rate until water discharge occurs. Collect the purge water into graduated 5-gallon buckets. An initial flow rate of a maximum of 100 to 500 mL/min is typical. Adjust the flow rate until there is little or no water level drawdown. Measure water level as necessary to monitor drawdown rate and well recovery. If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging. Purge volume calculations should use the stabilized drawdown value, not initial drawdown.
4. If the initial water level is above the top of the well screen, do not allow the water level to drop below the top of the well screen.
5. Measure water quality parameters using the flow-through cell at key points during purging, such as at the beginning of purging, after the water level has stabilized, and periodically during purging until water quality stability is observed. Measure turbidity with a separate instrument that is either connected to the water discharge tubing through a connection separate from the flow-through cell or by using a standalone turbidity meter. Measure the parameters at a frequency approximately equal to the rate at which water in the flow-through cell is fully exchanged.

6.3.4 Purging Plumbed Wells

1. Small-volume well systems (e.g., domestic and livestock wells) typically have a 25-to-100-gallon pressure tank connected directly to the well. Consider clearing the volume of the pressure tank to purge the well.
2. Plan to purge from as close to the well head as possible, before water treatment systems, if present.
3. Wells that have been producing sufficiently to clear three to five times the well volume within the last 24 hours may not require extensive purging prior to sampling. Because this may not be known, and the casing volume also may not be known, plumbed wells are typically "purged" by opening the faucet or spigot nearest the well for approximately 10 to 15 minutes prior to sampling to allow for a fresh water sample to be collected.
4. Measure the purging flow rate by the time it takes to fill a container with a known volume (e.g., a graduated 5-gallon bucket).
5. Measure water quality parameters per the project planning documents. Purging is considered complete when the water quality parameters have stabilized.
6. Collect the purge water in the graduated bucket. Discharge the contents of the bucket as specified in project planning documents.
7. Record information such as flow rate, water quality measurements, and purge volume in the field logbook or sampling log.

6.4 Sampling

6.4.1 Sampling Considerations

Some steps in common to groundwater sampling regardless of the equipment used are as follows:

- Ensure that the well has adequately recharged after purging.
- Collect samples for VOCs, sulfide, and similar analyses as soon as possible in the sampling sequence and in a way that minimizes disturbance of the water, in order to minimize VOC loss. Sample retrieval systems generally viewed as suitable for the valid collection of samples for VOC analysis include bailers, submersible pumps, and bladder pumps. When collecting samples for the analysis of VOCs, do the following:
  - If the samples are required to be preserved, use pre-preserved volatile organic analysis (VOA) vials.
  - Open the VOA vial and set the cap in a clean place.
  - If using a bailer, deploy and retrieve the bailer as gently as possible. If using a pump, reduce the pumping rate as much as possible, e.g., to approximately 100 mL/min.
  - Fill the vial to the top until a convex meniscus forms on the top of the water. Do not overfill the vial.
  - Place the cap directly over the top of the vial and screw down firmly. Do not overtighten and break the cap.

  - Invert the vial and tap gently. If an air bubble appears, discard the sample and re-collect it. The sample must not contain trapped air.
  - Place collected samples on their sides in a cooler chilled to 4±2°C pending sample management and transport to the analytical laboratory.

- Filter samples as required by the project planning documents. Filtering is commonly performed when testing for metals in the groundwater, in which case both an unfiltered and filtered sample are collected to analyze total metals and dissolved metals, respectively. When pumps are used to sample, filtration is often performed at the time of sampling using a 0.45-micrometer (µm) (same as micron) cartridge filter installed in-line with the sampling system. The filter is attached to the end of the water discharge tubing prior to discharge into the sample containers. When using an in-line filter, the pumping rate should be reduced somewhat to accommodate the resistance of the filter, thereby preventing damage to the filter or to pump parts such as bladders. If not filtered in-line, samples are filtered following collection, using a 0.45-µm barrel filter or vacuum filter and a powered vacuum pump, hand pump, or similar. The sample is poured from the sample container into the chamber atop the filter, vacuum-pumped through the filter, and directed back to the sample bottle.
- Use pre-preserved sample containers or preserve samples as soon as possible after sample collection and filtration. Pre-preserved sample containers typically cannot be used for samples that are not filtered in-line during sample collection. Verify and document proper preservation in the field by pouring a small amount of the sample into the container lid or other clean container and measuring pH using a test strip (the test strip should not be inserted directly into the sample container).
- Place samples requiring cooling to 4±2°C on ice immediately following collection.
- Collect applicable quality control samples as outlined in project planning documents (also see Section 7).
- Record sampling information in the field logbook or sampling log.
- Complete a chain-of-custody form and handle and pack samples in accordance with project planning documents and E & E SOP ENV 3.16, Sample Handling, Packing, and Shipping.
- Non-dedicated and non-disposable sampling equipment requires decontamination prior to each sample location.

6.4.2 Sampling Wells Using Various Equipment

Each of the procedures below assumes that the well was recently purged and the necessary equipment is already at the well location (see Section 6.3.3). As well, the steps in Section 6.4.1 that are common to all procedures are not repeated below.

6.4.2.1 Bailer

1. Attach a bailer line to the bailer. If a bailer was used for purging, the same bailer and line may be used for sampling.
2. Lower the bailer slowly and gently into the well, taking care not to shake the well casing or splash the bailer into the water. Lower the bailer to different points adjacent to the well screen to ensure that a representative water sample is collected.

3. Slowly and gently retrieve the bailer from the well, minimizing contact with the well riser.
4. Carefully pour the water into individual sample containers or insert a stopcock valve into the bottom of the bailer to more cleanly direct the water into the sample containers.
5. After collecting all samples from the well, either dispose of, decontaminate, or dedicate the bailer to that well to ensure no cross-contamination between wells or samples.

6.4.2.2 Submersible Pump

1. Ensure that the pump and assembly are positioned in the well at a point at least a few feet below the water level and above the bottom of the well. A point just above the screened interval is often used.
2. Attach a gate valve to the discharge line, and adjust the flow rate to the minimum that will allow groundwater to come to the surface. If no gate valve is available, discharge the sample into a clean glass jar and fill the sample containers from the jar. Increase the flow rate as long as rapid well drawdown is not occurring and volatile constituents are not being collected. Measure water level as necessary to monitor drawdown rate and well recovery.
3. After collecting all samples from the well, remove the pump and assembly and properly decontaminate it prior to use in the next well. Do not reuse the tubing in another well. If dedicated to a particular well, tubing may be left in place for future sampling events.

6.4.2.3 Bladder Pump

1. Ensure that the pump and assembly are positioned in the well at a point at least a few feet below the water level and above the bottom of the well. A point just above the screened interval is often used.
2. Increase the cycle time and reduce the pressure to the minimum that will allow groundwater to come to the surface. Increase the flow rate as long as rapid well drawdown is not occurring and volatile constituents are not being collected. Measure water level as necessary to monitor drawdown rate and well recovery.
3. After collecting all samples from the well, remove the pump and tubing from the well and properly decontaminate the pump prior to use in the next well. Do not reuse the tubing and bladder in another well. If dedicated to a particular well, the bladder and tubing may be retained for future sampling events.

6.4.2.4 Suction Pump (Peristaltic Pump)

1. Ensure that the tubing is positioned in the well at a point at least a few feet below the water level and above the bottom of the well. A point just above the screened interval is often used.
2. Attach a gate valve to the discharge line if the suction pump discharge rate cannot be controlled. If no gate valve is available, discharge the sample into a clean glass jar and fill the sample containers from the jar. Increase the flow rate as long as rapid well drawdown is not occurring and volatile constituents are not being collected. Measure water level as necessary to monitor drawdown rate and well recovery.
3. After collecting all samples from the well, remove the tubing from the well. Do not reuse the tubing in another well. If dedicated to a particular well, tubing may be left in place for future sampling events.

6.4.2.5 Low-Flow Sampling

Some key steps related to low-flow sampling are included below. Refer to EPA SOP EQASOP-GW 001, Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, for the complete procedure.

1. Ensure that the pump and assembly are positioned in the well at a suitable pump intake depth (often based on the location of the well screen), which also should ideally be at least a few feet above the bottom of the well.
2. Disconnect the water discharge tubing from the flow-through cell. Discharge sample directly into the sample containers without passing the water through the flow-through cell. Adjust the flow rate to the minimum that will allow groundwater to come to the surface. Increase the flow rate with discretion as long as rapid well drawdown is not occurring and volatile constituents are not being collected. Measure water level as necessary to monitor drawdown rate and well recovery. One of the objectives of low-flow sampling is collect samples under conditions that are representative of ambient flow conditions in the subsurface. Do not allow the water level to drop below the top of the well screen.
3. After collecting all samples from the well, remove the pump and assembly from the well and properly decontaminate the pump prior to use in the next well. Do not reuse the tubing in another well. If dedicated to a particular well, tubing may be left in place for future sampling events.

6.4.3 Sampling Plumbed Wells

1. Following purging, remove any diversion hoses and similar items from the sampling port or tap and run the water briefly to clear any immediate contaminants.
2. Adjust the flow rate to a smooth flowing water stream, without splashing, for sample collection. This will minimize spikes or dips in flow pressure when sampling, which may dislodge material in the system. This step is especially important during sample collection for VOC analysis.
3. Attempt to collect water before it is directed through an in-line filter, water heater, water softener, or other treatment system. If determining how well the filter or treatment system is working is an additional goal of the project, collect additional samples after these systems.
4. Collect the water into individual sample containers.
5. After collecting all samples from the well, either dispose of or decontaminate sampling supplies, before reuse at another location, to ensure no cross-contamination between samples.

7 Quality Assurance/Quality Control

The program/project manager should identify personnel for the field team who have knowledge, training and experience in the groundwater sampling to be conducted. One member of the field team should be designated as the lead for groundwater sampling and will be responsible, with support from other field personnel, for implementing the procedures in this SOP. The program/project manager should also identify additional personnel, if necessary, to complete associated procedures (e.g., field logbook documentation, equipment decontamination, sample shipment, and waste disposal).

Prior to initiating field work, the project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, and site-specific health and safety plan [SHASP]) will be reviewed by field personnel to understand the sampling procedures that have been specified to result in groundwater samples that will meet project DQOs. Project planning documents will define the quality assurance/quality control (QA/QC) procedures necessary to meet project DQOs, including the sampling protocol for QC samples such as trip blanks, equipment rinsate blanks (to assess the effectiveness of field decontamination methods for non-dedicated and non-disposable equipment, or to test non-inert field equipment for the potential to leach contaminants into the samples), field duplicates, and other types of field and analytical QC samples. Field duplicates are typically collected from at least one location and treated as separate samples, blind to the laboratory. Certain field blanks should be processed at the site location to account for ambient and other site-specific conditions.

Collecting representative groundwater samples is an important quality consideration. Techniques to maximize the collection of samples that are representative of the aquifer or formation of interest are included in the procedures in Section 6 and include first purging the well of the required volume of standing, stagnant water; measuring water quality during purging to monitor stability; and the use of low-flow purging/sampling procedures if prescribed.

8 Health and Safety

Prior to entering the field, all field personnel will acknowledge in writing that they have read and understand the SHASP, which will be in compliance with the Corporate Health and Safety Program.

Unique hazards associated with collecting samples from groundwater wells can include:

- The use of gas-powered generators or electrical sources to provide power for sampling pumps: Gas-powered equipment will be fueled only when it is off and cool to the touch. Batteries, generators, and other sources of electrical power will be handled safely in accordance with the SHASP.

- The potential for contacting groundwater contaminated with site contaminants such as chemical, radioactive, and/or pathogenic biological material: The SHASP will provide instruction for safe handling of contaminated site materials.

- The use of sample preservatives either in pre-preserved sample containers or as added by the field team during sample management: The field team will wear the personal protective equipment specified by the SHASP, handle samples with care, and collect and process such samples in a well-ventilated area.

9 Special Project Requirements

Project-specific requirements will be included with the project planning documents.

10 References

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END OF SOP

ecology and environment, inc.

STANDARD OPERATING PROCEDURE

SURFACE and SHALLOW SUBSURFACE SOIL SAMPLING

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1 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures utilized by E & E for collecting surface and shallow subsurface environmental soil samples. The purpose of soil sampling may range from simple reconnaissance to complex sampling programs. This SOP can be followed for all routine sample collection activities which may include: visual or other observations, in situ or ex situ field measurements (monitoring), or sample collection for biological, chemical, geological, radiological or physical analysis. Site-specific sampling procedures vary depending on the data quality objectives (DQOs) identified in program/project planning documents.

E & E routinely utilizes three types of surface and shallow subsurface environmental soil collection procedures, hand scoop, hand coring, and hand auger. Powered hand augers are sometimes used and the procedure is addressed in this SOP. The definition of the depth of a "surface" soil sample is dependent on the program/project specific DQOs); and may be driven by regulatory, risk-based or other considerations. Hand sampling is generally limited to no more than three feet (one meter) below ground surface. The site-specific depth interval of soil collection is identified in the project planning documents.

Procedures for collecting soil samples for volatile organic compound (VOC) analyses are presented in the E & E VOC Soil and Sediment Sampling SOP ENV 25.

Procedures for collecting "deeper" subsurface soil samples (using back hoes, drill rigs and direct push equipment) are presented in the E & E Borehole Installation Methods SOP GEO 4.7.

Procedures for sample handling are defined in E & E Environmental Sample Handling, Packaging and Shipping SOP ENV 3.16. Site-specific sample handling procedures are dependent on the project DQOs.

Procedures for equipment decontamination are defined in E & E Sampling Equipment Decontamination SOP ENV 3.15. Site-specific equipment decontamination procedures are dependent on the project DQOs.

This surface and shallow subsurface soil sampling SOP is intended for use by personnel who have knowledge, training and experience in the field soil sampling activities being conducted.

2 Definitions and Acronyms

cm	centimeter
DQO	Data Quality Objective
E & E	Ecology and Environment, Inc.
SHASP	Site Specific Health and Safety Plan
SOP	Standard Operating Procedure
VOC	Volatile Organic Compound

3 Procedure Summary

Pre-cleaned spoons, trowels, or other types of scoops are used to collect shallow (usually less than 6 inches [15 cm] deep) soil samples using a hand scoop procedure. Shallow subsurface

soil is collected manually using scoops from the sides of hand dug excavations. Pre-cleaned hand soil core samplers and/or bucket augers are used for collecting relatively undisturbed shallow (usually no deeper than 3 feet [1 meter]) subsurface soil samples. The corer barrel/bucket auger is advanced into the soil to the pre-determined depth identified in the project planning documents. In some cases, corers may include a liner on the interior of the core barrel. Soil cores may be sectioned to provide vertical profiles of soil characteristics.

Disturbed soil samples are collected directly from the auger when continuous flight (screw) augers are used

Unless otherwise specified, surface soil scoop aliquots are combined, homogenized and then placed in appropriate sample containers. Volatile organic and sulfide samples are collected immediately after sample retrieval, regardless of the sampling procedure used. VOC samples are not homogenized (see E & E VOC Soil and Sediment Sampling SOP ENV 25) If multiple samples are required to provide the sample volume identified in the project planning documents, then samples are thoroughly homogenized prior to collection of aliquots for testing.

4 Cautions

This SOP is applicable to routine E & E surface and shallow subsurface soil sampling and is limited to relatively shallow soil sampling depths Hand augers and corers used in this SOP are generally effective only to a maximum depth of 3 feet (1 meter) below the soil surface. The depth of sample collection will be limited if soil is sandy, clayey or rocky. Grass, roots, or other natural or anthropogenic materials may not be considered part to the soil sample.

Because the sampling devices specified within this SOP provide limited sample volumes, multiple samples may be required to collect sufficient volume for sample analysis. Samples from multiple locations also may be collected and composited to provide a sample representative of a larger area. Sample compositing and homogenization should be addressed in the project planning documents. If a compositing scheme is employed and an area(s) is not visually consistent with other areas, then observations should be noted in the field log and a course of action determined based on the program/project DQOs. Samples for volatile organics, sulfide, or similar analyses are normally collected as discrete aliquots and should be containerized as soon as possible after collection and prior to compositing and homogenization. Field personnel must maintain an awareness of the soil sample volume collected versus the volume required to meet program/project DQOs.

Maintaining sample integrity requires selecting a soil sampling device and procedure that meets project DQOs. Carefully following procedures minimizes the disruption of the soil structure and subsequent changes in physiochemical and biological characteristics.

Continuous flight augers are satisfactory for use when a composite of the soil column is desired.

If a powered auger is used, if possible, position the power unit downwind of the sample location to avoid fumes from fuel used to power the unit.

At sites with known or suspected contamination, based on the data available, samples are collected moving from least to most contaminated soil.

Re-use of equipment may be unavoidable given size and cost. Decontamination matched to DQOs is specified in the project planning documents.

Experience has shown that real-world conditions (e.g., variable soil conditions such as the presence of rocks or trash) may lead to unacceptable soil sample recoveries and multiple attempts to collect soil samples will be required at some locations.

Abandon auger and/or core holes according to applicable regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

Standard measures, such as the use of disposable gloves, that meet project DQOs, are used to avoid cross contamination of samples.

As with all intrusive sampling work, project planning should address the potential for encountering subsurface "utilities" and the measures to be taken to avoid problems in the field.

5 Equipment and Supplies

The equipment and supplies required for field work depend on the program/project DQOs. The following is a general list of equipment and supplies. A detailed list of equipment and supplies should be prepared based on the project planning documents. In general, the use of dedicated or disposal equipment is preferred but equipment may be re-used after thorough decontamination between sample locations (refer to E & E Sampling Equipment Decontamination SOP ENV 3.15).

- Stainless-steel or Teflon™ spoons, trowels, or scoops. Other construction material may be acceptable depending upon the program/project planning documents and DQOs
- Stainless-steel mixing bowls. Other bowl construction material may be acceptable depending upon the program/project planning documents and DQOs
- Hand-driven bucket/continuous flight auger(s), split core sampler(s), and single or multistage core sampler(s)
- Rubber mallet or T-bar to help drive hand augers
- Powered auger(s)
- Spade(s) and/or shovel(s)
- Liners and/or catchers for augers or core samplers as specified in the project planning documents
- Pipe cutter(s), stainless steel knives(s), or power saw to cut liners
- Survey stakes or flags to mark locations
- Ancillary equipment and supplies, e.g., meter stick or tape measure, aluminum foil, plastic sheeting, disposable gloves

Supporting equipment and supplies also may be required to address the following:

- Field logbooks and supplies (Refer to project planning documents and the E & E Field Activity Logbooks SOP DOC 2.1 for details)
- Decontamination equipment and supplies (Refer to project planning documents and E & E Sampling Equipment Decontamination SOP ENV 3.15for details)
- Sample containers, preservatives, and shipping equipment and supplies (Refer to project planning documents and the E & E Environmental Sample Handling, Packaging and Shipping SOP ENV 3.16 for details)
- Waste handling supplies (Refer to project planning documents and E & E Handling Investigation-Derived Wastes SOP ENV 3.26 for details)

6 Procedures

E & E staff will use the following procedures for completing soil sampling:

- Review relevant project planning documents, e.g., work plan, sampling and analysis plan, quality assurance project plan, health and safety plan, etc.
- Select the sampling procedure(s) that meet project DQOs.
- Refer to the E & E Field Activity Logbooks SOP DOC 2.1 for guidance on the types of information that should be recorded for each sample.
- Refer to the E & E Environmental Sample Handling, Packaging and Shipping SOP ENV 3.16 for guidance on how samples should be labeled, packaged, and shipped.

6.1 Hand Scoop Surface and Subsurface Soil Sampling

- Surface and shallow subsurface soil samples may be collected by hand using scoops.
- Pre-cleaned spoons, trowels, or scoops are used to excavate shallow soil.
- Sample collection intervals are identified in the project planning documents.
- Clear the area to be sampled of surface debris (e.g., twigs, rocks, and litter).
- Carefully remove the top layer of soil to the desired sample depth with a precleaned tool.
- When sampling from the sides or bottom of an excavation, use a pre-cleaned, scoop, spoon, or trowel to remove and discard the thin layer of soil from the area that came into contact with the shovel or spade.
- Collect sufficient sample volume to meet the DQOs identified in the project planning documents
- Place aliquots to be analyzed for volatile organic analytes and/or sulfides directly into sample containers (i.e., prior to homogenization). Procedures for collecting soil samples for VOC analyses are presented in the (see E & E VOC Soil and Sediment Sampling SOP ENV 25).
- Empty hand-collected samples into a pre-cleaned stainless steel bowl (or other type as specified in the project planning documents).
- If multiple hand collected samples are necessary to collect adequate sample volume, they should all be combined in the bowl prior to homogenization.
- Homogenize the sample(s) as thoroughly as possible.
- Transfer sample aliquots to appropriate sample containers and preserve as required in the project planning documents.
- Return unused soil to the excavation, level the area, replace grass turf as necessary.

6.2 Subsurface Soil Sampling with a Soil Core Samplers

This system consists of pre-cleaned corer barrels (with liners and liner caps, as appropriate), caps, core tips, and slide hammer. The dimensions of the core barrel define the volume and depth interval of possible sample collection. Core sampling is recommended if accurate resolution of sample depths is a DQO. Hand coring will generally be limited to 2-inch diameter – 3 foot (1 meter) long samples.

There are a variety of manual soil core sampling devices available for collecting undisturbed soil core samples. Split core, single core, and multistage core samplers may be used with or without liners that are used to avoid contact between the soil and the corer.

The following procedures are used for collecting soil samples with the soil core sampler:

- Assemble the soil core sampler based on manufacturer instructions and project DQOs (e.g., using a liner and/or catcher).
- Clear the area to be sampled of surface debris (e.g., twigs, rocks, and litter).
- Using the slide hammer or sledge hammer or pounding sleeve, begin driving the pre-cleaned corer into the soil until the desired upper sampling depth is reached.
- Carefully retrieve the corer from the boring.
- Decontamination or replace the core barrel with a pre-cleaned core barrel and resume coring. See E & E Sampling Equipment Decontamination SOP ENV 3.15 for decontamination procedures.
- Soil cores should be extruded or split as soon as possible following collection.
    - Place core barrel or liner on clean surface
    - Carefully remove end caps and/or catchers
    - Evaluate compaction (core length versus depth of penetration)
    - For transverse sectioning, beginning at the soil surface, measure and mark the sample sections on the outside of the liner
        - Cut the liner with a manual pipe cutter or core liner and core with a decontaminated saw blade into marked sections.
        - Extrude the soil from the cut segments of the liner. If necessary use a plunger cover with aluminum foil to aid in extruding the core.
        - Empty the core segment into a stainless steel bowl (or other type as specified in the project planning documents).
        - Record observations of the soil types.
        - Immediately collect volatile organic analyte and sulfide samples.
    - For longitudinal sectioning, open the split tube or use a knife to cut the liner and expose the upper half of the soil cylinder.
        - Beginning at the soil surface, measure and mark the sample sections using a tape measure set aside the core.
        - Record observations of the soil types.
        - Immediately collect volatile organic analyte and sulfide samples.
        - Scope the core segment into a stainless steel bowl (or other type as specified in the project planning documents).
- If multiple core segments are necessary to collect adequate sample volume, they should all be combined in the bowl prior to homogenization
- Homogenize the sample as thoroughly as possible

- Transfer sample aliquots to appropriate sample containers and preserve as required in the project planning documents.
- Return unused soil to the boring, level the area, replace grass turf as necessary.

6.3 Subsurface Soil Sampling with Bucket Augers

This system consists of pre-cleaned bucket augers, a series of extensions, and a T-handle. The dimensions of the bucket define the volume and depth interval of possible sample collection. The following procedures are used for collecting soil samples with the bucket auger:

- Attach the bucket auger bit to a drill rod extension, and attach T-handle to the drill rod.
- Clear the area to be sampled of surface debris (e.g., twigs, rocks, and litter).
- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole until the desired upper sampling depth is reached.
- Decontaminate the bucket auger or replace the bucket auger with a pre-cleaned auger bucket and resume augering. After reaching the desired depth (no more than the maximum length of the auger bucket), carefully remove the auger from the boring.
- Empty bucket auger-collected samples into a pre-cleaned stainless steel bowl (or other type as specified in the project planning documents) OR use pre-cleaned scoops and carefully subsample soil from within the bucket that has not come in contact with the auger.
- Immediately collect volatile organic analyte and sulfide samples.
- If multiple bucket auger collected samples are necessary to collect adequate sample volume, they should all be combined in the bowl prior to homogenization.
- Homogenize the sample(s) as thoroughly as possible.
- Transfer sample aliquots to appropriate sample containers and preserve as required in the project planning documents.
- If another sample is to be collected in the sample hole, but at a greater depth, decontaminate or re-attach a pre-cleaned auger bucket, and follow steps above.
- Return unused soil to the excavation, level the area, replace grass turf as necessary

6.4 Subsurface Soil Sampling with Continuous Flight Augers

This system consists of pre-cleaned continuous flight augers, a series of extensions, and a T-handle. The dimensions of the flight define the volume and depth interval of possible sample collection.

When continuous flight augers are used, the sample can be collected directly off the flights. Continuous flight augers are satisfactory for use when a composite of the soil column is desired.

A powered auger may be used at this time. The following procedures are used for collecting soil samples with an auger:

- Attach the continuous flight auger to a drill rod extension, and attach T-handle to the drill rod.
- Clear the area to be sampled of surface debris (e.g., twigs, rocks, and litter).

- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole until the desired upper sampling depth is reached.
- Decontaminate or replace the auger flight with a pre-cleaned auger flight and resume augering. After reaching the desired depth (no more than the maximum length of the auger flight), carefully remove the auger from the boring.
- Place auger-collected samples into a pre-cleaned stainless steel bowl (or other type as specified in the project planning documents) OR use pre-cleaned scoops and carefully subsample soil from within the auger flights as it comes to the surface.
- Immediately collect volatile organic analyte and sulfide samples.
- If multiple auger flight-collected samples are necessary to collect adequate sample volume, they should all be combined in the bowl prior to homogenization
- Homogenize the sample(s) as thoroughly as possible.
- Transfer sample aliquots to appropriate sample containers and preserve as required in the project planning documents.
- If another sample is to be collected in the sample hole, but at a greater depth, decontaminate or re-attach a pre-cleaned auger flight, and follow steps above.
- Return unused soil to the excavation, level the area, replace grass turf as necessary.

7 Quality Assurance/Quality Control

Prior to initiating field work, the project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, SHASP, *et al*) should be reviewed by field personnel to identify sampling procedure(s) that will most likely provide surface and shallow subsurface soil samples that meet project DQOs.

The program/project manager should identify personnel for the field team who have knowledge, training and experience in the field soil sampling activities being conducted. One member of the field team should be designated as the lead for soil sampling and will be responsible, with support from other field personnel, for implementing the procedures in this SOP. The program/project manager should also identify additional personnel, if necessary, to complete ancillary procedures, e.g., field logbook documentation, equipment decontamination, sample shipment, and waste disposal.

The soil sampling lead should prepare a detailed equipment checklist before entering the field and verify that sufficient and appropriate equipment and supplies are taken into the field.

Quality assurance/quality control samples (e.g., co-located samples) are collected according to the site quality assurance project plan. Field duplicates are collected from one location and treated as separate samples. Field duplicates are typically collected after the samples have been homogenized. Collocated samples are generally collected from nearby locations and are collected as completely separate samples.

In cases where multiple hand-collected scoop, auger or core samples are required to generate an adequate sample volume, homogenization is important. Field personnel should collect sample aliquots only after mixing has produced soil with textural and color homogeneity.

At sites with known or suspected contamination, samples should be collected moving from least to most contaminated areas.

8 Health and Safety

Prior to entering the field, all field personnel formally acknowledge that they have read and understand the project specific health and safety plan.

Augers and soil core sampling apparatus are inherently dangerous pieces of heavy equipment which a high "pinch" potential. Care should be taken at all times when handling such equipment, not just during sample collection.

Prior to any subsurface work, verify that underground utilities have been located and marked.

9 Special Project Requirements

Project or program-specific requirements that modify this procedure should be entered in this section and included with the project planning documents.

10 References

The following list sources of technical information on soil sampling.

Barth, D. S. and B. J. Mason, 1984, *Soil Sampling Quality Assurance User's Guide*, EPA-600/4-84-043.

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END OF SOP

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STANDARD OPERATING PROCEDURE

SAMPLING AND FIELD EQUIPMENT DECONTAMINATION

SOP NUMBER: ENV 3.15

REVISION DATE: 6/30/2017 **SCHEDULED REVIEW DATE: 6/30/2022**

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1 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures used by E & E for decontaminating sampling and other field equipment to 1) minimize sample cross-contamination and 2) promote health and safety by preventing the transfer of site contaminants to other locations. This SOP is applicable to the decontamination of equipment that will be re-used in the field and equipment that will be returned to a rental vendor, subcontractor (e.g., drilling equipment), warehouse, or other facility prior to re-use.

Project-specific data quality objectives (DQOs) dictate the scope and goals of the field investigation, including the sampling design, which further dictate the types of sampling and other field equipment needed for a project. Project planning documents will identify the site-specific decontamination procedures. This SOP applies to equipment routinely used for:

- Water sampling (e.g., buckets, bailers, pump, and tubing);
- Flow/water depth measuring (e.g., velocity meters, stream gauges, and depth sounders);
- Soil and sediment sampling (e.g., corers, augers, trowels, shovels, scoops, direct-push samplers, homogenization buckets, and mixing tools);
- Field and sampling support (e.g., tapes/rulers/meter sticks, tools); and
- Ambient monitoring and sampling (e.g. dust monitors, vapor monitors, air samplers, radiation monitors).

Decontamination of reusable sampling equipment can be time-consuming and costly and may require additional sampling and analyses to verify the effectiveness of decontamination procedures (e.g., rinsate blanks) and/or determine the content of generated decontamination waters. The use of dedicated or clean disposable equipment (e.g., Teflon or plastic bailers for groundwater sampling, aluminum bowls for soil homogenization) is typically preferred, when practicable (assuming that the disposable equipment does not eventually have to be handled as a hazardous waste).

This SOP does not address decontamination of protective clothing or personnel, which will be addressed in the site-specific health and safety plan (SHASP) developed for the fieldwork. This SOP also does not address decontamination for biohazards, reactive or explosive materials, or prolonged exposure to a contaminant; or decontamination necessary to result in ultra-clean sampling equipment required for the investigation and analysis of very low levels of certain environmental contaminants.

This SOP is intended for use by personnel who have knowledge, training, and experience in the field activities being conducted and who understand the importance of decontamination in meeting project-specific DQOs.

2 Definitions and Acronyms

ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
Deionized water	Purified water produced by filtration through deionizing columns or other similar means, which removes charged particles and mineral ions

Distilled water	Purified water produced by distillation, which removes minerals, salts, particulates, and certain other impurities
DQO	Data quality objective
E & E	Ecology and Environment, Inc.
EPA	(U.S.) Environmental Protection Agency
Potable water	Water from a treated municipal or industrial drinking water distribution system
QA	Quality assurance
QC	Quality control
SHASP	Site-specific health and safety plan
SOP	Standard operating procedure

3 Procedure Summary

Equipment decontamination procedures vary depending on the DQOs identified in the project planning documents. These planning documents will identify the types and levels of contamination anticipated, specify appropriate decontamination procedures and supplies, and address the handling of investigation-derived waste.

A typical hazardous waste site will have a specific location for decontamination activities in an area designated as the contamination reduction zone.

Several different procedures are presented for the decontamination of equipment. In general, equipment that is in direct contact with collected samples will be washed with a detergent solution followed by a series of rinses with decontamination agents and water. Equipment that is not in direct contact with material that is sampled will be washed or wiped clean and rinsed with water. These procedure can be expanded to include additional or alternate wash/rinse steps designed to remove specific target analytes/compounds, if required by site-specific work plans or as directed by a particular client.

4 Cautions

The decontamination of field and sampling equipment will generate one or more waste streams, some of which could be potentially hazardous waste. All wastes will be handled in accordance with E & E SOP ENV 3.26, Handling Investigation-Derived Wastes, as well as project planning documents.

Decontamination agents, including water, detergents, acids, and solvents, can be potentially damaging to some equipment and instrumentation. Care should be taken to ensure that the decontamination process is compatible with the equipment/materials being decontaminated.

Decontamination agents, including waters, detergents, acids, and solvents, must be stored in their original containers or in clearly marked secondary containers onto which information from the original label has been transferred. The secondary labeling should include reagent name, source, date opened/transferred, and expiration date, as well as any applicable hazardous labels, and should be consistent with the Occupational Safety and Health Administration Hazard Communication standard in 29 Code of Federal Regulations (CFR) 1200.

5 Equipment and Supplies

Project planning documents will provide direction on specific decontamination equipment and supplies. The following equipment and supplies are commonly used for the routine decontamination of sampling and field equipment for a broad-scale field sampling program:

- Galvanized steel or similar wash basins;
- Plastic buckets (5-gallon);
- Long-handled brushes;
- Spray/squeeze bottles;
- Non-phosphate detergent (e.g., Alconox™ or Liquinox™);
- Pesticide-grade (or equivalent) organic solvents (e.g., methanol, hexane, or other) as specified in the planning documents;
- Ten percent, by volume in deionized water, nitric acid (ultrapure) (used when metals are a target field analyte);
- Potable water;
- Deionized water (e.g., American Society for Testing and Materials [ASTM] Type II);
- Organic-free water;
- Plastic sheeting for ground cover;
- Paper towels;
- Aluminum foil;
- Trash bags;
- Waste collection drums (if required);
- Protective clothing appropriate for conducting decontamination (including safety glasses or splash shield, splash apron, and nitrile or neoprene gloves); and
- Decontamination verification supplies (e.g., samples bottles for equipment rinsate blank collection, wipes for wipe sampling).

6 Procedure

6.1 General Decontamination Considerations

To minimize decontamination, E & E personnel should follow best practices to minimize contamination of equipment and cross-contamination of cleaned equipment. Measures to minimize contamination include:

- Designate an exclusion zone that isolates areas of contamination from clean areas of the site. Between the exclusion zone and support zone, a contamination reduction zone should be established, within which decontamination activities will be conducted;
- Employ work practices that minimize contact with hazardous or toxic substances (e.g., avoid areas of obvious contamination, avoid touching potentially contaminated materials);

- Use plastic to cover certain parts of monitoring and sampling equipment;
- Use disposable protective apparel and disposable sampling equipment;
- Keep contaminated and uncontaminated equipment and supplies segregated from each other;
- Ensure that decontamination wastes and other investigation-derived wastes are appropriately contained and containerized;
- Use disposable towels to clean the outer surfaces of sample bottles after sample collection; and
- Enclose sources of contamination in plastic sheeting or other barriers.

Because some practices to minimize decontamination can result in more waste to manage (e.g., using disposable sampling implements), it is important to balance decontamination and waste management plans and procedures. The proper balance will be driven by the field investigation tasks and the nature of the contaminants on site.

Potable water, which can be used for certain decontamination steps, can be obtained from a municipal or treated water system. The use of an untreated water supply is not an acceptable substitute for potable water.

The use of distilled, deionized, or ultrapure water is typically acceptable for decontamination of sampling equipment provided that the water has been verified by laboratory analysis to be analyte-free. Analyte-free water is commonly available from commercial vendors and sometimes can be obtained from the project analytical laboratory. Distilled or deionized water available from local grocery stores and pharmacies is generally not acceptable for final decontamination rinses. Analyte-free water that has been stored in unsealed containers or stored at a contaminated site for a prolonged time period also should not be used for final decontamination rinses because the water could have absorbed atmospheric contaminants over time.

The use of solvent rinses (e.g., hexane, methanol, acetone, nitric acid) as part of a decontamination protocol must balance the goals of the decontamination (i.e., to effectively remove the site contaminant as well as other contaminants with the potential to cross-contaminate the investigative samples) with the potential detriment of introducing a contaminant similar to that being investigated (e.g., using hexane as a decontamination solvent would not be advised if hexane is a site contaminant of interest).

6.2 Decontamination Procedure for Equipment in Direct Contact with Sample

Routine decontamination steps for equipment that directly contacts samples are described below.

1. Physically remove gross contamination from equipment by abrasive scraping and/or brushing.
2. Wash equipment with non-phosphate detergent (e.g., Alconox™ or Liquinox™) in potable water.
3. Rinse equipment with potable water.
4. Rinse equipment with deionized water.
5. Decontamination step if sampling/analyzing for metals:

   a. If specified in project planning documents, rinse with 10% nitric acid solution. Nitric acid solution is made from reagent grade nitric acid and deionized water. If equipment is comprised of low-carbon steel, then a 1% nitric acid solution would typically be used.

   b. Rinse equipment with deionized water (a water rinse should always follow an acid rinse).

6. Decontamination step if sampling/analyzing for high levels of organic constituents:

   a. If specified in project planning documents, rinse with specified organic solvent. In general, use a methanol rinse to dissolve and remove soluble (polar) organic contaminants for high-concentration samples, and use a hexane rinse to dissolve and remove waste lubricating oils, tars, and bunker fuels (non-polar organics) for high-concentration samples.

   b. Rinse equipment with deionized, organic-free water,

7. Air dry the equipment.

8. If a rinsate blank sample is specified in project planning documents for verification of decontamination effectiveness, the sample should be collected from sampling equipment at this step.

9. Air dry the equipment again if necessary.

10. Wrap decontaminated equipment in aluminum foil or plastic if the equipment will not be used immediately. Determine the best material to wrap equipment with based on the site contaminants of interest (e.g., the use of plastic would be minimized if sampling for volatile and extractable organics).

11. Containerize decontamination wastes that require testing and/or regulated disposal. Dispose of all wastes in conformance with applicable regulations as defined in the project planning documents.

6.3 Decontamination Procedure for Pumps and Water Quality Meters

Pumps and meters with internal parts that come into direct contact with samples often cannot be thoroughly or directly decontaminated. Consult the manufacturer's guidelines before decontaminating such equipment, to safeguard against damaging it. General decontamination steps are described below.

1. Physically remove visible contamination from equipment by brushing the outside of the equipment or wiping with a dry or damp paper towel.

2. Rinse with or pump acceptable decontamination agents through the equipment.

3. Rinse with or pump potable water through the equipment.

4. Rinse with or pump deionized water through the equipment..

5. Air dry the equipment.

6. If exterior surfaces have not been in direct contact with sample, follow the decontamination procedure described in Section 6.4.

7. If a rinsate blank sample is specified in project planning documents for verification of decontamination effectiveness, the sample should be collected from the equipment at this step.

8. Air dry the equipment again if necessary.
9. Wrap decontamined equipment in aluminum foil or plastic if the equipment will not be used immediately. Determine the best material to wrap equipment with based on the site contaminants (e.g., the use of plastic would be minimized if sampling for volatile and extractable organics).
10. Containerize decontamination wastes that require testing and/or regulated disposal. Dispose of all wastes in conformance with applicable regulations as defined in the project planning documents.

6.4 Decontamination Procedure for Equipment Not in Direct Contact with Sample

Field equipment that does not come into direct contact with samples may be potentially contaminated by exposure to contaminants in dust, by inadvertent contact with contaminated materials, or otherwise. Such equipment could include ambient and air monitoring instruments, tools, generators, computers, and other reusable supplies. In this case, the goal of the decontamination is to remove the site contaminant for health and safety reasons; potential cross-contamination of samples caused by improper decontamination is not a concern. Because this type of equipment often cannot be thorough or directly decontaminated with standard decontamination agents or methods, consideration should be given to discarding the equipment if there is any question regarding whether the decontamination described below is adequate. Consult the manufacturer's guidelines before decontaminating such equipment, to safeguard against damaging it. General decontamination steps are described below.

1. If equipment has tubing or other removable or disposable components (such as with air monitors), they should be removed if practicable and handled separately from the rest of the equipment. It may be possible to thoroughly decontaminate separate parts using the steps in Sections 6.2 or 6.3, or discard them as contaminated waste.
2. Physically remove visible contamination from the outside of the equipment by brushing it or wiping with a dry or damp paper towel.
3. Wash any watertight parts with detergent and water as described in Sections 6.2 and 6.3.
4. Air dry the equipment.
5. Use canned air to dust off computer keyboards and other electronics.
6. Containerize decontamination wastes that require testing and/or regulated disposal. Dispose of all wastes in conformance with applicable regulations as defined in the project planning documents.

6.5 Decontamination Procedure for Heavy Equipment

For heavy equipment such as drill rigs, excavators, loaders, and direct-push technology samplers, a decontamination pad should be established by the subcontractor. Decontamination of heavy sampling equipment (e.g., augers, split spoon samplers) typically includes a steam cleaning and/or high-pressure water wash step after gross contamination is removed by detergent and brushing. Equipment should be final-rinsed and air dried. If a wipe or rinsate sample is specified in project planning documents for verification of decontamination effectiveness, the sample should be collected from equipment after these steps.

6.6 Decontamination Procedure for Equipment at a Radiation Site

For equipment used at sites where radioactive materials are contaminants of concern, the decontamination steps are similar to those described in Sections 6.2 through 6.5, with a few special considerations. Radiation contamination monitoring is used to help locate contamination and guide the success of the decontamination process. The liberal use of water as a decontamination agent is often minimized, where practicable, because of the expense that can be incurred with disposing of radioactively contaminated decontamination water. Containerized decontamination wastes must be evaluated for radioactive content and disposed of appropriately depending on their content. Specific requirements will be included in the project planning documents.

7 Quality Assurance/Quality Control

Prior to inititating fieldwork, the project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, and SHASP) will be reviewed by field personnel to understand the equipment decontamination procedures that have been specified to meet project DQOs. The project planning documents will define the quality assurance/quality control (QA/QC) procedures necessary to meet project DQOs, including the collection of equipment rinsate blanks and similar QC samples intended to evaluate the effectiveness of decontamination. An equipment rinsate blank typically consists of passing analyte-free water through or over a fully decontaminated sampling device, collecting that water, and analyzing it to assess whether the specified decontamination steps thoroughly removed contaminants of interest and confirm that samples are not being cross-contaminated from unclean equipment.

In cases where it is not feasible to pass water through or over a sampling device or piece of equipment, a wipe sample can be used. A wipe sample typically consists of an analyte-free absorbent material like paper, cloth, glass fiber material, or filter paper that is wiped over the decontaminated surface and analyzed to evaluate the effectiveness of decontamination.

8 Health and Safety

Prior to entering the field, all field personnel will acknowledge in writing that they have read and understand the SHASP, which will be in compliance with the Corporate Health and Safety Program.

Unique hazards associated with decontamination activities include the use of hazardous decontamination agents, the use of steam or high-pressure water cleaning systems, working around heavy equipment (pinch or crush potential), and the generation of potentially hazardous wastes.

Exposure to hazardous decontamination agents is controlled by practices such as contamination avoidance, the use of appropriate personal protective equipment, and proper handling and storage of the agents and wastes, as specified in the SHASP and other project planning documents.

Safety Data Sheets should be available on site for all hazardous decontamination agents, in accordance with the requirements of 29 CFR 1200, Hazard Communication.

Decontamination procedures that employ steam or high-pressure water systems must be performed following equipment manufacturer's operating and safety guidelines. Care must be taken when working around and decontaminating heavy equipment, especially equipment that is

in motion while entering/exiting the contamination reduction zone or while being cleaned (e.g., when ensuring that all parts of the equipment are decontaminated).

9 Special Project Requirements

Project-specific requirements will be included in the project planning documents.

10 References

American Socity for Testing and Materials. 2015. Standard Practice for Decontamination of Field Equipment Used at Waste Sites. ASTM D5088-15a. West Conshohocken, Pennsylvania.

United States Department of Defense. 2013. *DoD Environmental Field Sampling Handbook.* Revision 1.0. April 2013.

United States Environmental Protection Agency (EPA). Sampling Equipment Decontamination. SOP# 2006, REV.# 0.0. August 11, 1994. Environmental Response Team.

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END OF SOP

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STANDARD OPERATING PROCEDURE

SAMPLE HANDLING, PACKING, AND SHIPPING

SOP NUMBER: ENV 3.16

REVISION DATE: 2/28/2018 **SCHEDULED REVIEW DATE: 2/28/2023**

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1 Scope and Application

This Standard Operating Procedure (SOP) describes the handling, packing[1], marking, labeling, and shipping procedures routinely used by E & E field personnel to ship samples from the field to off-site laboratories. Shipping includes transport by air, motor vehicle, or rail.

Samples collected of the following matrices typically would be classified as nonhazardous samples (commonly called "environmental samples"):

- Drinking water, groundwater, and surface water;
- Soil and sediment;
- Air;
- Treated municipal and industrial effluent; or
- Biological specimens (e.g., non-pathogenic plant or animal tissue).

Samples collected from drums, storage tanks, impoundments, and lagoons; from known or suspected contaminated areas; and of leachate may potentially need to be classified as hazardous samples.

This SOP does not address sample collection, which is addressed in other E & E SOPs, and assumes that properly collected, filtered (as applicable), preserved, and labeled samples are presented for shipment.

This SOP also does not address the specific procedures for packing, marking, labeling, documenting, and shipping hazardous samples as United States Department of Transportation (DOT) hazardous materials or International Air Transport Association (IATA) dangerous goods, and directs the reader to E & E's Hazardous Materials/Dangerous Goods Shipping Manual for those steps. The project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, and site-specific health and safety plan (SHASP) will address the types and degrees of contamination anticipated and also might address certain handling and shipping procedures.

This SOP is intended for use by personnel who have knowledge, training, and experience in the procedures described herein.

E & E SOP DOC 2.1, Field Activity Logbooks, also would typically apply to sample handling, packing, and shipping.

2 Definitions and Acronyms

APHIS	Animal and Plant Health Inspection Service
^{o}C	degrees Celsius
CLP	Contract Laboratory Program
COC	Chain of custody

[1] Although some common vernacular might be to "package" samples, the term "pack" samples is used in this SOP: 1) for alignment with the reference SOPs used to develop this SOP, and 2) to prevent confusion with the definitions in hazmat transport regulations for "packaging," which is the receptacle used to contain a hazardous material, and "package," which is the packaging plus its contents.

DOT	(United States) Department of Transportation
DQO	Data quality objective
EPA	(United States) Environmental Protection Agency
IATA	International Air Transport Association
QA/QC	Quality assurance/quality control
RHTC	Regional Hazmat Transportation Coordinator
SHASP	Site-specific health and safety plan
SOP	Standard operating procedure
USDA	United States Department of Agriculture
VOA	Volatile organic analysis

3 Procedure Summary

Properly preserved, containerized, and labeled samples provided by field personnel are maintained under secure custody during sample handling, packing, and shipping. Samples presented for shipment are sealed in plastic bags and secured in a plastic-lined cooler. Double-bagged ice is added to the cooler for samples requiring cold preservation. A chain-of-custody (COC) form is completed in full, carefully cross-checked with the samples in the cooler, and enclosed in the cooler. Shipping papers are completed and attached to the cooler, which is custody-sealed and taped closed. The E & E project manager and designated analytical laboratory are notified daily of impending shipments.

4 Cautions

Cautions related to health and safety are discussed in Section 8.

In order to ship hazardous samples, E & E personnel must have received training consistent with the requirements in Title 49 of the Code of Federal Regulations Part 172 (49 CFR 172) Subpart H. If the samples will be shipped by air, E & E personnel also must have received training consistent with Section 1.5 of the IATA Dangerous Goods Regulations. E & E provides this training to applicable employees. The training includes instruction in the use of E & E's on-line Hazardous Materials/Dangerous Goods Shipping Manual and the role of E & E Regional Hazmat Transportation Coordinators (RHTCs), who provide technical support for hazardous sample shipping. This SOP does not specifically address the requirements to properly pack and ship samples that are a hazardous material/dangerous good.

Soil samples from foreign countries, United States (U.S.) territories (i.e., Puerto Rico, U.S. Virgin Islands, and North Mariana Islands), Hawaii, and certain parts of the U.S. fall under federal quarantine as authorized under 7 CFR 301 and are regulated by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS). Some areas in the U.S. also are under state or local agricultural quarantine. Soils from these regulated areas may contain bacteria, viruses, fungi, nematodes, invertebrates, or seeds of undesirable plant species that could be harmful to U.S. agriculture or natural resources. The movement of these soils within the continental U.S. is regulated under 7 CFR 330.300, which may impose additional special handling, packing, and shipping requirements. Although the general packing for environmental samples likely will suffice, APHIS may have additional requirements, such as for the use of specialized electronic barcoded shipping labels. The project team should refer to the

USDA APHIS and analytical laboratory requirements before handling, packing, and shipping such samples.

International shipping requirements will apply to samples shipped to or from foreign countries and are not addressed by this SOP.

5 Equipment and Supplies

Project planning documents will provide direction on specific equipment and supplies. The following equipment and supplies are commonly used to handle, pack, and ship samples that are presented for shipment:

- Filtered (as necessary), preserved, containerized, and labeled samples, prepared by the field team;
- Coolers, custody seals, and COC documentation forms (typically provided by the laboratory);
- Electrical tape, clear tape, duct tape, and fiber-reinforced packing tape (strapping tape);
- Resealable plastic bags, typically 1-gallon and 2-gallon sizes; freezer-style is preferable because they are thicker;
- Large plastic bags or drum liners, to line coolers;
- Shock-absorbing packing material (e.g., foam block, bubble wrap);
- Packaged ice (commercially available, typically in sizes such as 7-pound and 20-pound bags); and
- Shipping documentation, consisting of an air waybill (air transport) or bill of lading (ground transport).

6 Procedure

6.1 Prior to Field Activity

The following activities are performed prior to field mobilization.

1. Team personnel will assemble and stage equipment and supplies needed to handle, pack, and ship samples;
2. Temperature blanks (typically tap water-filled 40-milliliter volatile organic analysis [VOA] vials or other containers specified in the sampling and analysis plan) will be prepared for use in the field;
3. The project manager or designee will determine the best mode of transportation and verify available locations and pickup/delivery schedules; and
4. The project manager or designee will coordinate with the assigned analytical laboratory regarding schedule and availability to receive and log in the shipped samples. Laboratory receipt of samples on a weekend or holiday will require additional coordination with the laboratory.

6.2 Sample Custody

Collected samples must be either in the custody of responsible personnel or sealed and secured if samples are being stored or transported. Samples are considered to be secure if they are in a locked area with controlled access or when being transported by approved field personnel, a commercial carrier (such as FedEx or UPS), or an approved courier.

A COC form is used to document who has custody of a sample, when, and any exchange of sample custody between the field, shipper/transporter, and laboratory. The COC form also documents sample information and analysis requirements. The final signed COC form becomes the permanent record for sample collection, requested analyses, and custody for each collected sample.

A custody seal is a specialized adhesive label or tape that is used to seal sample containers and the shipment packaging, which for samples is typically a cooler. Custody seals must be affixed such that the seal will be visibly broken if the containers or cooler are opened or tampered with. An intact custody seal means that the samples and their shipping container have not been accessed during storage or shipping. When the laboratory logs in the samples, they will report the condition of the custody seals on the COC or otherwise in the laboratory analytical report.

6.3 Determining Whether Samples are Hazardous

Trained and competent field personnel (see Section 4) will determine if the samples could be considered to contain hazardous materials (dangerous goods) according to U.S. DOT and/or IATA regulations. If so, the samples will be packed, marked, labeled, documented, and shipped in accordance with those regulations. E & E's online Hazardous Materials/Dangerous Goods Shipping Manual provides guidance concerning shipping hazardous samples, and E & E's RHTCs should be consulted during the process.

Types of samples that likely would be classified as hazardous materials/dangerous goods include:

- Samples collected from waste lagoons, drums, tanks, heavily stained soils, and groundwater contaminated with a non-aqueous phase liquid;
- Known or suspected polychlorinated biphenyl- or dioxin-containing samples;
- Samples preserved with methanol, such as from using a Terra Core™ kit (although such samples can be shipped as an excepted quantity of hazardous material, which has some less rigorous shipping requirements); and
- Some biological specimen samples, such as those known or suspected to contain an infectious agent.

Water samples preserved with acids or bases typically will not be considered hazardous materials/dangerous goods. (The containers of acid or base preservatives themselves would be a hazardous material/dangerous good.)

6.4 Environmental Sample Packing

It is E & E's intent to pack samples securely to prevent damage and leakage during shipment. This is to prevent the loss of samples and the expenditure of funds to re-obtain the samples or for potential emergency response to a leaking package or spill. Liquid samples are particularly vulnerable. Even if a package is classified and transported as a nonhazardous material, transporters (carriers) are not able to know the difference between a package leaking distilled

water and a package leaking a hazardous chemical and may react to a spill in an emergency fashion, potentially causing expense to E & E or its clients for the cleanup of the sample material. Therefore, samples are packed in plastic bags with the use of shock-absorbent/cushioning material to help prevent leaking of samples both inside and outside the transport package.

Environmental samples will be packed securely whether the samples are shipped via commercial carrier or courier. Environmental samples are usually shipped in 80-quart, solid outer-shell plastic or metal coolers, although other size coolers may be used if they meet project needs. Disposable, pressed Styrofoam™ coolers must not be used to store or ship samples.

Initial Steps

1. Remove non-applicable labels from the cooler.
2. Seal the cooler drain hole with duct tape or equivalent both inside and outside the cooler to prevent leakage.
3. Assemble the containerized samples that will be shipped in the cooler.
4. Ensure that the sample containers are clean, dry, and labeled (wipe container with a paper towel if the container is not clean or dry).
5. Verify that sample container caps/lids are tight.
6. Apply a custody seal over the cap/lid and then secure the custody seal and cap/lid to the container using fiber-reinforced tape, electrical tape, or equivalent. Do not obscure the sample label with the custody seal or tape.
7. Ensure that each container is fully documented on the COC form. COC forms may be completed electronically or by hand depending on project requirements. E.g., EPA Contract Laboratory Program (CLP) sampling/analysis may require electronically generated and completed COC forms.
8. Place each sample container into a resealable plastic bag.
9. Place at least 1 inch of inert shock-absorbent material (e.g., bubble wrap) in the bottom of the cooler.
10. Line the cooler with a heavy-duty plastic trash bag or drum liner.
11. For samples requiring cold preservation:
    a. Maintain the samples on ice during sample handling and packing.
    b. Fill resealable plastic bags with ice and enclose each bag in a second resealable plastic bag such that the ice is double-bagged. These bags of ice will be needed for the cooler.

Securing Sample Containers in the Cooler

1. The sample containers themselves will typically be secured inside the cooler using one of the following methods intended to prevent container damage or breakage.
    a. Pre-cut foam block insert:
        i. Place the foam block insert (with holes cut for the sample containers) inside the plastic bag.
        ii. Place the containers upright in the holes in the foam block.

b. Bubble wrap or equivalent:

   i. Surround each sample container (including the bottom) with bubble wrap, taping the wrap securely around the container; or place the container in a bubble bag. (Some personnel opt to surround the sample container with bubble wrap before placing the sample container in its resealable bag.)

   ii. Place the containers upright in the plastic bag.

   iii. Fill void spaces with additional bubble wrap or other shock absorbent.

c. Loose material that provides shock absorption and liquid absorption (e.g., small animal bedding material made from recycled paper/wood waste):

   i. Place at least 1 inch of the absorbent material in the bottom of the plastic bag lining the cooler.

   ii. Place each sample container upright inside the plastic bag, maintaining about 3 inches between containers.

   iii. Fill the void spaces around the containers with absorbent to at least half the height of the largest container.

2. For liquid samples packed by methods 1a or 1b above, void spaces in the plastic-lined cooler additionally can be filled with non-combustible, absorbent packing material to absorb any sample liquid should breakage or leakage occur and breach the plastic bags containing the individual samples. Vermiculite or light-weight cat litter should not be used for this purpose because they are dusty, staticky, and difficult to remove from the sample containers and cooler. The animal bedding material described in method 1c above is a suitable material for this purpose, as is cellulose wadding and super-absorbent packets. The use of liquid absorbent is not strictly required, and the consequences of sample container leakage are largely mitigated by following the other steps in this section (e.g., the use of multiple layers of plastic bags).

3. If the samples require cold preservation, fill void spaces with double-bagged ice. The ice should be sufficient to maintain the temperature of the samples to about 4 degrees Celsius (°C), ±2 °C, and also not freeze the samples. Additional ice likely will be needed in warmer climates, during warmer times of the year, and if the samples will not be immediately checked in by the laboratory (such as during weekends or holidays). Samples that do not arrive at the laboratory at the proper temperature might need to be re-collected if analysis of those samples would result in qualified data. Analysis of improperly preserved samples and/or re-collection of samples will result in additional expense to E & E and its client that is far greater than shipping the additional sample coolers that might be needed to accommodate a sufficient quantity of ice.

4. Place a temperature blank inside a resealable plastic bag and place the blank inside the cooler.

5. Close and seal the plastic bag lining the cooler and affix a custody seal. This custody seal is an additional layer of custody security in case the cooler is opened and inspected by the U.S. Transportation Security Administration or by customs for international shipments, or the outer custody seals on the cooler fail.

Final Steps

1. Complete and sign the COC form, maintain the required copies, place it in a resealable plastic bag or pouch, and tape the bag/pouch to the inside of the cooler lid.

2. Close the cooler. Place custody seals in two locations along the top of the cooler such that the cooler cannot be opened without breaking the seals. Do not place the custody seals on the hinged side of the cooler lid.
3. Secure the cooler with strapping tape or equivalent over the hinges, over the custody seals, and and around the entire cooler.

6.5 Marking, Labeling, and Shipping

Marking, labeling, and shipping will be performed in accordance with the requirements of the carrier (e.g., Federal Express) or courier that will be used.

Each cooler of environmental (nonhazardous) samples will be marked with an address label showing the name and address of the sender and recipient. "This Side Up" labels will be applied to at least two sides of the cooler.

Shipping documentation will consist of an airbill for air transport or a bill of lading for ground transport, which will be affixed to the lid of the cooler. A hazardous materials/dangerous goods shipper's declaration is not used when shipping environmental (nonhazardous) samples.

The field team will notify the E & E project manager and the recipient laboratory daily of impending shipments. The E & E project manager will notify E & E's client if required. The field team or project manager will follow up daily using shipper tracking numbers and review of laboratory log-in documentation to ensure that each shipment of samples has been received as scheduled and logged in immediately upon receipt, and that samples requiring cold preservation have been placed in cold storage upon receipt at the laboratory.

7 Quality Assurance/Quality Control

The program/project manager will identify personnel for the field team who have knowledge, training, and experience in the sample handling, packing, and shipping activities to be conducted.

Prior to initiating field work, the project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, SHASP) will be reviewed by team personnel to understand the procedures that have been specified to result in samples that will meet project data quality objectives (DQOs). Project planning documents will define the quality assurance/quality control (QA/QC) procedures necessary to meet project DQOs. QA/QC steps important to sample handling, packing, and shipping have been incorporated into the procedures in Section 6 and include steps such as the following:

- Maintaining samples under secure custody;
- Completely and accurately filling out COC forms and diligently checking the samples in the cooler against the samples listed on the COC form;
- Using sufficient ice to maintain appropriate sample temperatures during the shipping of samples requiring cold preservation;
- Coordinating with the recipient laboratory regarding scheduled sample shipments; and
- Following up with the laboratory to ensure that samples have been received as scheduled and logged in, and that samples requiring cold preservation have been placed in cold storage upon receipt at the laboratory.

8 Health and Safety

Prior to entering the field, personnel will acknowledge in writing that they have read and understand the SHASP, which will be in compliance with the Corporate Health and Safety Program.

Unique hazards associated with sample handling, packing, and shipping include handling containerized samples that have been preserved with acids, bases, or other chemicals, and the ergonomic hazards of lifting heavy coolers of samples. Exposure to these hazards will be controlled by following the SHASP and the hazard control measures and safe work practices it prescribes, such as wearing gloves and using safe lifting practices.

9 Special Project Requirements

Project-specific requirements will be included with the project planning documents. Programs such as the EPA CLP may have additional, specific proceedures for handling, packing, and shipping samples.

10 References

United States Environmental Protection Agency (EPA). 2014. *Sampler's Guide. Contract Laboratory Program Guidance for Field Samplers.* OSWER 9200.2-147. EPA-540-R-014-013. Office of Superfund Remediation and Technology Innovation. October 2014.

_____. 2015. Packing, Marking, Labeling and Shipping of Environmental and Waste Samples. SESDPROC-2009-R3. EPA Region 4. Science and Ecosystem Support division. February 4, 2015. Athens, Georgia.

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END OF SOP

ecology and environment, inc.

STANDARD OPERATING PROCEDURE

COLLECTING SOIL AND SEDIMENT SAMPLES FOR VOC ANALYSIS

SOP NUMBER: ENV 3.25

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1 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures used by E & E for collecting and containerizing soil and sediment samples for off-site analysis of volatile organic compounds (VOCs) in accordance with United States Environmental Protection Agency (EPA) SW-846 Methods 5035, 5035A, or similar. These collection procedures are designed to minimize disturbance of the sample and loss of VOCs. The purpose of soil and/or sediment sampling may range from simple reconnaissance to complex sampling programs. Specific sampling procedures may vary depending on the data quality objectives (DQOs) identified in project planning documents. Both low-concentration and high-concentration VOC sampling procedures are provided herein.

This SOP does not address the procedures to initially obtain the soil or sediment material, which would be collected using hand implements, augers, corers, or heavy equipment such as split-spoon samplers. This SOP addresses only the specific methods to properly collect and containerize the subsample (or aliquot) being submitted for VOC analysis.

This SOP is intended for use by personnel who have knowledge, training, and experience in the field sampling activities being conducted.

Other E & E SOPs that would typically also apply to the collection of soil and sediment samples for VOC analysis include the following:

- DOC 2.1, Field Activity Logbooks;
- ENV 3.8, Aquatic Sediment Sampling;
- ENV 3.13, Surface and Shallow Subsurface Soil Sampling;
- ENV 3.15, Sampling and Field Equipment Decontamination;
- ENV 3.16, Environmental Sample Handling, Packing, and Shipping;
- ENV 3.26, Handling Investigation-Derived Wastes; and
- GEO 4.7, Borehole Installation and Subsurface Soil Sampling.

2 Definitions and Acronyms

°C	Degrees Celsius
DI	Deionized
DQO	Data quality objective
E & E	Ecology and Environment, Inc.
EPA	(United States) Environmental Protection Agency
g	gram
µg/kg	micrograms per kilogram (parts per billion)
mL	milliliter
$NaHSO_4$	Sodium bisulfate
QA	Quality assurance
QC	Quality control

SHASP	Site-specific health and safety plan
SOP	Standard operating procedure
VOA	Volatile organic analysis
VOC	Volatile organic compound

3 Procedure Summary

The subsample or aliquot of a soil or sediment sample that is submitted for analysis of VOCs is collected using specialized methods and containers designed to minimize disturbance of the sample and loss of VOCs. Project planning documents will specify methods appropriate for the low and/or high concentrations of VOCs anticipated to be in the samples. The methods and containers typically consist of specialized samplers such as Terra Core™ samplers, En Core™ samplers, or equivalent; sample preparation or preservation solutions such as deionized (DI) water, sodium bisulfate ($NaHSO_4$), or methanol; and volatile organic analysis (VOA) vials or jars.

4 Cautions

Cautions related to health and safety are discussed in Section 8.

Standard measures, such as the use of disposable gloves, should be used to avoid cross-contamination of samples between sample locations.

The quantities of methanol and $NaHSO_4$ used as preservatives in some of the sampling methods are likely considered to be hazardous materials (as defined by the United States Department of Transportation) or dangerous goods (as defined by the International Air Transport Association), and therefore will require transportation in accordance with proper regulations. An E & E hazardous materials shipping specialist and E & E's Hazardous Materials Shipping Manual should be consulted for guidance.

5 Equipment and Supplies

The following is a general list of equipment and supplies that applies to the sampling methods discussed in Section 6. A detailed list of equipment and supplies will be prepared based on the project planning documents.

- Terra Core™ or En Core™ samplers or equivalent;
- Laboratory-provided or vendor-provided pre-preserved VOA sample vials (typically pre-weighed, labeled, with preparation solution, preservative, stir bars, and other analysis-specific components);
- 40-milliliter (mL) VOA vials;
- 2- or 4-ounce Teflon-lined, septum-sealed VOA jars;
- Plastic 5-mL disposable syringes, where the barrel outside diameter is less than the sample vial neck inside diameter, or sample coring devices supplied by the laboratory;
- Cutting tool (for syringes if not pre-cut);
- If samples are weighed in the field, then:
  - Portable analytical balance (range 0 to 100 grams [g]) and capable of weighing to ±0.01 g,

  - Calibration weight set (1 to 50 g), and
  - Weighing dishes (disposable);
- Specialized quality control samples provided by the project laboratory, e.g., purified-grade sea sand trip blanks or field blanks; and
- Supporting equipment and supplies, e.g., disposable gloves, field logbook, sample custody and documentation supplies, decontamination supplies, sample packaging/shipping supplies, safety supplies, and waste handling supplies.

6 Procedure

6.1 General Sampling Considerations

The E & E project manager will coordinate with qualified project laboratories and vendors to ensure that the correct sampling procedures and equipment are used in accordance with project DQOs, project planning documents, and laboratory requirements. VOC sample vial size, type, and style may vary by laboratory.

The sampling method specified in the project planning documents takes into account whether low-concentration VOCs (generally in the range of approximately 0.5 to 200 micrograms per kilogram [µg/kg]) or high-concentration VOCs (greater than approximately 200 µg/kg) are anticipated. Collection methods suitable for the analysis of both low and high concentrations of VOCs are used if the VOC concentrations are unknown.

Soil and sediment samples collected for VOC analysis might be able to be collected directly from the enviroment, but most often are collected by subsampling the soil/sediment initially collected using some type of sampling equipment (e.g., hand implements, augers, corers, or split spoons). Soil and sediment samples collected and prepared for VOC analysis are collected as soon as possible after the soil or sediment material is initially collected and before any homogenization of that material.

Dedicated laboratory- or vendor-supplied equipment such as Terra Core™ or En Core™ (or equivalent) sampling tools do not require decontamination prior to use and prevent sample cross-contamination. Other field equipment used to collect soil/sediment samples for VOC analysis should be cleaned/decontaminated or disposed of between sampling locations to prevent cross-contamination between samples. Chemical solvents should not be used as decontamination agents because they could result in false positive VOC results for the collected sample if the solvents are not rinsed off well enough.

If not otherwise specified by the project planning documents, a separate and additional sample for percent moisture determination should be obtained for each sample location by filling a standard 40-mL VOA vial or a 2- or 4-ounce jar with the same material being submitted for VOC analysis.

6.2 Low-Concentration Vial Sampling (DI Water or Preservative)

This procedure is the most common one used to collect a soil or sediment sample for the analysis of low concentrations of VOCs. The procedure uses laboratory-provided VOA vials containing either 5 mL of DI water or a small amount of $NaHSO_4$ preservative ($NaHSO_4$ slightly acidifies the sample and reduces biological activity) and a sample collection/coring (e.g.,Terra Core™) device. For most sampling under this procedure, E & E typically uses vials containing DI water.

Typically, the laboratory or vendor provides pre-weighed unpreserved (DI water) or preserved ($NaHSO_4$) VOA vials, and sample weights are estimated based on sample volumes defined by the coring device volume. Sample weights will vary depending on the soil/sediment sample density. If sample weights are too low, analytical detection limits may be affected and more accurate determination of sample weights may be required, as per Step 1, although Step 1 is seldom required.

1. **Calculate the sample volume required for sample collection (optional)**

   If the laboratory does not provide pre-weighed vials or if the project DQOs require accurate determination of sample weight and volume, then a portable balance and work station are set up in the field. The following steps are followed to weigh the vials and determine an appropriate sample weight.

   a. Calibrate the analytical balance daily before use. Check the balance with four weights ranging from 1 to 50 g. Record readings against expected values in the logbook. Readings must be within $\pm$ 0.01 g of the expected value or the balance must be checked and recalibrated.

   b. To determine or verify a laboratory- or vendor-provided VOA vial weight, place the sample vial with DI water or $NaHSO_4$, cap, stirring bar, etc. on the balance. If the vial weight is not within $\pm$ 0.1 g of the laboratory-reported or acceptable weight, do not use the vial.

   c. Prepare a sample corer by cutting the tip off of a 5-mL plastic syringe or use the sample corer provided by the laboratory. The diameter of the syringe barrel needs to be less than the diameter of the sample vial.

   d. Determine the sample volume necessary to provide a 4.5 to 5.5 g sample.

   e. Collect approximately 5 g of sample using the syringe barrel or Terra Core™ sampler.

   f. Extrue the sample onto a tared weighing dish and weigh it. If the sample weight is between 4.5 and 5.5 g, then proceed to Step 2. If the sample weight is outside of the range of 4.5 to 5.5 g, dispose of the weighing dish and sample. Adjust the sample volume, recollect, and reweigh a sample expected to be within the required range. Once the correct sample volume has been determined, proceed to Step 2.

2. **Sample Collection**

   a. Confirm that a sample vial weight has been provided by the laboratory or vendor or otherwise determined, such as via Step 1.

   b. Inspect the sample vials and verify that the sample stir bar is present and that water or solution levels are consistent. If it appears that water or solution is lost from the vial, do not use it.

   c. Prepare a sample corer by cutting the tip off of a 5-mL plastic syringe or use the sample corer (e.g., Terra Core™) provided by the laboratory. The diameter of the syringe barrel needs to be less than the diameter of the sample vial.

   d. Collect the calculated or desired sample volume by driving the coring device into a representative section of the soil or sediment material.

   e. Carefully extrude the soil/sediment into the sample vial taking care not to lose any water or solution from the vial. If water or solution is inadvertently pushed out of the vial, then discard the vial and re-collect the sample.

f. Wipe the exterior of the sample vial and cap. Ensure that no soil is on the vial top and that a tight seal is formed when capping the vial.

g. Soil/sediment samples that contain carbonate material may effervesce on contact with $NaHSO_4$. After capping the vial, check the sample and solution. If there is significant effervescence, discard the sample and use a vial containing DI water. Note the amount of effervescence in the field logbook and any decisions made to retain the use of $NaHSO_4$ vials or switch to DI water vials. The amount of effervescence for retained samples will be reviewed during data validation because effervescence can lead to vial overpressure and potential loss of VOCs during sampling. Allow any discarded effervescing vials to vent slightly prior to disposal to prevent the vial from breaking.

h. For each sample, collect into additional vials using the same coring device and from the same area of the material. The number of vials per sample will be determined with the laboratory, but at least two to three vials are typically collected.

i. Place the vials for the same sample into one sealable plastic bag. A custody seal can be applied to the bag closure instead of each vial.

j. If a percent moisture determination sample has not yet been collected, collect and place one separate standard percent moisture determination soil/sediment aliquot into a 40-mL VOA vial or a 2- or 4-ounce jar. Place the sample in a sealable plastic bag.

k. Place the soil samples on ice (4±2°C). Lay the vials on their side so that the septum remains wet on the inside, thereby preventing vapor leaks around it in case any bubbles form. As well, if the sample is later frozen by the laboratory, being on its side allows water to expand into the flexible septum rather than break the vial.

If the sample is extruded into DI water, the vial may be cooled to 4±2°C for no more than 48 hours, after which the sample must be analyzed or frozen to < -7°C by the laboratory. The holding time between collection and analysis in this case is typically 14 days, if frozen. The holding time between collection and analysis for samples preserved with $NaHSO_4$ is typically 14 days.

6.3 High-Concentration Vial Sampling (Methanol-Preserved)

This procedure can be used to collect a soil or sediment sample for the analysis of high concentrations of VOCs. Collection and analysis of samples for high concentrations of VOCs is typically conducted in addition to that for low concentrations of VOcs in cases where VOC concentrations are unknown or high VOC concentrations are expected. Analytical detection limits for high-concentration sampling and analysis may be elevated by several orders of magnitude above low-concentration detection limits. Methanol is used in this procedure as both a preservative and analytical extraction solution.

Collect the sample as follows:

1. Use the steps in Section 6.2 Step 1 if needed to determine the sample volume to be collected, to verify laboratory- or vendor-provided vial weights, or if pre-weighed VOA vials are not provided.
2. Use a sample vial with methanol, cap, stirring bar, etc. The methanol will be analyzed directly on the instrument for very high-concentration samples.

3. Prepare a sample corer by cutting the tip off of a 5-mL plastic syringe or use the sample corer (e.g., Terra Core™) provided by the laboratory. The diameter of the syringe barrel needs to be less than the diameter of the sample vial.
4. Collect the calculated or desired sample volume (same as the low-concentration aliquot) by driving the coring device into a representative section of the soil or sediment material.
5. Carefully extrude the soil/sediment into the sample vial.
6. Wipe the exterior of the sample vial and cap. Ensure that no soil is on the vial top and that a tight seal is formed when capping the vial.
7. For each sample, collect into a second vial using the same coring device and from the same area of the material.
8. Place the vials for the same sample into one sealable plastic bag. A custody seal can be applied to the bag closure instead of each vial.
9. If a percent moisture determination sample has not yet been collected, collect and place one separate standard percent moisture determination soil/sediment aliquot into a 40-mL VOA vial or a 2- or 4-ounce jar. Place the sample in a sealable plastic bag.
10. Place the soil samples on ice (4±2°C). Lay the vials on their side so that the septum remains wet on the inside, thereby preventing vapor leaks around it in case any bubbles form.

The holding time between collection and analysis for vial samples preserved with methanol is typically 14 days.

6.4 Low- or High-Concentration Vial Sampling (Unpreserved)

This procedure can be used to collect a soil or sediment sample for the analysis of low or high concentrations of VOCs using no preservation or preparation solution (i.e., no DI water or chemical preservative) in the field. The soil or sediment is extruded into a pre-weighed and unpreserved vial. The laboratory will add the appropriate amount of extraction solution to the sample as required for low-concentration analysis (DI water) or high-concentration analysis (methanol).

Collect the sample as follows:

1. Use the steps in Section 6.2 Step 1 if needed to determine the sample volume to be collected, to verify laboratory- or vendor-provided vial weights, or if pre-weighed VOA vials are not provided.
2. Use a sample vial, cap, stirring bar, etc.
3. Prepare a sample corer by cutting the tip off of a 5-mL plastic syringe or use the sample corer (e.g., Terra Core™) provided by the laboratory. The diameter of the syringe barrel needs to be less than the diameter of the sample vial.
4. Collect the calculated or desired sample volume by driving the coring device into a representative section of the soil or sediment material.
5. Carefully extrude the soil/sediment into the sample vial.
6. Wipe the exterior of the sample vial and cap. Ensure that no soil is on the vial top and that a tight seal is formed when capping the vial.

7. For each sample, collect into two more vials using the same coring device and from the same area of the material.
8. Place the vials for the same sample into one sealable plastic bag. A custody seal can be applied to the bag closure instead of each vial.
9. If a percent moisture determination sample has not yet been collected, collect and place one separate standard percent moisture determination soil/sediment aliquot into a 40-mL VOA vial or a 2- or 4-ounce jar. Place the sample in a sealable plastic bag.
10. Place the soil samples on ice (4±2°C).

The vial may be cooled to 4±2°C for no more than 48 hours, after which the sample must be analyzed or frozen to < -7°C by the laboratory. The holding time between collection and analysis for this type of VOC sample collection is typically 14 days, if frozen.

6.5 High-Concentration Bulk Sampling (Unpreserved)

This procedure can be used to collect a soil or sediment sample for the analysis of high concentrations of VOCs. Collection and analysis of samples for high concentrations of VOCs is typically conducted in addition to that for low concentrations of VOCs in cases where VOC concentrations are unknown or high VOC concentrations are expected. Analytical detection limits for high-concentration sampling and analysis may be elevated by several orders of magnitude above low-concentration detection limits.

Collect the sample as follows:

1. Completely fill a septum-sealed 2- or 4-ounce VOA sample container with soil or sediment, leaving as little headspace as possible.
2. For each sample, fill a second container using the same implement and from the same area of the material. This additional quantity is most needed if only high-concentration samples are being collected under the sampling program.
3. Apply a custody seal to each sample container and place each in a sealable plastic bag.
4. If a percent moisture determination sample has not yet been collected, collect and place one separate standard percent moisture determination soil/sediment aliquot into a 40-mL VOA vial or a 2- or 4-ounce jar. Place the sample in a sealable plastic bag.
5. Place the soil samples on ice (4±2°C).

The holding time between collection and analysis for bulk soil or sediment samples is typically 14 days. These samples should not be frozen.

6.6 En Core™ Sampling

The En Core™ sampler can be used to collect a soil or sediment sample for the analysis of low or high concentrations of VOCs. The En Core™ sampler consists of a sampler unit, T-handle, and cap. The collected sample is not required to be chemically preserved in the field. The En Core™ sampler works best in cohesive granular materials and may not be appropriate for sample collection of some matrices (e.g., dry sands).

Collect the sample as follows:

1. Remove the sampler from the sealed foil package.
2. Insert the sampler in the T-handle, turn, and allow the locking arm to click into place.

3. Place the sampler over the soil sample. The view hole should be open.
4. Push down until you see a gasket in the view hole. Twist the sampler and remove it from surrounding soil.
5. Check that the sampler is full of soil. Place the cap over the sample unit and lock it into place.
6. Release the locking arm and remove the sampler unit from the T-handle.
7. Label the sampler unit with the sticker located on the foil pouch.
8. Return the labeled sampler unit to the foil pouch and seal it.
9. For each sample, collect into two additional sampler units from the same area of the material.
10. If a percent moisture determination sample has not yet been collected, collect and place one separate standard percent moisture determination soil/sediment aliquot into a 40-mL VOA vial or a 2- or 4-ounce jar.
11. Place the samples on ice (4±2°C). (The pouched samples may be frozen prior to shipping, although this is seldom feasible in the field.)
12. Decontaminate the T-handle between unique sample locations.

The holding time between collection and analysis for samples collected using an En Core™ (or equivalent) sampling device is typically 48 hours.

7 Quality Assurance/Quality Control

The project manager should identify personnel for the field team who have knowledge, training and experience in the soil/sediment sampling activities to be conducted. One member of the field team should be designated as the lead for soil/sediment sampling conducted for VOC analysis and will be responsible, with support from other field personnel, for implementing the procedures in this SOP. The project manager should also identify additional personnel, if necessary, to complete ancillary procedures, e.g., field logbook documentation, equipment decontamination, sample shipment, and waste disposal.

Prior to initiating field work, the project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, and site-specific health and safety plan [SHASP]) will be reviewed by field personnel to understand the sampling procedures that have been specified to result in soil/sediment samples and VOC data that meet project DQOs. Project planning documents will define the quality assurance/quality control (QA/QC) procedures necessary to meet project DQOs, including the sampling protocol for QC samples such as trip blanks, equipment rinsate blanks (to assess the effectiveness of field decontamination methods for non-dedicated and non-disposable equipment), field duplicates, and other types of field and analytical QC samples. Trip blank samples for soil and sediment VOC analyses are typically prepared by the project laboratory using pre-cleaned sea sand in appropriate vials and/or samplers. For other types of field blanks prepared in the field, pre-cleaned sea sand provided by the project laboratory can be used, following the same sample collection procedures in this SOP. Field duplicates are typically collected from at least one location and treated as separate samples, blind to the laboratory. Certain field blanks should be processed at the site location to account for ambient and other site-specific conditions.

The E & E project manager will coordinate with qualified project laboratories and vendors to ensure that the correct procedures and equipment for collecting samples for VOC analysis are used in accordance with project DQOs and planning documents.

The use of different procedures to collect soil/sediment samples for VOCs within the same project (or between projects) can affect the comparability of the VOC data if samples collected by different procedures are evaluated together.

The small size of the samples collected and analyzed by the procedures addressed in this SOP can inherently limit the representativeness of the sample data when compared to larger, homogenized samples. If the collocated sample portions collected for each sample do not appear to be homogeneous, the field sampler should attempt to sample one type of material to the extent practicable and note this in the field logbook. Because field duplicate samples for VOC analysis also are collocated, and are not homogenized replicates, some degree of field variability is inherently added that may result in less precision between field duplicate sample results than is seen when homogenized samples are analyzed as field duplicates.

8 Health and Safety

Prior to entering the field, all field personnel will acknowledge in writing that they have read and understand the SHASP, which will be in compliance with the E & E Corporate Health and Safety Program.

Unique hazards associated with collecting soil and sediment samples for VOC analysis consist of:

- The use and presence of chemical preservatives such as $NaHSO_4$ and methanol in pre-preserved sample containers. The field team will wear the personal protective equipment specified by the SHASP, handle the sample containers with care, and collect and process such samples in a well-ventilated area.
- The potential for contamination of soil and sediment with site contaminants such as chemical, radioactive, and/or pathogenic biological material. The SHASP will provide instruction for safe handling of contaminated site soils and sediment.

9 Special Project Requirements

Project-specific requirements will be included with the project planning documents.

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END OF SOP

ecology and environment, inc.

STANDARD OPERATING PROCEDURE

HANDLING INVESTIGATION-DERIVED WASTES

SOP NUMBER: ENV 3.26

REVISION DATE: 6/30/2017 **SCHEDULED REVIEW DATE: 6/30/2022**

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1 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures used by E & E for handling investigation-derived waste (IDW). Procedures for handling non-hazardous and hazardous categories of IDW are provided. IDW commonly includes:

- Cuttings from drilling (e.g., soil, sediment);
- Rotary drilling fluids (e.g., muds or solutions);
- Groundwater obtained through well development or well purging;
- Spent decontamination/cleaning fluids (e.g., solvents, wash water);
- Used personal protective equipment (PPE) (e.g., protective suits, gloves);
- Disposable equipment and materials (e.g., sampling equipment, containers); and
- Used packing and shipping materials.

This SOP provides references to certain federal regulatory standards for hazardous waste management and does not address state or local regulatory standards or requirements. The contents of regulatory standards for characterizing and transporting hazardous waste are outside the scope of this SOP. Users of this SOP are required to comply with applicable regulations.

This SOP does not apply to IDW associated with explosive, radioactive, mixed (hazardous and radioactive), or pathogenic wastes or to projects outside of the United States.

The IDW expected to be generated during an investigation and the procedures to manage it should be identified in project planning documents.

This SOP for handling IDW is intended for use by personnel who have knowledge, training, and experience in field activities that generate IDW and how that IDW is handled.

2 Definitions and Acronyms

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DOT	(U.S.) Department of Transportation
E & E	Ecology and Environment, Inc.
EPA	(U.S.) Environmental Protection Agency
Hazardous waste	Discarded material that is dangerous or potentially harmful to human health or the environment. Hazardous waste can be solid, semisolid, liquid, or contained gaseous material. EPA defines hazardous waste under RCRA as waste that exhibits specific hazardous characteristics, is a listed hazardous waste under the statute, or otherwise meets the definition. For the purposes of this SOP, hazardous waste also will include wastes that contain hazardous constituents regulated under CERCLA, TSCA, CWA, and similar regulations.

IDW	Investigation-derived waste, specifically as pertaining to solid or liquid wastes resulting from E & E field activities
Non-hazardous waste	For the purposes of this SOP, non-hazardous waste means traditional garbage or refuse and does not include wastes that meet the RCRA definition of a hazardous waste; wastes that contain hazardous constituents regulated under CERCLA, TSCA, CWA, and similar regulations; or regulated non-hazardous waste such as industrial waste
PPE	Personal protective equipment
RCRA	Resource Conservation and Recovery Act
SHASP	Site-specific health and safety plan
SOP	Standard operating procedure
TDU	Treatment/disposal unit
TSCA	Toxic Substances Control Act
TSD	Treatment, storage, and disposal

3 Procedure Summary

The IDW procedures identified in the project planning documents will vary depending on the site contaminants, site conditions, sampling procedures, and applicable regulatory requirements. Non-hazardous and hazardous wastes will be handled separately. IDW management requires pre-investigation planning, on-site IDW waste minimization, IDW waste segregation, and specific IDW handling and disposal depending on the type of IDW that is generated.

4 Cautions

Cautions related to health and safety are discussed in Section 8.

The U.S. Environmental Protection Agency's (EPA's) Resource Conservation and Recovery Act (RCRA) defines hazardous waste and imposes limitations and restrictions on its storage, transport, and disposal. Hazardous wastes may require separate sampling and analysis to determine proper IDW disposition. Because sampling and analysis of wastes can be time-consuming and expensive, best professional judgment combined with knowledge of historical site activities and existing site processes/raw material/waste stream information should be the first source of data in the characterization IDW.

Because hazardous waste transporters move regulated wastes on public roads, highways, rails, and waterways, the EPA and the U.S. Department of Transportation (DOT) jointly developed the hazardous waste transporter regulations, which are found in Title 40 Part 263 of the U.S. Code of Federal Regulations (40 CFR 263). Certain DOT regulations in 49 CFR Parts 100 to 185 also are applicable to the off-site transportation of hazardous IDW.

Other regulations also may apply to IDW handling, including those of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Toxic Substances Control Act (TSCA), Clean Water Act (CWA), and state, local, and tribal entities.

5 Equipment and Supplies

Equipment needed for handling IDW typically includes:

- Fifty-five-gallon drums;
- Five-gallon buckets;
- Labels for drums and buckets;
- Wrench and hammer to secure drum lids;
- Lumber, plastic sheeting, and plywood for creating a temporary storage area;
- Trash bags;
- Sample containers;
- Indelible ink pen/permanent marker for labeling drums/containers;
- Manifests/shipping documents;
- Plastic trash bags; and
- PPE.

6 Procedure

6.1 Planning

Prior to site investigation activities, E & E project personnel will develop appropriate project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, and site-specific health and safety plan [SHASP]), which collectively will address the types of IDW expected to be generated and how that IDW will be managed. Prior to field activities, E & E and subcontractor field personnel are required to review and understand site-specific procedures established for handling IDW.

6.2 Waste Minimization

The generation of IDW should be minimized to reduce the need for handling, storage, and disposal that may result in substantial additional costs yet provide little or no reduction in site risks. Waste minimization will be initiated during site planning by identifying and eliminating site activities that may generate IDW or identifying methods to reduce the generation of IDW. Methods and techniques that will contribute to eliminating or reducing IDW include:

- Replace solvent-based cleaners with aqueous-based cleaners for decontamination of equipment;
- Eliminate solvent use when possible;
- Avoid the generation of excess decontamination liquid (e.g., use less water);
- Limit traffic between clean and hot zones;
- Limit field team contact with site contaminants;
- Minimize the use of disposable equipment and materials;
- Use non-disposable equipment/materials that can effectively be decontaminated and reused;
- Use non-intrusive or minimally intrusive investigation methods and sampling techniques that generate little waste (e.g., direct-push samplers);

- Avoid co-mingling hazardous and non-hazardous wastes;
- Recycle clean and non-hazardous traditional recyclables such as cardboard, paper, metal, and beverage containers; and
- Collect only the amount of sample that is needed.

6.3 Management of Non-hazardous IDW

For the purposes of this SOP, non-hazardous IDW means traditional garbage or refuse and does not include wastes that meet the RCRA definition of a hazardous waste; wastes that contain hazardous constituents regulated under CERCLA, TSCA, CWA, and similar regulations; or regulated non-hazardous waste such as industrial waste.

For non-hazardous IDW comprised of uncontaminated or decontaminated PPE, disposable equipment/materials, paper towels, and other wastes that are known to be non-hazardous, the following procedures are typically employed:

- Render the IDW unusable (e.g., by cutting or tearing the material).
- Double-bag the IDW in plastic bags.
- If the investigation is at an active facility, request permission from the owner/operator to dispose of the non-hazardous waste in the facility's operational trash and recycling receptacles/dumpsters.
- If the investigation is not at an active facility, arrange with the client for the non-hazardous IDW to be disposed of at a permitted municipal solid waste disposal facility.

For non-hazardous IDW comprised of site media like soil cuttings, drilling mud, purge or development water, and decontamination wash water that are known to be non-hazardous, the following procedures are typically employed:

- Spread soil/sediment cuttings around the well or borehole or place the cuttings back in the borehole or excavation.
- Pour groundwater from potable water wells and monitoring wells onto the ground in locations where no environmental impacts are anticipated.
- Pour decontamination water (which may contain low levels of non-phosphate detergents) onto the ground in locations where no environmental impacts are anticipated.
- Pour decontamination water down a sanitary sewer if available and allowed.

Record in the field logbook the methods used to handle, containerize, and dispose of non-hazardous IDW.

6.4 Management of Hazardous IDW

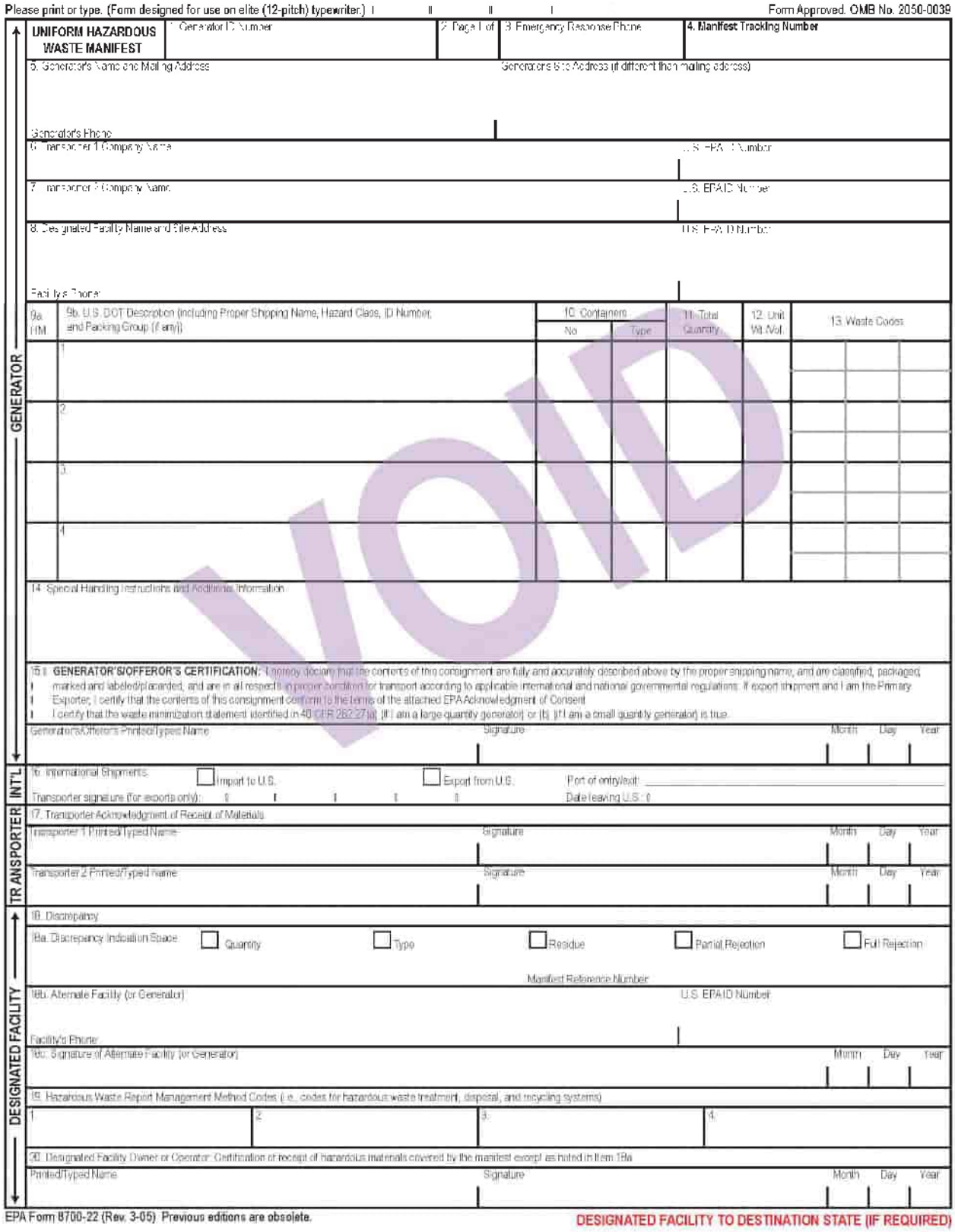
For the purposes of this SOP, hazardous waste means waste meeting the RCRA definition (e.g., waste that exhibits specific hazardous characteristics, is a listed hazardous waste under the statute, or otherwise meets the definition) or waste that contains hazardous constituents regulated under CERCLA (hazardous substances), TSCA (lead, asbestos), CWA, and similar regulations.

The RCRA regulations address the requirements for the handling, storage, transport, disposal, and tracking of hazardous waste. Hazardous IDW containing CERCLA-defined hazardous

substances, TSCA-regulated toxic constituents, and other regulated substances similarly must also be handled, stored, transported, disposed, and tracked in accordance with associated regulations.

For hazardous IDW, the following procedures are typically employed:

- Make reasonable efforts to characterize the hazardous IDW. Use available knowledge of historical site activities and existing site processes/raw material/waste stream information, site monitoring, and/or sample analysis data to characterize wastes. Project planning documents will provide the procedures required for sampling/analysis of wastes necessary for waste characterization.
- Containerize hazardous IDW in accordance with regulations.
- Store hazardous IDW in accordance with regulations, with consideration for secure storage and EPA 90-day interim storage rules. For active sites, it may be possible to store hazardous IDW in the facility's designated area.
- Complete any required hazardous waste labels using indelible ink and apply the labels to the waste containers. The labels will typically require generator identification information (the client, never E & E), the date the waste was first accumulated, and the accompanying waste manifest number.
- Complete, or assist others with completion of, the Uniform Hazardous Waste Manifest (see Figure 6-1).
- For sites with an operational treatment/disposal unit (TDU), it may be possible to dispose of hazardous wastes in the on-site TDU, with client approval.
- If off-site disposal of hazardous IDW is required, coordinate with the client to ensure that the hazardous IDW is transported by an approved hazardous waste transporter and disposed of at a permitted treatment, storage, and disposal (TSD) facility, and that the transporter and TSD facility have passed compliance verification. E & E can assist clients with these arrangements but does not take responsibility for hazardous waste transport and ultimate treatment, storage, and disposal. E & E also is not allowed, per E & E legal instructions, to be identified as the hazardous waste generator or to sign hazardous waste shipping manifests. If E & E subcontracts hazardous waste transport and disposal for a project to a qualified subcontractor, E & E still is not identified as the generator, does not sign hazardous waste manifests, and coordinates with the subcontractor and client to ensure that the transporter and TSD facility have passed compliance verification.
- If off-site disposal of hazardous IDW is required, verify that waste container labels comply with EPA and DOT regulations and the requirements of the receiving TSD facility.
- Record in the field logbook the methods used to characterize, handle, containerize, store, dispose of, and track hazardous IDW.



Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number | 2. Page 1 of | 3. Emergency Response Phone | 4. Manifest Tracking Number

5. Generator's Name and Mailing Address | Generator's Site Address (if different than mailing address)

Generator's Phone:

6. Transporter 1 Company Name | U.S. EPA ID Number

7. Transporter 2 Company Name | U.S. EPA ID Number

8. Designated Facility Name and Site Address | U.S. EPA ID Number

Facility's Phone:

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
	1.					
	2.					
	3.					
	4.					

14. Special Handling Instructions and Additional Information

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name | Signature | Month | Day | Year

INT'L

16. International Shipments: ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:

Transporter signature (for exports only): Date leaving U.S.:

TRANSPORTER

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name | Signature | Month | Day | Year

Transporter 2 Printed/Typed Name | Signature | Month | Day | Year

DESIGNATED FACILITY

18. Discrepancy

18a. Discrepancy Indication Space: ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

18b. Alternate Facility (or Generator) | U.S. EPA ID Number

Facility's Phone:

18c. Signature of Alternate Facility (or Generator) | Month | Day | Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1.	2.	3.	4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a

Printed/Typed Name | Signature | Month | Day | Year

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

VOID

Figure 6-1 Uniform Hazardous Waste Manifest

In cases where an E & E subcontractor (e.g., driller) produces hazardous IDW, the subcontractor may take responsibility for proper containerization, characterization, labeling, storage, transport, disposal, and tracking of the wastes if authorized under the subcontract. The E & E subcontracting documentation should include relevant subcontractor SOPs for these activities and specify the documentation to be provided to E & E before, during, and after IDW disposal, The E & E project manager or field team leader should verify that subcontractor IDW handling complies with applicable or relevant and appropriate requirements as well as subcontracting requirements. The E & E project manager also should verify that the subcontractor's proposed transporter and TSD facility have passed compliance verification. When a subcontractor is used, the subcontractor and pricing will be identified in the resultant task order.

7 Quality Assurance/Quality Control

The program/project manager will identify personnel for the field team who have knowledge, training, and experience in the handling and management of IDW in accordance with applicable regulations. The field team leader or designee is the lead for IDW handling and will be responsible, with support from other field personnel, for implementing the procedures in this SOP.

The field team leader will verify that IDW handling, storage, transport, disposal, and tracking information is recorded in the field logbook.

The field team leader and project manager will verify that handling and management of both non-hazardous and hazardous waste comply with DOT and other applicable regulations.

8 Health and Safety

IDW associated with explosive, radioactive, mixed (hazardous and radioactive), or pathogenic wastes, and IDW that poses specific toxicity or other safety (e.g., extreme flammability) concerns, are not specifically addressed by this SOP and must be addressed in project planning documents, including the SHASP.

If heavy drums or containers of IDW need to be moved, appropriate mechanical devices such as drum-handling equipment or the equivalent will be used. Prior to moving a drum, it should be visually inspected for labeling to verify the contents, signs of deterioration, signs that it is under pressure (bulging or swelling), or leaking. If the drum shows signs of deterioration, being under pressure, or leaking, it will not be moved until a safe procedure is determined in conjunction with the project manager and site safety officer.

Appropriate PPE will be worn when handling IDW, as specified in the SHASP.

9 Special Project Requirements

Additional project- and site-specific requirements for IDW handling will be included in the project planning documents.

10 References

Scientific, Engineering, Response and Analytical Services (SERAS). 2015. Investigation-Derived Waste Management. SERAS SOP 2049, Rev 0.1. October 5, 2015. Prepared for EPA Emergency Response Team activities. Edison, New Jersey.

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END OF SOP

Title:	**SOIL VAPOR INTRUSION INVESTIGATION**
Category:	ENV 3.30
Revised:	November 2006

STANDARD OPERATING PROCEDURE

Soil Vapor Intrusion Investigation in New York State

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368 Pleasant View Drive / Lancaster, New York 14086 / (716) 684-8060

TITLE:	**SOIL VAPOR INTRUSION INVESTIGATION**
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TITLE:	SOIL VAPOR INTRUSION INVESTIGATION		
CATEGORY:	ENV 3.30	REVISED:	November 2006

1. Introduction

This Standard Operating Procedure (SOP) describes procedures for sample collection and evaluation for a soil vapor intrusion investigation in the State of New York. It incorporates guidance provided by the New York State Department of Health (NYSDOH) on the general steps and strategies that should be applied when conducting a soil vapor intrusion investigation. This SOP may be applied in other states; however, New York State guidance includes some specific procedures and excludes use of vapor intrusion modeling and collection of some samples that may be applicable elsewhere. Therefore, this SOP **must** be confirmed and discussed with the appropriate regulatory agencies, even in New York State, prior to the investigation start date, to verify that it has been accepted by the reviewing agency. This SOP must be used in combination with an appropriate analytical method (e.g., USEPA TO-15).

2. Scope

Included in this SOP are the sample collection procedures for the following sample media:

1. Subsurface Soil Vapor Samples (collected outdoors, typically at foundation level directly from the soil);

2. Sub-slab Vapor Samples (collected beneath a structure's slab);

3. Indoor Air Samples (collected from ambient air within a structure); and

4. Outdoor Air Samples (collected from ambient air outside of a structure).

The purpose of this investigation is to identify soil vapor intrusion pathways and determine if any migrating contaminant vapors have the potential to adversely impact humans that are exposed to these vapors. It is recommended that this investigation be conducted during the heating season because it is the period where the greatest impact is anticipated - when a building's heating system is in operation typically causing a pressure gradient into the building and vapors may be drawn into the building. Heating season dates will vary with locale, but is generally defined by NYSDOH as November 15 through March 31.

3. Equipment

The survey will be performed using the equipment listed below.

- Hammer drill;
- Hand auger or post digger;
- Vacuum with high efficiency particulate air (HEPA) filtration for dust and debris cleanup;
- Dustpan and brush;
- ½-inch bottle brush;
- Drill bits, 1-inch diameter x 6 inches long (typical, minimum usable length);
- Drill bits, ½-inch diameter x 12 inches long (typical, minimum usable length);
- Building power source, generator, or batteries for hammer drill;
- Bentonite (fine granular or powder);
- Glass beads or coarse sand;
- Water;
- Inert laboratory- or food-grade-quality tubing (e.g., polyethylene, Teflon-lined polyethylene, or stainless steel), typically ¼- to ⅜-inch ID;
- Organic vapor monitor that reads in the parts per billion range (e.g., ppbRAE) <*to be used only when product inventories or indoor air sampling are conducted*>;
- Enclosure such as a small bucket (5-gallon, typical) and three, ⅜-inch holes with rubber grommets (typical) <*for leak detection testing during soil vapor sampling only*>;
- Helium (ultra-pure, when possible) gas tank < *for leak detection testing during soil vapor sampling only*>
- Portable helium detector < *for leak detection testing during soil vapor sampling only*>
- Syringe without needle (100-cc volume, typical);

- Tedlar bag for vapor purge collection <*for use only during sub-slab vapor sampling when indoor air sampling will be conducted concurrently*>;
- Adjustable wrench and screwdriver/nutdriver;
- Hydraulic cement and mixing tools; and
- Digital camera.

Samples are collected using canisters with vacuum gauges and flow controllers. The sampling equipment is provided by a laboratory certified to perform EPA Method TO-14 or TO-15 by New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP). NYSDOH ELAP will certify the sampling canister preparation procedure and equipment. Canisters may be 1-liter (L) or 1.4-L "Mini-Cans" or 6-L Summa canisters. The choice of canister depends on the sampling conditions and laboratory availability. Canisters must be certified clean (in accordance with EPA Method TO-15) and under a vacuum pressure of no more than -25 inches of mercury (in Hg). Batch cleaning is acceptable as long as the cleaning process is certified by NYSDOH. Flow controllers must be set for the appropriate collection period (1- or 24-hour, typical) (flow rate dependent upon size of canister). Flow controllers must maintain a constant flow over the sampling period. Note the method description below:

> "With a critical orifice flow restrictor, there will be a decrease in the flow rate as the pressure approaches atmospheric. However, with a mass flow controller, the subatmospheric sampling system can maintain a constant flow rate from full vacuum to within about 7 kPa [kilopascals] (1.0 psi [pound per square inch) or less below ambient pressure."

The laboratory must be notified at least two weeks in advance of sampling to ensure the canisters are available. The laboratory should provide enough canisters for one week of sampling with an extra 10% to account for added samples (e.g. multiple sub-slab samples in one structure) and regulator/canister failures (e.g., sampling rate incorrect, initial canister pressure too high).

4. Multimedia Sampling Procedures

4.1 Soil Vapor Samples

4.1.1 Selection of Sampling Locations

1. **To evaluate the potential for current on-site or off-site exposures, collect soil vapor samples:**
   - In the vicinity of a building's foundation at a point located between the building and the contaminant source or along the site's perimeter. <*For buildings with no surrounding surface confining layer (e.g., pavement or sidewalk), samples should*

be located in native or undisturbed soils away from fill material surrounding the building (approximately 10 feet away from the building) to avoid sampling in an area that may be influenced by the building's operations. For example, operation of HVAC systems, fireplaces, or mechanical equipment (e.g., clothes dryers or exhaust fans/vents) in a building may exacerbate the infiltration of outdoor air into the vadose zone adjacent to the building. As a result, soil vapor samples collected in uncovered areas adjacent to the building may not be representative>; and

- At a depth of approximately 8 feet below grade or comparable to the depth of foundation footings (determined on a building-specific or site-specific basis). *<In areas where the groundwater table is less than 6 feet below grade, collect soil vapor samples at least 1 foot above the water table but no shallower than 4 feet below grade>*.

2. **To evaluate the potential for future exposures if development on a known or suspected contaminated area on-site or off-site is possible, collect soil vapor samples:**

   - In areas with either known or suspected subsurface sources of volatile chemicals, where elevated readings were obtained with field equipment during previous investigations, or where volatile organic compound contamination is reported to be present in the upper groundwater. *<If information is limited for the area, collect soil vapor samples in a grid pattern across the area at an appropriate spacing interval relative to the size of the area>*; and

   - At multiple depths from the suspected subsurface source (no deeper than 1 foot above the water table), or former source, to a depth comparable to the expected depth of foundation footings.

3. **To evaluate the potential for off-site vapor contamination, collect soil vapor samples:**

   - Along the site's perimeter or in areas of potential subsurface sources of vapor contamination (e.g., a groundwater source that has migrated off-site); and

   - At a depth comparable to the depth of foundation footings (determined on a site-specific basis). *<In areas where the groundwater table is less than 6 feet below grade, collect soil vapor samples at least one foot above the water table but no shallower than 4 feet below grade >*.

4. **To evaluate on-site and off-site preferential migration pathways in areas with low permeability soils, collect soil vapor samples:**

   - Along preferential soil vapor flow paths, such as sewer lines, utility corridors, trenches, pipelines, and other subsurface structures that are likely to be bedded with higher permeability materials; and

   - At depths corresponding to these subsurface features (depends on site-specific conditions).

5. **To characterize on-site or off-site contamination in the vadose zone, collect soil vapor samples:**

   - In areas with either known or suspected subsurface sources of volatile chemicals, where elevated readings were obtained with field equipment (eg; PID) during previous investigations, or where volatile chemical contamination is reported to be present in the upper groundwater; and

   - At appropriate depths associated with these areas (depends on site-specific conditions).

6. **To investigate the influence of contaminated groundwater or soil on soil vapor and to characterize the vertical profile of contamination, collect soil vapor samples:**

   - From clusters of soil vapor probes at varying depths in the vadose zone (no deeper than 1 foot above the water table) and preferably in conjunction with the collection of groundwater or soil samples.

4.1.2 Preparation

For **permanent soil vapor sampling probes**, the following sampling preparation procedure is to be followed:

- Create a hole in the soil of at least 1-inch diameter using direct push or an auger to the desired sampling depth (typically 8 feet below grade).

- Insert rigid tubing (e.g., stainless steel) of the appropriate size (typically ⅛- to ¼-inch inner diameter) into the constructed soil probe hole, keeping the bottom of the tubing at least 6 inches off the bottom of the hole and extend it to the surface. Alternatively, install a soil gas implant such as that manufactured by Geoprobe Systems. The Geoprobe Soil Gas Implant consists of double-woven stainless steel screen available in 6-, 14-, and 21-inch lengths. The implant is installed through the bore after the Geoprobe rods have been driven to depth. Flexible tubing (e.g., polyethylene or Teflon-lined polyethylene) is connected to the top of the implant and extended to the surface. Cap the tubing at the surface.

- Place porous backfill material (e.g., glass beads or coarse sand) into soil probe hole around the tubing/implant to create a sampling zone of 1 to 2 feet in length.

- Place a minimum of 6 to 12 linear inches of granular bentonite above the glass beads/sand pack and hydrate with potable water.

- Mix and install at least 3 linear feet of grout (Portland cement with 5% bentonite by weight or a premixed non-shrinking grout) in the annular space around the tubing to prevent direct infiltration of air from the surface. Backfill the remainder of the hole with clean material. For multiple probe depths in one borehole, the annular space should be grouted with bentonite between the probes to create discrete sampling zones.

- Install a protective casing around the top of the probe tubing and grout (e.g., concrete) in place.

For **temporary soil vapor sampling probes**, the installation procedures are identical to those described above with the following exceptions:

- A system such as the Geoprobe Post-Run Tubing (PRT) System may be used to eliminate the need for soil vapor implants, porous backfill, bentonite, and grout. Instead, soil vapor samples are collected using flexible tubing connected directly to a fitting at the bottom of the direct push rods after they have been advanced to depth and withdrawn approximately 6 inches. Soil vapor is drawn in from the open space beneath the rods.

- The interface between the rods and the soil must be sealed at the surface by excavating a small (1 to 3 inches deep) hole around the rods and packing it with hydrated bentonite, forming a slight mound at the surface.

- Direct-push rods and associated tooling must be decontaminated between locations.

4.1.3 Purging and Pre-Sample Testing

Prior to completing probe construction or attempting sample collection, the sample probe should be tested to determine if it will yield vapor for sampling (this is particularly important at sites with low permeability soils). Connect a syringe to the sample tubing and attempt to draw vapor into the syringe several times, sealing the sample tubing between draws. If a vacuum pressure is generated, the syringe plunger will be drawn back in when released and vapor sample collection will not proceed. Alternatively, the pump of an organic vapor or helium detector may be used by connecting the inlet of the operating device to the sample tubing and observing the ability of the pump to operate without creating a vacuum and stopping.

To purge ambient air from the sample tubing and to ensure that representative samples are being collected that are not affected by ambient air, the following steps should be followed:

- Connect the helium detector to the sample tubing to obtain "background" helium concentrations (helium is unlikely to be present in the subsurface at a detectable concentration; however, water vapor and certain organic vapors can interfere with the helium detector yielding a false detection).

- Place the bucket over the sample tube, gasket side down, and slip the sample tube through one of the predrilled holes. Insert a tube from the helium tank through another of the predrilled holes with the tubing outlet just above the ground surface (bottom of the inverted bucket). If a good seal cannot be obtained between the bucket gasket and the ground surface, place a hydrated bentonite seal around the bucket.

- Connect the helium detector to a test port installed near the base of the bucket and release helium into the bucket. The target concentration within the bucket is at least 25% helium.

- Disconnect the helium detector and plug the sample port. Connect the helium detector to the sample tube and measure the helium concentration in the soil vapor. Purge approximately 3 volumes of the tubing using the helium detector (approximately 10 milliliters [ml] per foot for ¼-inch inner diameter tubing).

- If the purge vapor is greater than 1% helium above background, reseal the probe hole with bentonite and repeat the purge/helium test process again. If after two successive attempts, the sample tube penetration cannot be thoroughly sealed, move to a new location or eliminate the soil vapor sample.

- Disconnect the helium detector from the sample tubing and reconnect to the test port in the bucket to ensure that helium was maintained with the test chamber throughout the duration of the test.

- Remove the bucket and helium supply when purging is complete.

- Begin sample collection.

4.1.4 Sample Collection

Soil vapor samples will be collected in specially prepared canisters equipped with a flow controller pre-set for a 1-hour sampling duration. For preparation of the canister and collection of the sample, the following procedure is to be followed:

- Place canister on a stable surface (ground) adjacent to the sample tube.

- Record the canister's serial number on the chain of custody (COC) and field notebook/sample form.

- Assign sample identification on canister ID tag and record on COC and field notebook/sample form.

- Samples should be assigned an ID according to the following convention:

  SID-###-SC/Q

  - SID - Three letter code identifying the site (note that private property information such as street address must not be used in the sample identifier);
  - ### - Sequential location number (note that all samples from a single structure should have the same location ID for grouping of sample types by location ID);
  - SC – Sub-code identifying type of sample (note that additional numeric characters may be added for multiple samples of one type in a single structure);
  - Q - Quality control sample code such as D for duplicate.

  - The matrix codes are as follows:
    - BA - Indoor Air from Basement or Crawlspace
    - FA - Indoor Air, First Floor (not basement)
    - OA - Outdoor Air
    - SS - Sub-slab Vapor
    - SV - Soil vapor
    - TB - Trip Blank

- Remove plug from canister fitting, if equipped.

- Connect the sample tubing to the pressure gauge/flow controller.

- Install pressure gauge/metering valve on canister valve fitting if not already installed. *<For compression fittings [e.g., Swagelok], ensure the ferrule is properly seated, tighten the nut by hand, and complete tightening the nut ¼-turn with a wrench.>*

- Open and close the canister valve, if so equipped. *<Some flow controllers do not include valves and sample collection is initiated immediately when the controller is connected to the canister. In this case, it is important to ensure that the sample tubing is properly connected to the flow controller prior to connecting the flow controller to the sample canister.>*

- Record gauge pressure; vacuum gauge pressure must read -25 in Hg or less or the canister cannot be used without verification from the laboratory that the canister did not leak during transport (i.e., the laboratory should supply the vacuum pressure for the canister when it was measured prior to shipment).

- Open canister valve to initiate sample collection. Observe the gauge pressure after approximately 1 to 2 minutes. The pressures should increase by approximately 1 in Hg per 2 minutes. If the pressure increases too rapidly, there may be a leak in the system and sample collection should be terminated. Identify the leak and recollect the sample using a new cylinder and flow controller.

- Take digital photograph of canister setup and surrounding area.
- Record the start time on COC and in the field notebook/sample form.

Procedure for termination of sample collection:

- Close the canister valve.
- Record the stop time on COC and in the field notebook/sample form. The date of the stop time will be considered the date of sampling for QC purposes.
- Record the final gauge pressure; vacuum gauge pressure should read between approximately -5 and 0 in Hg.
- Disconnect the sample tubing and pressure gauge/flow controller from canister, if applicable.
- Install plug on canister inlet fitting <*and on sample tubing for permanent probes*>.
- Place the sample container in the original box.
- For temporary sampling locations, remove the sample tubing and rods and backfill the hole with clean material.
- Fill in the sample collection log with the appropriate information; including, sample identification, date and time of sample collection, sampling depth, identity of samplers, sampling methods and devices, purge volumes, volume of soil vapor extracted, canisters used, the vacuum before and after samples collected, apparent moisture content (dry, moist, saturated, etc.) of the sampling zone, and log each sample on the COC form.
- All canisters will be returned at the completion of the field sampling to the laboratory by overnight shipment or courier. No work or shipment of samples will be expected on weekends or holidays, without prior notice.

4.2 Sub-slab Vapor Samples

4.2.1 Selection of Sampling Locations

To evaluate the potential for current human exposure within a building, collect sub-slab vapor samples:

- In structures with a concrete slab or other flooring from a central location away from foundation footings and within the soil or aggregate immediately below the basement slab or slab-on-grade. <*The number of sub-slab vapor samples required in a building depends upon the number of slabs (e.g., multiple slabs-on-grade in a large ware-*

house) and foundation types (e.g., combined basement and slab-on-grade in a residence). At least one sub-slab sample should be collected from each representative area. In structures within partial slabs or utility pads, collect the sub-slab vapor sample from beneath the pad>.

- In structures with dirt floors (basement or crawlspaces), sub-slab samples are not collected but indoor air samples in the basement or crawlspace will be collected.

4.2.2 Preparation

For the sub-slab vapor sampling, the following sampling preparation procedure is to be followed for concrete basement/floor slabs:

- Drill a ½-inch diameter hole (or appropriate size for the sample tubing to be used) completely through the concrete floor slab using an electric rotary hammer drill and masonry bit; brush the concrete dust away from the hole. Record the approximate thickness of the slab.

- Drill a 1-inch diameter hole (nominal diameter) 1 to 2 inches into the concrete floor centered on the ½-inch hole. *<The 1-inch diameter hole may be drilled first at the discretion of the field team leader>*.

- Sweep excess concrete dust away from the drill hole and clean the hole with a ½-inch bottle brush.

- Insert flexible tubing through the hole with the bottom no more than 2 inches below the bottom of the slab.

- Mix a paste of bentonite and water. Place the bentonite paste at the bottom of the 1-inch diameter drill hole around the tubing and form a small mound over the area to seal the interface between the tubing and the concrete.

- Concrete dust can be cleaned up with a vacuum equipped with a HEPA filter only after the sample tubing is properly sealed and sample collection has begun.

4.2.3 Purging and Pre-Sample Testing

To purge ambient air from the sample tubing and to ensure that representative samples are being collected from beneath the slab, the following steps should be followed:

- Attach the syringe to the sample tubing and withdraw approximately 3 volumes of the sample tubing (approximately 10-ml per foot for ¼-inch inner diameter tubing). *<Note the difficulty with which the air is withdrawn; if it is very difficult to withdraw the purge volume, then the sample tube may be plugged at the bottom and should be reinstalled and repurged. If indoor air sampling is to be conducted, then the purged vapor should be discharged outside to prevent cross-contamination (either cap the syringe or discharge to a Tedlar bag and empty the Tedlar bag outside). Prior to*

discharge, measure the organic vapor concentration of the purged air using a photoionization detector (PID) and record the reading. A PID may be used to purged the sample tubing; however, the exhaust must be captured for discharge outside if indoor air sampling is planned>.

- Begin sample collection.

4.2.4 Sample Collection

For preparation of the canister and collection of the sub-slab vapor sample, the procedure described in Section 4.1.4 is to be followed with the following exceptions:

- Flow controllers must be set for a **24-hour** collection period.

- Upon initiation of sample collection, the pressure should not appear to change in a short period. If the pressure increases too rapidly, there may be a leak in the system and sample collection should be terminated. Identify the leak and recollect the sample using a new cylinder and flow controller.

- When possible, return to the sample location after approximately 1 hour to verify that sample collection is progressing (the gauge pressure should increase by approximately 1 in Hg per hour).

4.3 Indoor Air Samples

4.3.1 Selection of Sampling Locations

To characterize contaminant concentration trends and potential exposures within a building, collect indoor air samples

- From the crawlspace area;

- From the basement (where vapor infiltration is suspected or in a central location) at a height approximately 3 feet above the floor to represent a height at which occupants normally are seated and/or sleep;

- From the lowest level living space (in centrally-located, high-use areas) at a height approximately 3 feet above the floor to represent a height at which occupants normally are seated and/or sleep; and

- If in a commercial setting (e.g., a strip mall), from multiple tenant spaces at a height approximately 3 feet above the floor to represent a height at which occupants normally are seated.

4.3.2 Preparation

- Conduct a pre-sampling inspection prior to each sampling event to identify conditions that may affect or interfere with the proposed testing including the type of structure,

floor layout, physical conditions, and airflows of the building(s) being studied. *<Many State health departments provide reporting forms for this information. For example, in New York State use the NYS Department of Health Indoor Air Quality Questionnaire and Building Inventory form. This form is attached for reference and may be modified for use outside of New York.>*

- Conduct a product inventory to identify potential air sampling interference by characterizing the occurrence and use of chemicals and products throughout the building, keeping in mind the goal of the investigation and site-specific contaminants of concern. *<For example, it is not necessary to provide detailed information for each individual container of like items. However it is necessary to indicate that "20 bottles of perfume" or "12 cans of latex paint" were present with containers in good condition>*.

- Take inventory of each room on the floor of the building being tested and on lower floors, if possible. *<This is important because even products stored in another area of a building can affect the air of the room being tested. For example, when testing for a petroleum spill, all indoor sources of petroleum hydrocarbons should be scrutinized. These can include household and commercial products containing volatile organic compounds (VOCs), petroleum products including fuel from gasoline-operated equipment, unvented space heaters and heating oil tanks, storage and/or recent use of petroleum-based finishes and paints or products containing petroleum distillates. This information should be detailed on the Product Inventory Form>*.

- Draw plot sketches of the building interior (crawlspace, basement, and/or first floor) that includes sample locations, possible indoor air pollution sources, floor types, footings that create separate foundation sections, and vapor intrusion pathways into the building (cracks, utility penetrations, sumps, etc.).

- If the inventory identifies indoor sources of air contamination that may interfere with the objectives of the investigation, the following measures should be implemented:

- Remove products or eliminate activities that may result in the release of volatile chemicals from the indoor environment prior to testing.

- Make sure all containers storing volatile chemicals are tightly sealed.

- Ventilate building by operating the building's heating ventilation and air conditioning (HVAC) system to maximize outside air intake or open windows/doors and operate exhaust fans if the building has no HVAC system.

- Note any measures taken to control indoor air interferences on the building inspection form.

- Do not begin sample collection for at least 24 hours after implementing these measures.

FOR 24 HOURS PRIOR TO SAMPLING, ALL REASONABLE MEASURES SHOULD BE TAKEN TO AVOID:

- Opening any windows, fireplace dampers, openings, or vents;
- Operating ventilation fans unless special arrangements are made;
- Smoking in the house;
- Painting;
- Using wood stoves, fireplaces or other auxiliary heating equipment (e.g., kerosene heaters);
- Operating or storing automobiles in an attached garage;
- Allowing containers of gasoline or oil to remain within the house, except for fuel oil tanks;
- Cleaning, waxing, or polishing furniture or floors with petroleum- or oil-based products;
- Using air fresheners or odor eliminators;
- Engaging in any hobbies that use materials containing volatile organic chemicals;
- Using cosmetics, including hairspray, nail polish, nail polish removers, perfume/cologne, etc.;
- Applying pesticides; and
- Storing recently dry-cleaned clothing and materials.

4.3.3 Purging and Pre-Sample Testing

- Use portable vapor monitoring equipment readings (e.g., PIDs for VOCs, Mercury Vapor Analyzer for mercury) to evaluate potential sources of chemical products stored in the building. Due to the low detection limits typically achieved for air sampling, a PID capable of measuring VOCs in the parts-per-billion (ppb) range is recommended. However, the ionization potential of the chemicals of interest must be considered when selecting a PID.
- Take inventory of products stored in buildings **every time** air is tested. *<If available, chemical ingredients of interest should be recorded for each product. If the ingredi-*

ents are not listed on the label, record the product's exact and full name, and the manufacturer's name, address and phone number, if available. In some cases, Material Safety Data Sheets may be useful for identifying confounding sources.>

4.3.4 Sample Collection

For preparation of the canister and collection of the indoor air sample, the procedure described in Section 4.2.4 is to be followed with the following exceptions:

- The canister may be placed on a stable surface approximately 3 feet above the floor or it may be placed on the floor with flexible sample tubing extended from the canister to a collection height of approximately 3 feet.

4.4 Outdoor Air Samples

4.4.1 Selection of Sampling Locations

To characterize "background" contaminant concentrations in ambient air, collect outdoor air samples from a representative upwind location:

- Whenever indoor air sampling is being conducted;
- Away from wind obstructions (e.g., trees or bushes); and
- At a height above the ground to represent breathing zones (3 to 5 feet).

A representative sample is one that is not biased toward obvious sources of volatile chemicals (e.g., automobiles, lawn mowers, oil storage tanks, gasoline stations, industrial facilities, etc.). Outdoor ambient air samples should be collected at the rate of one per day in the vicinity of indoor air sample locations.

4.4.2 Preparation

The following actions should be taken to document conditions during outdoor air sampling and ultimately to aid in the interpretation of the sampling results:

- Draw a plot sketch of the sampling area that includes sample locations, buildings and other nearby structures, possible sources of outdoor air pollution (industries, gas stations, repair shops, etc.), and wind direction.
- Record weather (e.g., precipitation, temperature, and barometric pressure); and
- Record any pertinent observations, such as odors, readings from field instrumentation, and significant activities in the vicinity (e.g., operation of heavy equipment or dry cleaners).

4.4.3 Purging and Pre-Sample Testing

None.

4.4.4 Sample Collection

For preparation of the canister and collection of the outdoor air sample, the procedure described in Section 4.3.4 is to be followed.

5. Quality Assurance

5.1 Quality Assurance/Quality Control Samples

Field quality control (QC) samples may include duplicates and trip blanks, as determined on a site-specific basis. Duplicate samples provide insight as to the homogeneity of the sample matrix and establish a degree of confidence that the sample represents site conditions. The relative percent difference between the concentrations in the original and duplicate samples measure the overall precision of the field sampling and analytical method. Field duplicates must be collected at a rate that satisfies the data quality objectives of the program and can be project specific. In the absence of project-specific requirements, collect duplicates at the rate of one duplicate per 20 original samples (5%).

Trip blanks are collected to establish that the transport of sample canisters to and from the field does not result in the contamination of the sample from external sources. Trip blanks consist of an unopened, precleaned, certified canister shipped from the laboratory with the sample collection canisters, stored on site with the sample collection canisters, and returned to the laboratory unopened. Typically, trip blanks are submitted for analysis with each sample shipment. However, the applicability of trip blanks must be determined on a site-specific basis since they are not required by the analytical method (typically TO-15). It is not possible to mimic round-trip shipping conditions with a single trip blank since sample canisters are shipped from the lab under vacuum pressure and are returned to the lab at or close to ambient pressure.

Field QC sample results must be assessed during data review.

5.2 Sample Analysis

All air and vapor samples will be analyzed using USEPA Method TO-15 or another approved method suitable to meet the data quality objectives of the project. Analyses must be performed by a laboratory certified for the particular analysis in the State or Federal program in which the project is being conducted. In New York State, laboratories must be certified by the NYSDOH ELAP. The analyte list must be selected to comply with the data quality objectives of the project. For example, chlorinated solvents may be selected for drycleaner sites and aromatic/petroleum hydrocarbons may be selected for fuel spill sites. Reporting limits should be approximately 1 microgram per cubic meter ($\mu g/m^3$) for all compounds, unless otherwise specified to meet data quality objectives. For example, in New York State, a reporting limit of 0.25 $\mu g/m^3$ must be met for trichloroethene in indoor and outdoor air samples.

6. Health and Safety

The type of personnel protective equipment (PPE) to be used during sampling is outlined in the site-specific Health and Safety Plan (HASP) and is contaminant specific. The HASP should be reviewed with specific emphasis placed on the safety procedures to be followed. Standard safe operating practices should be followed, such as minimizing contact with potential contaminants in both the vapor phase and liquid matrix through the use of respirators and protective clothing during soil vapor sampling. Typically, exposure to contaminants is minimal during sub-slab vapor, indoor air, and outdoor air sampling and PPE is not required; however, this must be determined on a site- and location-specific basis.

7. References

New York State Department of Health, February 2005, *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, Public Comment Draft.

United States Environmental Protection Agency, November 2002, *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)*, EPA530-D-02-004.

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name _____ Date/Time Prepared _____

Preparer's Affiliation _____ Phone No._____

Purpose of Investigation_____

Property Address:_____

Location/Sample ID:_____

1. OCCUPANT: Interviewed: Y / N

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: Y / N**

Last Name: _____First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

3. BUILDING CHARACTERISTICS -Type of Building: (Circle appropriate response)

Residential	School	Commercial / Multi-use
Industrial	Church	Municipal / Government
Other (Describe): _____		

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)? Y / N If yes, how many? _____

Other Building Characteristics:

Number of floors_____ Approx. building age_____

Is the building insulated? Y / N How air tight? Tight / Average / Not Tight

4. AIRFLOW
Qualitatively describe:

Airflow between floors

_____
_____
_____

Airflow near source

_____
_____
_____

Outdoor air infiltration

_____
_____
_____

Infiltration into air ducts

_____
_____
_____

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick	other _____
b. Basement type:	full	crawlspace	slab	other _____	
c. Basement floor:	concrete	dirt	stone	other _____	
d. Basement floor:	uncovered	covered	covered with _____		
e. Concrete floor:	unsealed	sealed	sealed 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		
j. Sump present?	Y / N				
k. Water in sump?	Y / N / NA				
l. Sump covered/sealed?	Y / N / NA				
m. Floor drains present?	Y / N / NA				
n. Perimeter trench drains present?	Y / N / NA				
o. Indoor cisterns/drywell?	Y / N / NA				
p. Laundry chute to 1st or 2nd Floors?	Y / N / NA				

Basement/Lowest level depth below grade: _____(feet)

Identify and describe potential soil vapor entry points and approximate size (e.g., floor cracks, utility ports, floor drains, wall cracks, weeps, or indoor wells)

_____

_____

_____

Other Comments: _____

_____

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply) Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other _____

Approximate age of heating system(s): _____

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: _____

Fuel oil storage location/condition/size, if applicable:_____

Boiler/furnace located in: Basement Outdoors Main Floor Other _____

Storage wood or coal: Basement Outdoors Main Floor Other _____

Fireplace(s) located in: Basement Main Floor Other _____

Air conditioning: Central Air Window units Open Windows None

Dehumidification: Stand alone unit Located on central air system

Are there air distribution ducts present? Y / N

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.

_____

_____

_____

_____

7. OCCUPANCY Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., family room, bedroom, laundry, workshop, storage)**
Basement	_____
1st Floor	_____
2nd Floor	_____
3rd Floor	_____
4th Floor	_____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / N

b. Does the garage have a separate heating unit? Y / N / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car, boat) Y / N / NA
Please specify_____

d. Has the building ever had a fire? Y / N When?_____

e. Is a kerosene or unvented gas space heater present? Y / N Where? _____

f. Is there a workshop or hobby/craft area? Y / N Where & Type? _____

g. Is there smoking in the building? Y / N How frequently? _____

h. Have cleaning products been used recently? Y / N When & Type? _____

i. Have cosmetic products been used recently? Y / N When & Type? _____

j. Has painting/staining been done in the last 6 months? Y / N Where & When? _____

k. Is there new carpet, drapes or other textiles? Y / N Where & When? _____

l. Have air fresheners been used recently? Y / N When & Type? _____

m. Is there a kitchen exhaust fan? Y / N If yes, where vented? _____

n. Is there a bathroom exhaust fan? ☐ Basement ☐ First floor Y / N If yes, where vented? _____

o. Is there a clothes dryer? ☐ Gas ☐ Electric Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type? _____

q. Basement windows? Type: Casement Awning Glass block Condition: _____

r. Are there exterior doors in the basement (e.g. "Bilco") Y / N / NA

Are there odors in the building? Y / N
If yes, please describe: _____

Do any of the building occupants use solvents at work? Y / N (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? Y / N

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
Yes, 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? Y / N Date of Installation: _____

Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply:	Public Water	Drilled Well	Driven Well	Dug Well	Other: _____
Sewage Disposal:	Public Sewer	Septic Tank	Leach Field	Dry Well	Other: _____

11. OTHER ENVIRONMENTAL HAZARDS OBSERVED
Note factors that may impact vapor mitigation system installation or other construction activities:

A. Asbestos: Yes No Suspected

1. Location & Estimated Quantity: _____

_____

2. General Condition: Good Fair Poor

3. Other Comments: _____

_____

B: Lead Paint: Yes No Suspected

1. Location & Estimated Quantity: _____

_____

2. General Condition: Good Fair Poor

3. Other Comments: _____

_____

12. Photographs

Photograph the basement and first floor of the building including possible air sampling locations and/or possible indoor air pollution sources. Include photo ID, compass direction, date, and subject.

Photo ID:	**Direction:**	**Date/Time:**
Subject:		

Photo ID:	**Direction:**	**Date/Time:**
Subject:		

Photo ID:	**Direction:**	**Date/Time:**
Subject:		

13. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note. **Include compass orientation or reference to street or front of house.**

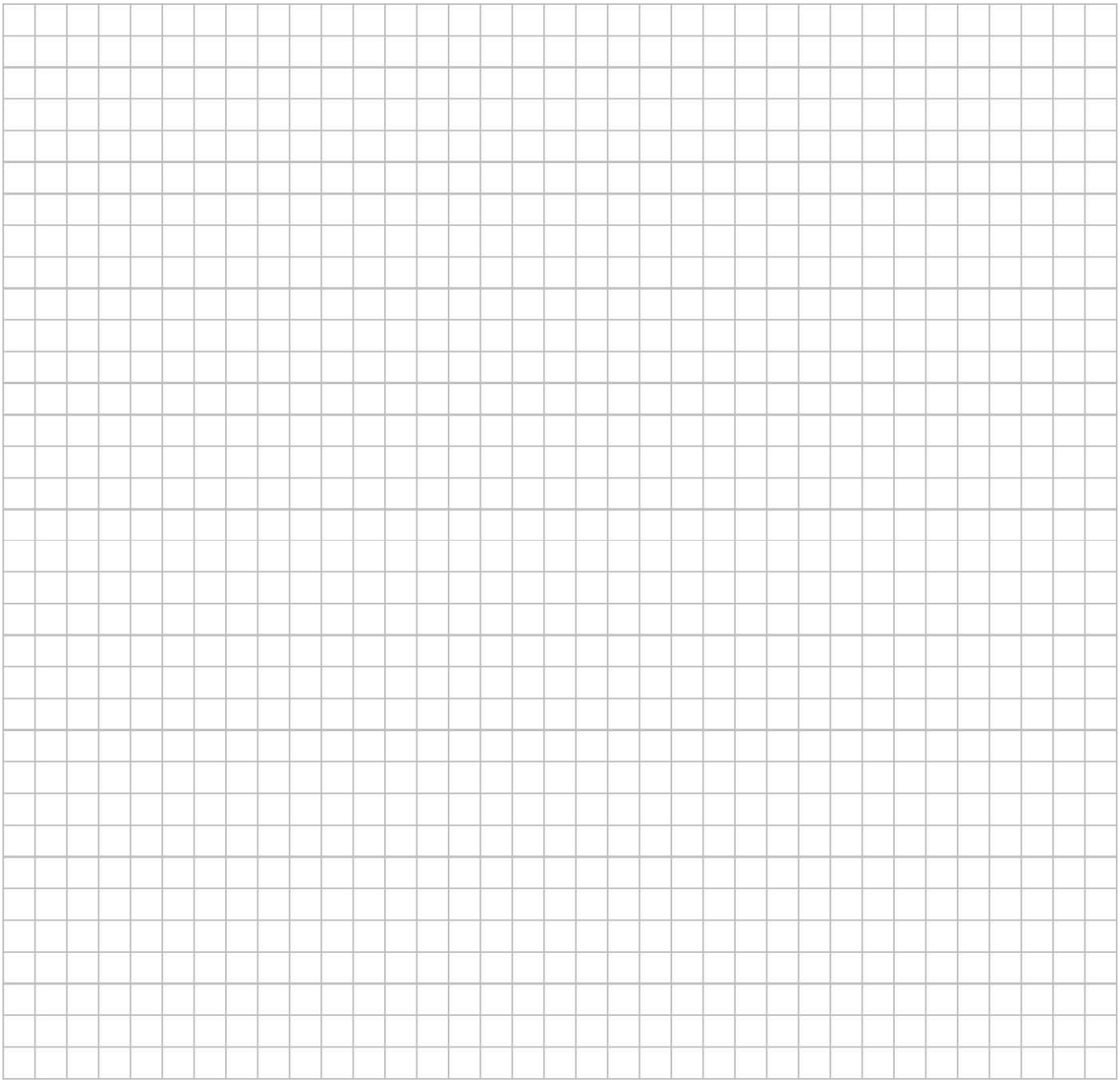
Basement:

First Floor:

14. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.



15. PRODUCT INVENTORY FORM **Page ___ of ___**

Make & Model of field instrument used: _____

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition *	Chemical Ingredients	Field Instrument Reading (units)	Photo Y / N **

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

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

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Soil Vapor Intrusion/Indoor Air Sampling Data Collection Form

Site Name:	Project No.:

Sample Location Information

Location ID/Description:

Address:	City:	State:

Sampler Names (Print):

Building Inspection & Inventory Performed? ☐ Yes ☐ No

Organic Vapor Meter Used: ☐ PID ☐ FID Model:

		Sub-slab Vapor	Basement Air	First-floor Air	Outdoor Air			
Sample ID								
Canister No.								
Regulator No.								
Duration (hours)								
Start	Date							
	Time							
	Pressure							
End	Date							
	Time							
	Pressure							
Quality Control								
OVM (ppb)								
Analysis Method								

Laboratory:	Date Shipped to Lab:

Associated Trip Blank Sample ID:

Comments:

Key: FID = flame-ionization detector
OVM = organic vapor meter
PID = photo-ionization detector
ppb = parts per billion
Pressure measured in inches of mercury, gauge (in Hg)

Implants Operation

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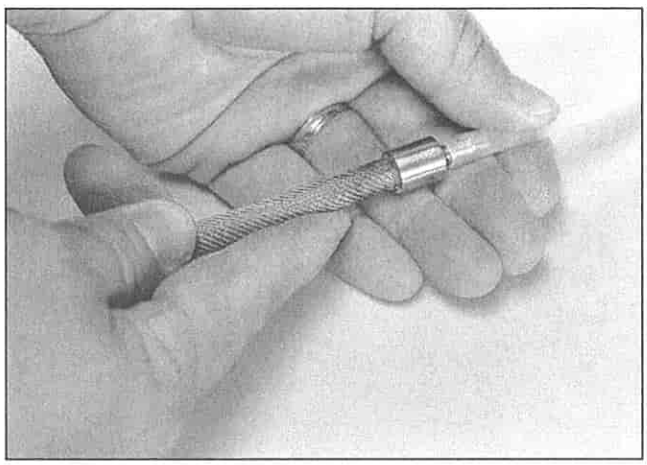


Attaching polyethylene tubing to the sampling implant.

Sampling Implants – Operation

Installation Instructions for Soil Gas Implants

1. Drive probe rods to the desired depth using a Point Holder (AT-13B) and an Implant Anchor/Drive Point (PR-14). DO NOT disengage the drive point when depth has been reached.

2. Attach appropriate tubing to the implant **(Figure 1)**. If tubing is pre-cut, allow it to be approximately 48 in. (1219 mm) longer than the required depth of the implant. Cover or plug the open end of the tubing.

3. Remove pull cap and lower the implant and tubing down inside the diameter of the probe rods until the implant hits the top of the Anchor/Drive Point. Note the length of the tubing to assure that proper depth has been reached.

4. Rotate tubing counterclockwise while exerting a gentle downward force to engage the PRT threads **(Figure 2)**. Pull up on the tubing lightly to test the connection. DO NOT cut excess tubing.

5. Position a Probe Rod Pull Plate or Manual Probe Rod Jack on the top probe rod. Exert downward pressure on the tubing while pulling the probe rods up. Pull up about 12 in. (305 mm).

6. If using 1/4-in. (6,4 mm) O.D. tubing or smaller, thread the excess tubing through the Implant Funnel and position it over the top probe rod. If using larger tubing, it may not be possible to install the glass beads.

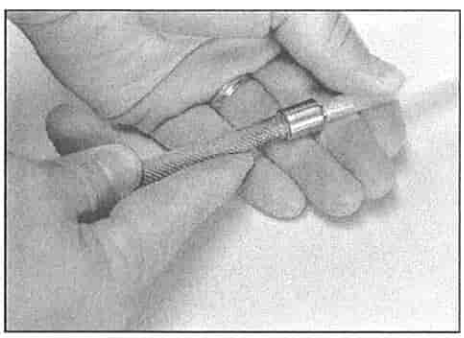


Figure 1. Attaching tubing to the sampling implant.

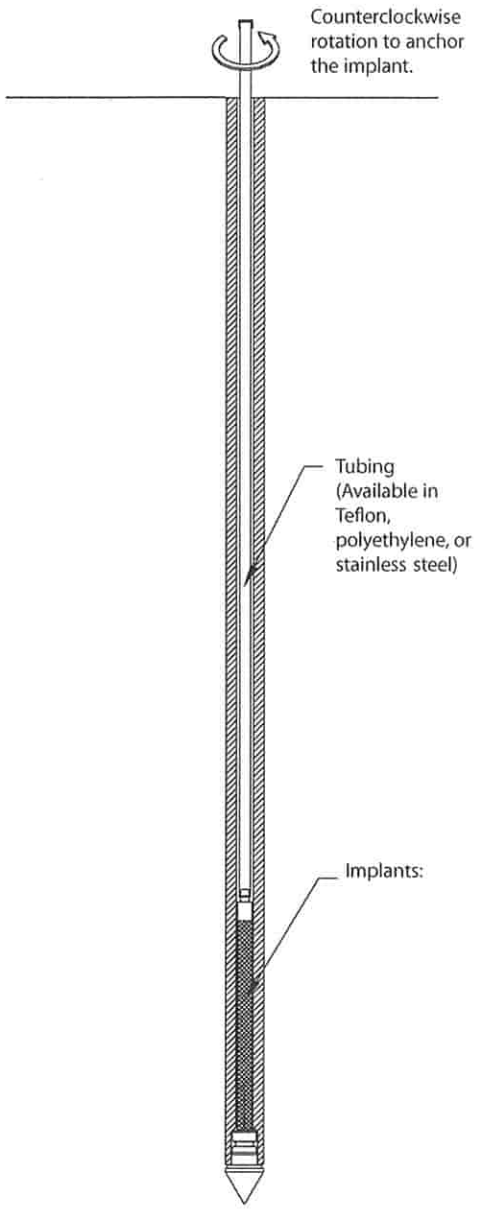


Figure 2. Once depth is achieved, the selected implant and tubing are inserted through the rods. The tubing is rotated to lock the implant into the drive point.

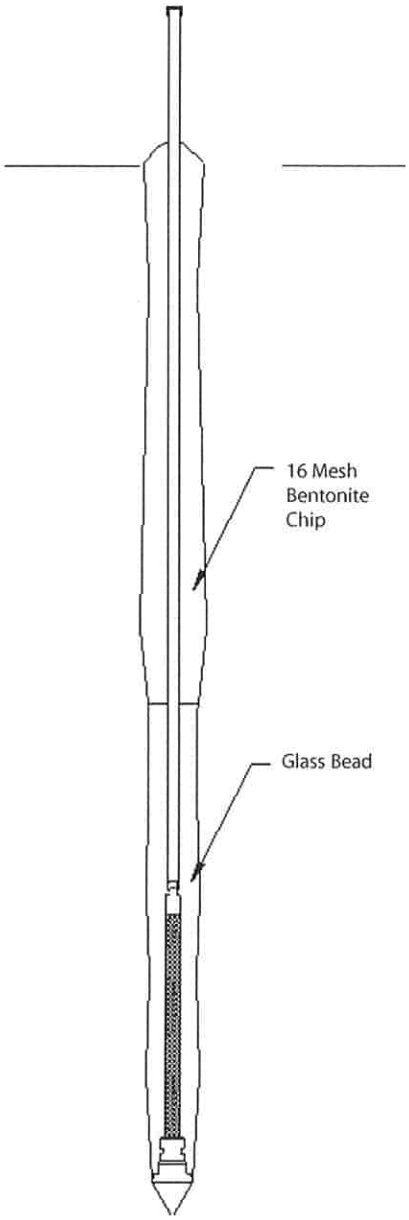


Figure 4. After the implant has been secured, the rods are removed and the annulus backfilled as appropriate.

7. Pour glass beads down the inside diameter of the probe rods around the outside of the tubing. Use the tubing to "stir" the glass beads into place around the implant. Do not lift up on tubing. It should take less than 150 mL of glass beads to fill the space around the implant.

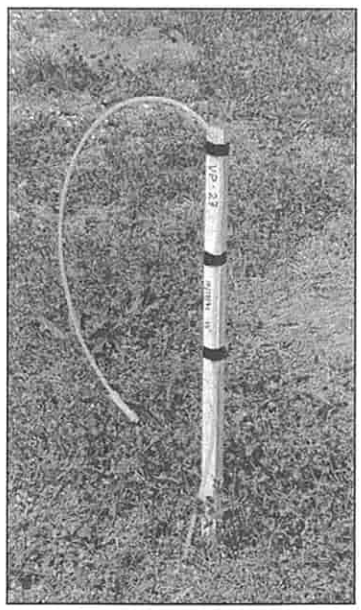
   NOTE: Backfilling through the rods with glass beads or glass beads/bentonite mixes can only be performed in the Vadose Zone, not below the water table.

8. Lift up an additional 18 to 24 in. (457 to 610 mm) and pour the bentonite seal mixture into place as in Step 7. The volume to be filled is about 154 mL per foot. It may be necessary to "chase" the seal mixture with distilled water to initiate the seal.

9. Pull the remaining rods out of the hole as in Step 5. Backfilling with sackcrete (cement/sand) or bentonite/sand may be done while removing the rods **(Figure 4)**. If the PR-14 Implant Anchor is used, the tubing may be cut flush with the top probe rod and a regular pull cap may be used to remove the remaining probe rods after Step 8.

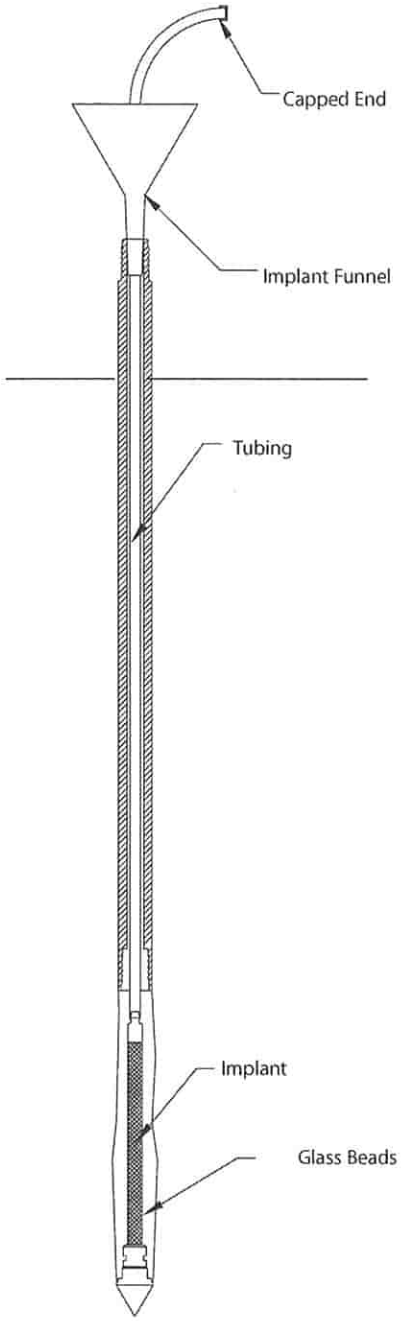
10. After the probe rods have been removed, cut the tubing at the surface, attach a connector or plug, and mark the location with a pin flag or stake. The point is ready for sampling now.

Figure 3. Glass Beads create a permeable layer around vapor sample implants.

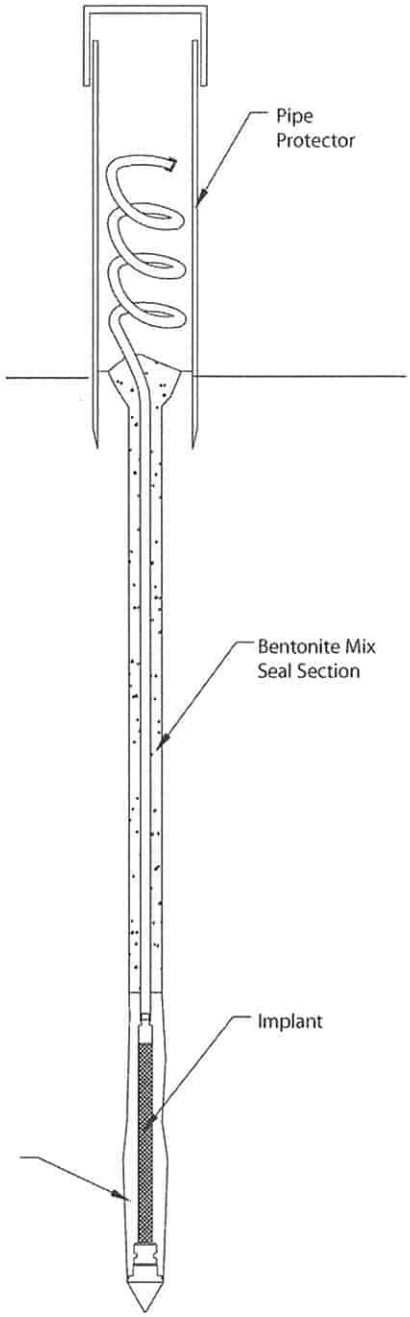


A vapor implant location.

Sampling Implants – Operation



Backfill materials include glass beads and bentonite sealants.



Example of completed permanent soil gas monitoring point.

Soil Gas Sampling – PRT System Operation

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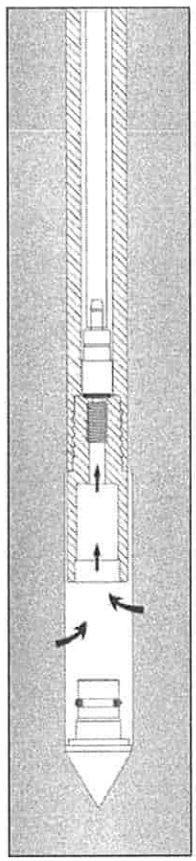


Soil Gas Sampling using the Post-Run Tubing (PRT) System.

Soil Gas Sampling — PRT System Operation

Basics

Using the Post-Run Tubing System, one can drive probe rods to the desired sampling depth, then insert and seal an internal tubing for soil gas sampling. The usual Geoprobe probe rods and driving accessories and the following tools are required:

- PRT Expendable Point Holder
- PRT Adapter
- Selected PRT Tubing

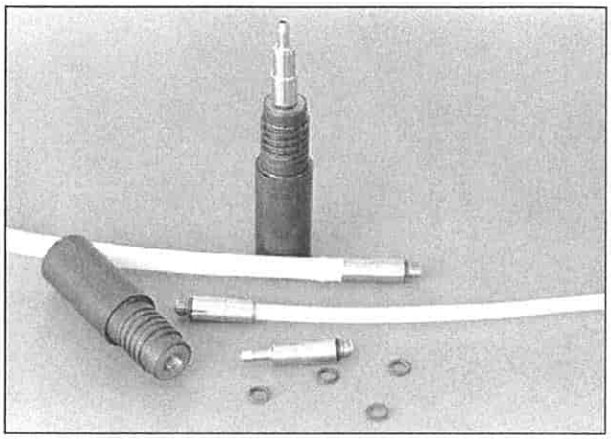
Preparation

1. Clean all parts prior to use. Install O-rings on the PRT Expendable Point Holder and the PRT adapter.
2. Inspect the probe rods and clear them of all obstructions.
3. TEST FIT the adapter with the PRT fitting on the expendable point holder to assure that the threads are compatible and fit together smoothly.

   NOTE: PRT fittings are left-hand threaded.

4. Push the adapter into the end of the selected tubing. Tape may be used on the outside of the adapter and tubing to prevent the tubing from spinning freely around the adapter during connection – especially when using Teflon tubing **(Figure 1)**.

   REMEMBER: The sample will not contact the outside of the tubing or adapter.



PRT SYSTEM PARTS
PRT Expendable Point Holder, PRT Adapters, Tubing, and O-rings.

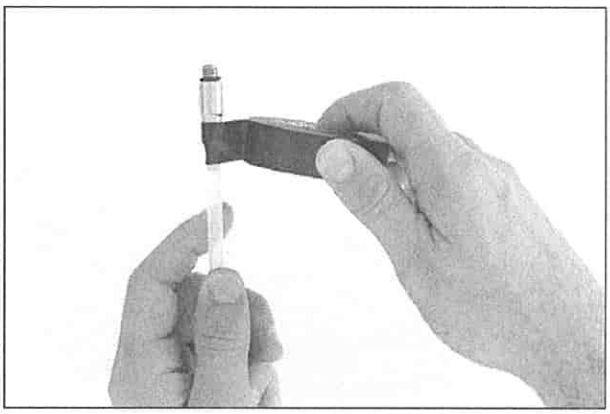


Figure 1. Securing adapter to tubing with tape. NOTE: Tape does not contact soil gas sample.

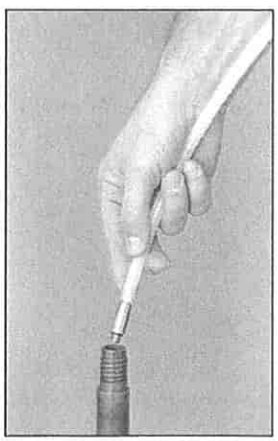


Figure 2. Insertion of tubing and PRT adapter.

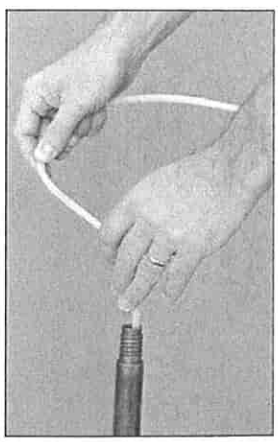
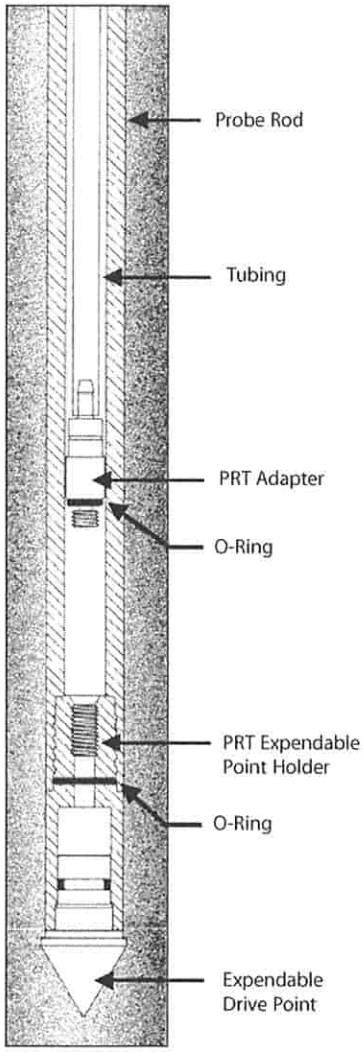


Figure 3. Engaging threads by rotating tubing.

Soil Gas Sampling — PRT System Operation



A cross section of probe rods driven to depth and then retracted to allow for soil gas sampling. The PRT adapter and tubing are now fed through the rods and rotated to form a vacuum-tight connection at the point holder. The result is a continuous run of tubing from the sample level to the surface.

Probing

Drive the PRT tip configuration into the ground. Connect probe rods as necessary to reach the desired depth. After depth has been reached, disengage the expendable point by pulling up on the probe rods. Remove the pull cap from the top probe rod, and position the Geoprobe unit to allow room to work.

Connection

1. Insert the adapter end of the tubing down the inside diameter of the probe rods **(Figure 2)**.

2. Feed the tubing down the rod bore until it hits bottom on the expendable point holder. Allow about 2 ft. (610 mm) of tubing to extend out of the hole before cutting it.

3. Grasp the excess tubing and apply some downward pressure while turning it in a counterclockwise motion to engage the adapter threads with the expendable point holder **(Figure 3)**.

4. Pull up lightly on the tubing to test engagement of the threads. (Failure of adapter to thread could mean that intrusion of soil may have occurred during driving of probe rods or disengagement of drive point.)

Sampling

1. Connect the outer end of the tubing to the Silicone Tubing Adapter and vacuum hose (or other sampling apparatus).

2. Follow the appropriate sampling procedure for collecting a soil gas sample **(Figure 1)**.

Removal

1. After collecting a sample, disconnect the tubing from the vacuum hose or sampling system.

2. Pull up firmly on the tubing until it releases from the adapter at the bottom of the hole. (Taped tubing requires a stronger pull.)

3. Remove the tubing from the probe rods. Dispose of polyethylene tubing or decontaminate Teflon tubing as protocol dictates.

4. Retrieve the probe rods from the ground and recover the expendable point holder with the attached PRT adapter.

5. Inspect the O-ring at the base of the PRT adapter to verify that proper sealing was achieved during sampling. The O-ring should be compressed. This seal can be tested by capping the open end of the point holder applying vacuum to the PRT adapter.

6. Prepare for the next sample.

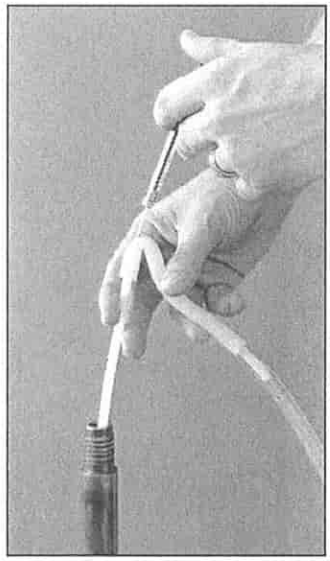


Figure 1. Taking a soil gas sample for direct injection into a GC with the PRT system.

ecology and environment, inc.

STANDARD OPERATING PROCEDURE

DRUM AND CONTAINER HANDLING AND SAMPLING

SOP NUMBER: ENV 3.31

REVISION DATE: 11/30/2017 **SCHEDULED REVIEW DATE: 11/30/2022**

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1 Scope and Application

This standard operating procedure (SOP) describes procedures used by Ecology and Environment, Inc. (E & E) for collecting samples from drums, tanks, vaults, and smaller containers in order to identify and characterize the material or waste for handling, management, transportation, and/or disposition. These procedures apply to drums, containers, tanks, and vaults such as those for which the contents are completely unknown and could contain hazardous materials or waste; drums containing purge water from groundwater well sampling; drums containing water resulting from decontamination activities; drums containing waste drill cuttings; lab pack drums and their contents; and miscellaneous small containers. Tanks and vaults containing hazardous substances will be handled in a manner similar to that for drums and containers, taking into consideration the size and orientation of the tank or vault. Specific handling and sampling procedures may vary depending on the data quality objectives (DQOs) identified in project planning documents. Procedures in this SOP are designed to meet the requirements of Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response regulations in Title 29 of the Code of Federal Regulations, Part 1910.120 (29 CFR 1910.120). Elements of these procedures are based on paragraph (j) of the standard, entitled Handling Drums and Containers (29 CFR 1910.120[j]).

This SOP does not include the sampling of containers or cylinders known to contain compressed gases.

Because the investigation of unknown drums and containers is one of the more hazardous activities that E & E conducts, this SOP addresses more health and safety-related information than is normally addressed in a procedural SOP. This SOP is intended for use by personnel who have knowledge, training, and experience in the drum and container sampling activities being conducted.

Other E & E SOPs that also would typically apply to drum and container sampling include the following:

- DOC 2.1, Field Activity Logbooks;
- ENV 3.2, Site Entry Procedures for Potentially Contaminated Sites;
- ENV 3.15, Sampling and Field Equipment Decontamination;
- ENV 3.16, Environmental Sample Handling, Packaging, and Shipping; and
- ENV 3.26, Handling Investigation-Derived Wastes.

2 Definitions and Acronyms

Bung	A threaded cap used to seal bung holes in a drum head or lid
Chine	A ridge in a metal drum
COLIWASA	Composite liquid waste sampler
DQO	Data quality objective
DOT	(United States) Department of Transportation
E & E	Ecology and Environment, Inc.
EPA	(United States) Environmental Protection Agency

NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PVC	Polyvinyl chloride
QA	Quality assurance
QC	Quality control
SHASP	Site-specific health and safety plan
SOP	Standard operating procedure

3 Procedure Summary

Prior to sampling, drums and containers will be safely inspected, inventoried, staged if necessary, and opened. Drums and containers are usually opened manually but can be opened remotely using specialized tools and equipment as necessary to ensure the health and safety of personnel. Drum and container sampling involves the selection and use of appropriate, often specialized, sampling devices.

4 Cautions

Cautions related to health and safety are discussed in Section 8, Health and Safety, and in certain procedural steps in Section 6, Procedure.

Drums and containers used for any site clean-up or investigation waste will be handled, transported, labeled, and disposed of according to appropriate United States Department of Transportation (DOT), OSHA, and United States Environmental Protection Agency (EPA) regulatory requirements.

5 Equipment and Supplies

Project planning documents will provide direction on specific equipment and supplies for handling and sampling drums and containers. In general, the use of dedicated or disposable equipment is preferred, to reduce the potential for cross-contamination between sampling locations, but equipment may be reused after thorough decontamination between sample locations. The following are standard equipment and supplies for sampling drums and containers:

- Drum/container marking and labeling supplies (e.g., paint, paint markers, tags, labels, bands);
- Vapor and temperature monitoring devices;
- Grounding equipment;
- Sample data sheets (such as those in Appendix A);
- Heavy equipment (e.g., forklift, grappler) or carts to move drums;
- Drum opening devices;
- Small container opening tools (prying tools, pliers, screwdriver, cutter, etc);
- Drum and container sampling devices (discussed in Sections 6.6 and 6.7);
- Sample containers;

- Spill containment supplies; and
- Ancillary equipment and supplies (e.g., sample preservatives, camera, field logbook, sample custody and documentation supplies, decontamination supplies, sample packaging/shipping supplies, safety supplies, and waste handling supplies).

Specific types of drum opening devices are described below.

Bung Wrench

A common method for opening drums manually is using a universal bung wrench, which has fittings made to remove nearly all commonly encountered bungs. Bung wrenches are usually constructed of cast iron, brass, or a bronze-beryllium nonsparking alloy formulated to reduce the likelihood of sparks. The use of a nonsparking wrench does not completely eliminate the possibility of sparks being produced.

Drum Deheader

One means by which a closed-head drum can be opened manually when a bung is not removable with a bung wrench is by using a drum deheader. This tool is constructed of forged steel with an alloy steel blade and is designed to cut the lid of a drum off or part way off by means of a scissors-like cutting action. A limitation of this device is that it can be attached only to closed-head drums. Drums with removable heads must be opened by other means.

Hand Pick, Pickaxe, and Hand Spike

These tools are usually constructed of brass or a nonsparking alloy with a sharpened point that can penetrate the drum lid or head when the tool is swung. The hand picks or pickaxes that are most commonly used are commercially available, whereas the spikes are generally uniquely fabricated 4-foot-long poles with a pointed end.

Backhoe Spike

A means to open drums remotely is the use of a metal spike attached or welded to a backhoe bucket or similar equipment.

Hydraulic Devices

Hydraulic devices used to open drums remotely use hydraulic pressure to pierce through the wall of a drum. An example of such a device consists of a manually operated pump that pressurizes oil through a length of hydraulic line.

Pneumatic Devices

A pneumatic bung remover consists of a compressed air supply that is controlled by a heavy-duty, two-stage regulator. A high-pressure air line of desired length delivers compressed air to a pneumatic drill, which is adapted to turn a bung fitting selected to fit the bung to be removed. An adjustable bracketing system positions and aligns the pneumatic drill over the bung. This bracketing system must be attached to the drum before the drill can be operated. Once the bung has been loosened, the bracketing system is removed before the drum is sampled. This remote bung opener does not permit the slow venting of the drum and, therefore, appropriate

precautions must be taken. It also requires the drum to be upright and relatively level. Bungs that are rusted shut cannot be removed with this device.

6 Procedure

6.1 General Considerations

The initial assessment made of the site and areas where drums and containers are located will help inform health and safety decisions. Procedures for site entry are discussed in SOP ENV 3.2, Site Entry Procedures for Potentially Contaminated Sites.

Because there is a potential for accidents or spills to occur during handling of any drum or container, they should only be handled if necessary and should be handled with caution. Until the contents of a drum or container are identified or characterized, field personnel should assume that an unlabeled or unmarked drum/container contains hazardous materials or waste. Prior to the movement of drums or containers, all workers exposed to the transfer operation shall be warned of the potential hazards associated with the contents of the drums or containers.

Small, non-drum containers that E & E encounters may contain used or expired chemicals or process chemical samples from laboratories, hospitals, and similar institutions. These small containers may have been filled and stored with inadequate consideration of chemical compatibility, and may be found in cabinets, on shelves, in boxes, or packed in lab pack drums. These small containers may contain shock-sensitive, explosive, highly volatile, highly corrosive, very toxic, exotic, or radioactive materials and should be considered hazardous until identified or characterized. Small containers also can pose unique handling challenges because they are often composed of materials such as glass, paper, fiber, plastic, or other materials not typically associated with sturdy waste or storage containers, and even can consist of inappropriate containers not designated for such use (e.g., food/beverage containers, plastic bags). The use of non-sturdy, incompatible, or inappropriate containers can lead to an increased likelihood of container rupture, breakage, or spillage during handling. A qualified chemist or chemically trained individual should therefore be part of the project team.

6.2 Drum/Container Inspection and Inventorying

Prior to any container moving, opening, and/or sampling, the drums/containers should be inspected, inventoried in place, and labeled. A description of each container (e.g., size, color, material of construction), its condition, labels, markings, and the location where it was found or stored will be recorded on a data sheet (see example in Appendix A). Drums and containers should be inspected for the following:

- Labels, markings, and other identifying information;
- Condition (age, corrosion, rust marks, punctures, bulges, and deformation). If available, a thermal imaging camera can be used to determine if the drum/container has contents and, in some cases, if they are reacting exothermically. Mark on the container the presumed level of material in the container;
- Temperature;
- Detection of vapors around container;
- Observation of leaks;

- Observation of surface staining; and
- Physical instability (e.g., stacked drums or drums on damaged pallets).

The inventorying step involves documenting the location of each drum/container and labeling or marking drums and containers with a unique identifier. To put the identifier on drums, use spray paint or paint makers (color-coded tags, labels, or bands also can be used, but are susceptible to being removed or lost from the drum). To put the identifier on small containers, use paint makers (paint pens), markers, labels, tags, or bands.

If a container is suspected to contain explosive or shock-sensitive material as determined by visual inspection, seek specialized assistance before further handling. If crystalline material is observed at the neck of any container, handle it as a shock-sensitive material because it may indicate the presence of picric acid. Note whether the label on the container lists chemicals that are known to form shock-sensitive explosives in certain conditions (see Appendix B). In some circumstances, it may be appropriate to use field-testing methods (e.g., peroxide test strips) to determine the presence of shock-sensitive crystals on containers. Drums and containers containing packaged laboratory wastes will be considered to contain shock-sensitive or explosive materials until they have been characterized. The practice of tapping the side of a drum/container to determine its contents is not always safe or effective and should not be used if the container is visibly over-pressurized or if shock-sensitive materials are suspected.

Drums or containers that cannot be inspected before being moved because of storage conditions (i.e., buried in the ground, stacked behind other drums, stacked several tiers high in a pile, etc.) will need to be moved to an accessible location and inspected prior to further handling. A ground-penetrating system or other type of detection system can be used to estimate the location and depth of buried drums and containers. Soil or material covering a buried drum should be removed with caution to prevent drum or container rupture.

6.3 Drum/Container Staging

Once the drums and smaller containers have been inspected and inventoried, and prior to staging, any immediate safety and spill hazards need to be addressed in accordance with the site-specific health and safety plan (SHASP) and work plan. For example, spill hazards typically can be eliminated by overpacking a damaged drum (i.e., placing it in a DOT-specified salvage drum), placing the drum in an area with adequate secondary containment of suitable volume, or transferring the contents to a new drum. Appropriate types and quantities of absorbent materials are required to be available to handle spilled drum and container contents. If it becomes necessary to transfer drum contents to a new container, appropriately rated devices constructed of compatible materials will be used. Drums that have been over-pressurized to the extent that the head is swollen above the level of the top chine (ridge) should not be moved (refer to Section 6.4.5 for measures to depressurize). After the immediate safety and spill hazards have been resolved, the containers can be staged as necessary for safety and better access for sampling.

Special consideration should be given to equipment used to move drums and containers. Equipment must not be a source of ignition of vapors emanating from leaking or ruptured drums and containers. Such equipment should be positioned upwind of the drums or containers, if possible; otherwise, manually operated equipment such as a pallet jack or drum cart should be used.

For staging to facilitate drum/container opening and sampling, the containers should be physically separated (if potential contents are known from drum type or existing labels) into the following categories: those containing liquids, those containing solids, lab packs, and those that

are empty. This is done because the strategy for sampling and handling drums and containers in each of these categories will be different. Solids and sludges are typically contained in open-top drums and wide-mouth containers, whereas liquids are typically contained in closed-head drums with a bung hole (opening) in the lid and narrow-mouth containers. Closed-head drums may contain materials that have solidified over time, in which case the drum may need to be deheaded prior to sampling.

Drums/containers determined to contain explosive or shock-sensitive material should be evaluated to determine if they are safe to move. If so, they should be staged in a separate, isolated area if possible. Placement of explosive or shock-sensitive materials in diked and fenced areas will help minimize the hazard and the adverse effects of any premature detonation of explosives. Such drums/containers will not be directly handled by E & E personnel, as discussed in Section 8.

Where space allows, the staging area should be physically separated from other work areas such as the container opening area. Ideally, the staging area should be located far enough from the opening area to prevent a chain reaction if a drum/container should explode or catch fire when opening.

Drums are moved from the staging area to the opening area one at a time using appropriate equipment such as forklifts or skid steers equipped with drum grabbers or a barrel grappler. In a large-scale drum handling operation, drums may be moved to the drum opening area using a roller conveyer. Some drums and smaller containers can generally be moved with a cart or wagon.

For staging to facilitate preparation of containers for off-site transport and disposition, drums and containers should be segregated and staged by hazard class (e.g., corrosives, poisons/toxics, flammables, etc.). These staging areas will be kept to the minimum number necessary and must be provided with adequate access and egress routes. Bulking of wastes within a hazard class will take place only after waste streams are tested (i.e., hazard categorization) by a qualified individual, a bulking scheme has been established, and the bulking scheme has been tested on a bench scale.

6.4 Opening Drums

6.4.1 General Considerations

There are two basic types of drums: open-head (open-top) and closed-head. Open-head drums have a removable lid and are typically used to store solid materials. An open-head drum also could have bungs in its lid and be used to store liquid material. Closed-head drums have permanently sealed tops with threaded bung holes that can be sealed with threaded bungs, and are almost exclusively used to store liquid material. A closed-head drum could contain materials that have solidified or polymerized over time into solid or semi-solid material.

In order to sample either type of drum, the lid (for open-head drums) or bung (any open-head or closed-head drum with bungs) needs to be loosened, allowing pressure in the drum to equalize with ambient pressure, and then removed.

Closed-head drums can be opened manually if that can be performed safely. Closed-head drums should be opened remotely, at a safe distance, using specialized tools and equipment if the drum's contents are potentially explosive, shock-sensitive, reactive, or otherwise unstable. The choice of drum opening technique will depend on the number of drums to be opened, their contents, and their physical condition.

Metal drums not in direct contact with the earth should be grounded before opening using grounding wires, alligator clips, and a grounding rod or a metal structure.

Only personnel essential to the opening of drums/containers should be present in the work area. Generally, only non-sparking hand tools will be used to pierce drums and remove bungs. Only intrinsically safe monitoring instruments will be used near drums and containers. Personnel working immediately at or near drums being opened will be equipped with a face shield, at a minimum, to protect them from injury from direct sprays or accidental explosion. Personnel will not climb or stand on drums/containers for any reason. Appropriate equipment will be used to reach drums/containers in elevated positions (e.g., manlifts, excavators with drum grapplers).

For drums/containers for which there is a potential explosion hazard when opening, a suitable shield that does not interfere with the work operation should be placed between employees and those drums/containers. Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment should be located behind the explosion-resistant barrier. Such drums/containers will not be directly handled by E & E personnel, as discussed in Section 8.

E & E personnel will open lab packs only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack according to the hazards of the wastes. This individual will have available to them reference material (e.g., Merck Index, Hawley's Chemical Dictionary, National Institue for Occupational Safety and Health [NIOSH] Pocket Guide to Chemical Hazards) to help with this process.

6.4.2 Opening of Open-Head Drums

An open-head drum with bungs should be treated as a closed-head drum and opened through its bung holes unless it is known that the drum contains a solid material or contains a liquid of known and benign origin (such as purge water from groundwater well sampling or water from on-site decontamination activities). See Sections 6.4.3 and 6.4.4 for the opening of closed-head drums. Only as a last resort, or if the drum contains solids that cannot be sampled through the bung hole, should an open-head drum containing bungs be opened by removing the lid.

Open-head drums have a lid that is secured in place by either a lever-latch ring or bolt ring. Each type of lid ring fits around the drum lip and drum lid such that, when tightened, the drum and lid are secured together. The lever-latch ring has a leverage mechanism that is pulled and secured against the ring. The bolt ring has a bolt and nut that fasten and tighten the ring in place with a ratchet wrench.

To open the drum, loosen and open the lever-latch ring or bolt ring slowly and carefully, and remove it. Gently loosen the drum lid to allow pressure in the drum to equalize with ambient pressure. If the lid is rusted to the drum and requires additional loosening prior to removal, use non-sparking tools, such as a rubber mallet, to the extent practicable. Gently remove the drum lid.

6.4.3 Manual Opening of Closed-Head Drums

Manual opening of closed-headed drums with bung wrenches, deheaders, or other tools should be performed only with structurally sound drums that are known to contain material that is not shock-sensitive, reactive, or explosive.

6.4.3.1 Bung Wrench

The drum should be positioned upright with the bung up or, for a drum with bungs on the side, laid on its side with the bung plugs up. Using a non-sparking bung wrench, apply a wrenching motion that consists of a slow, steady pull across the drum. If the length of the bung wrench handle provides inadequate leverage for unscrewing the plug, affix an extension to the bung wrench handle to improve leverage.

6.4.3.2 Drum Deheading

There are various types of drum deheaders. Prior to using a drum deheader, personnel should read and follow the manufacturer's instructions and safety precautions.

Drums are opened with a drum deheader by first positioning the cutting edge just inside the top chine and then tightening the adjustment screw so that the deheader is held against the side of the drum. Moving the handle of the deheader up and down while sliding the deheader along the chine will enable the entire top to be rapidly cut off if so desired. If the top chine of a drum has been damaged or badly dented, it may not be possible to cut the entire top off. Because there is always the possibility that a drum may be under pressure, the initial cut should be made very slowly to allow for the gradual release of any built-up pressure. It might be necessary to employ a remote method (Section 6.4.4) prior to using the deheader. Self-propelled drum openers are available, which are either electrically or pneumatically driven, and can be used for quicker and more efficient deheading.

6.4.3.3 Hand Pick, Pickaxe, or Spike

When neither a bung wrench nor a drum deheader is suitable, then the drum can be opened by using a hand pick, pickaxe, or spike. Often, the drum lid or head must be hit with a great deal of force in order to penetrate it, and drums cannot be opened slowly with these tools. As a result, the potential for splash or spraying is greater than with other opening methods and appropriate safety measures must be taken. Therefore, this method of opening drums of liquid is the least recommended and may not be used without approval from the Regional Safety Coordinator. This method also may not be used unless the contents of the drum or container are known to contain material that is not shock-sensitive, reactive, or explosive. Some spikes have been modified by the addition of a circular splash plate near the penetrating end. This plate acts as a shield and reduces the amount of splash in the direction of the person using the spike. Even with this shield, good splash gear is essential.

The pick or spike should be decontaminated after each drum is opened to avoid cross-contamination and adverse chemical reaction from incompatible materials.

6.4.4 Remote Opening of Closed-Head Drums

Remotely operated drum opening tools are the safest available means of opening closed-head drums where the bungs are difficult to remove. Remote drum opening is slow, but provides a higher degree of safety compared to manual methods of opening.

6.4.4.1 Backhoe Spike

Drums should be staged or placed in rows with adequate aisle space to allow ease of backhoe maneuvering. Once staged, the drums can be quickly opened by punching a hole in the drum head or lid with the spike.

The spike should be decontaminated after each drum is opened to prevent cross-contamination. Although some splash or spray may occur when this method is used, the operator of the backhoe can be protected by mounting a shatter-resistant shield in front of the operator's cage. This, combined with the normal personal protection gear, should be sufficient to protect the operator.

6.4.4.2 Hydraulic Devices

For this method, a piercing device with a metal point is attached to the end of a hydraulic line and pushed into the drum by hydraulic pressure. The piercing device can be attached so that a hole for sampling can be made in either the side or the head of the drum. Some metal piercers are hollow or tube-like so that they can be left in place if desired and serve as a permanent tap or sampling port. The piercer is designed to establish a tight seal after penetrating the container.

6.4.4.3 Pneumatic Devices

Pneumatically operated devices using compressed air are available to remove drum bungs or to dehead drums remotely.

6.4.5 Opening Over-Pressurized Drums

A number of devices can be used to vent swollen drums. One effective method is a tube and spear device. A light aluminum tube (about 3 meters long) is positioned at the vapor space of the drum, and a rigid hooking device attached to the tube goes over the chine and holds the tube securely in place. The spear is inserted in the tube and positioned against the drum wall. A sharp blow on the end of the spear drives the sharpened tip through the drum, and the gas vents along the grooves. The venting should be done from behind a wall or barricade. Once the pressure has been relieved, the bung can be removed and the drum sampled.

As an alternative, a backhoe spike can be used to relieve drum pressure. This remote approach provides an added margin of safety when drum contents are suspected of being shock-sensitive, reactive, or explosive.

6.5 Opening Small Containers

Jars, jugs, flasks, canisters, and bottles typically have screw top lids or stoppers that can be removed by a gloved hand, pliers, or wrenches. Cans and buckets typically have lids that can be pried open with a flat-head screw driver, paint-can opener, or prying tool. Boxed, bulked, or bagged materials can be opened using the intended box top or bag opening. If sealed, the box or bag can be carefully cut to create an opening for a sampling tool.

Small containers suspected of containing an explosive, shock-sensitive, reactive, or unstable material, or that are bulging or otherwise suspected of being over-pressurized, should be opened remotely using methods similar to those described in Section 6.4.4 for drums.

Following sampling of small containers, care should be taken to seal any openings to prevent spillage during later handling. In cases where the original container is in poor condition or is unsealable, the contents can be transferred to a better container.

6.6 Drum Sampling

After the drum has been opened, preliminary monitoring of headspace gases should be performed using an explosimeter and organic vapor analyzer. Record the approximate depth of the container contents if possible prior to sample collection.

In some cases, it is difficult to observe the contents of sealed or partially sealed drums. A thermal imaging camera can provide some information about contents. Since some layering or stratification is likely in any solution left undisturbed over time, a sample must be taken that represents the entire depth of the container. A depth measurement and description of each layer (color, clarity, viscosity) should be noted.

When sampling a previously sealed drum, a check should be made for the presence of a bottom sludge. This is accomplished by measuring the depth to the apparent bottom, then comparing it to the known interior depth.

Record sampling efforts in the field logbook and/or on a sampling data sheet such as the example in Appendix A.

6.6.1 Glass Thief Sampler

A widely used implement for drum sampling is a glass tube often called a glass thief or drum thief (approximately 6- to 16-millimeter interior diameter x 48-inch length). This disposable tool is simple, cost-effective, and quick to use, and collects a sample without the need to decontaminate.

Procedure for Use

1. Insert the glass sample thief almost to the bottom of the drum or until a solid layer is encountered. About one foot of the glass tube should extend above the drum.
2. Allow the material in the drum to reach its natural level in the tube. In many instances, there may be a sludge layer at the bottom of the drum. Slow insertion of the sample tube into this layer and then a gradual withdrawal will allow the sludge to act as a bottom plug to maintain the fluid in the tube. The plug can be gently removed and placed into the sample container by using a stainless steel lab spoon.
3. Cap the top of the sampling tube with a tapered stopper or thumb, ensuring that liquid does not come into contact with the stopper.
4. Slowly withdraw the capped tube from the drum with one hand while wiping the sample tube with a disposable towel with the other hand.
5. Insert the uncapped end into the sample container. Do not spill liquid on the outside of the sample container. Release stopper and allow the glass thief to drain completely into the sample container.
6. Remove the glass tube from the sample container and break it into the drum. (Because disposal of the tube by breaking it into the drums may interfere with eventual plans for disposition of the drum and its contents, be sure to obtain approval for this step from the project manager.)
7. Cap the sample container tightly and place it in a carrier.
8. Replace the bung or place plastic over the drum.
9. Log the sample in the field logbook and/or sampling data sheet.

10. Perform hazard categorization or other field screening analyses if included in the project scope. Each layer of the drum should be screened because they might be different from one another.
11. Move the sample to the contamination reduction (decontamination) zone and package it for transport to the analytical laboratory, as necessary. Complete chain of custody records. If the sample is not to be submitted to an analytical laboratory following field screening, the containerized sample may be placed with the original drum or container for later disposal or entered into the site waste stream through some other mechanism. The project manager will determine the appropriate pathway.

6.6.2 COLIWASA

The Composite Liquid Waste Sampler (COLIWASA) is designed to permit representative sampling of multiphase materials from drums and other containers. It collects a sample from the full depth of a drum and maintains it in a transfer tube until delivery to the sample bottle. One configuration consists of a 152-centimeter by 4-centimeter inner diameter section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper.

The drawback associated with using a COLIWASA is cost. A COLIWASA is more expensive to purchase than a glass thief and also is difficult to effectively decontaminate; therefore, it should be disposed of after use, which increases equipment supply and waste management costs. Its best application is for instances where a true representation of a multiphase material is necessary.

Procedure for Use

1. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.
2. Slowly lower the sampler into the drum. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sampler tube is lower than that outside the sampler, the sampling rate is too fast and may result in a less representative sample.
3. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.
4. Slowly withdraw the sampler from the drum with one hand while wiping the sampler tube with a disposable towel with the other hand.
5. Carefully discharge the sample into the sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in the sample container.
6. Cap the sample container tightly and place it in a carrier.
7. Replace the bung or place plastic over the drum.
8. Unscrew the T-handle of the sampler and disengage the locking block. Clean or dispose of the sampler as applicable.
9. Log the sample in the field logbook and/or sampling data sheet.

10. Perform hazard categorization or other field screening analyses if included in the project scope.
11. Move the sample to the contamination reduction (decontamination) zone and package it for transport to the analytical laboratory, as necessary. Complete chain of custody records. If the sample is not to be submitted to an analytical laboratory following field screening, the containerized sample may be placed with the original drum or container for later disposal or entered into the site waste stream through some other mechanism. The project manager will determine the appropriate pathway.

6.6.3 Syringe-Type Device

A syringe-type sampling device is typically used for sampling high-viscosity liquid materials and sludge. The device will have either a valve tip for liquids or a coring tip for sludge.

Procedure for Use with Liquids

1. Put the sampler in the piston-down position.
2. Ensure that the valve tip is pulled down to the open position.
3. Slowly lower the sampler into the liquid material.
4. As the sampler is being lowered, the sampler's piston is pulled up to collect the sample.
5. Once the sample is collected, close the valve tip by pushing the valve tip up using the bottom or side of the drum.
6. Slowly withdraw the sampler from the drum with one hand while wiping the sampler tube with a disposable towel with the other hand.
7. Discharge the sampler's contents into the sample container by opening the valve tip and pushing down on the sampler's piston.
8. Cap the sample container tightly and place it in a carrier.
9. Replace the bung or place plastic over the drum.
10. Clean or dispose of the sampler as applicable.
11. Log the sample in the field logbook and/or sampling data sheet.
12. Perform hazard categorization or other field screening analyses if included in the project scope.
13. Move the sample to the contamination reduction (decontamination) zone and package it for transport to the analytical laboratory, as necessary. Complete chain of custody records. If the sample is not to be submitted to an analytical laboratory following field screening, the containerized sample may be placed with the original drum or container for later disposal or entered into the site waste stream through some other mechanism. The project manager will determine the appropriate pathway.

Procedure for Use with Sludge

1. Put the sampler in the piston-down position.
2. Push the sampler body into the sludge.
3. As the sampler is being pushed into the sludge, the sampler's piston is pushed up to collect the sample.

4. Slowly withdraw the sampler from the drum with one hand while wiping the sampler tube with a disposable towel with the other hand.
5. Discharge the sampler's contents into the sample container by pushing down on the sampler's piston.
6. Continue sample collection in accordance with steps 8 through 13 above for liquids.

6.6.4 Plunger-Type Device

The drawback associated with using a plunger-type sampler is cost. Such a device is more expensive to purchase than other types of drum samplers and also is difficult to effectively decontaminate; therefore, it should be disposed of after use, which increases equipment supply and waste management costs.

Procedure for Use

1. Put the sampler in the open position.
2. Connect the sample container to the head section of the sampler.
3. Slowly lower the sampler into the liquid. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sampler tube is lower than that outside the sampler, the sampling rate is too fast and may result in a less representative sample.
4. When the sampler's plunger hits the bottom of the drum, engage the plunger by pulling the sampler rod upward, which will put the sampler in the closed position.
5. Without removing the sampler from the drum, pull the plunger rod upward, filling the sample container.
6. Slowly withdraw the sampler from the drum with one hand while wiping the sampler tube with a disposable towel with the other hand.
7. Prior to removing the sample container from the sampler, allow sufficient time for all of the sample to flow into the sample container.
8. Cap the sample container tightly and place it in a carrier.
9. Replace the bung or place plastic over the drum.
10. Clean or dispose of the sampler as applicable.
11. Log the sample in the field logbook and/or sampling data sheet.
12. Perform hazard categorization or other field screening analyses if included in the project scope.
13. Move the sample to the contamination reduction (decontamination) zone and package it for transport to the analytical laboratory, as necessary. Complete chain of custody records. If the sample is not to be submitted to an analytical laboratory following field screening, the containerized sample may be placed with the original drum or container for later disposal or entered into the site waste stream through some other mechanism. The project manager will determine the appropriate pathway.

6.6.5 Bailer

A bailer can be used to sample homogeneous and non-viscous liquids in a drum, such as purge water from groundwater well sampling or water resulting from on-site decontamination activities.

A bailer is particularly useful when a large volume of sample is needed. Reusable bailers, which are higher quality and intended to be decontaminated or dedicated to a particular drum, typically would not be used to sample drums/containers for the purposes of characterization and removal from a site. Instead, inexpensive, single-use bailers would more commonly be used, to avoid the need to decontaminate.

Procedure for Use

1. Make sure the bailer is in the open position.
2. Slowly lower the bailer into the drum. Lower the bailer at a rate that permits the levels of the liquid inside and outside the bailer to be about the same. If the level of the liquid in the bailer is lower than that outside the bailer, the sampling rate is too fast and may result in a less representative sample.
3. When the bailer hits the bottom of the waste container, pull the bailer up, at which point the ball stopper should close the bailer.
4. Slowly withdraw the bailer from the drum with one hand while wiping the outside of the bailer with a disposable towel with the other hand.
5. Carefully discharge the bailer's content into the sample container by using the tube that inserts into the bottom of the bailer.
6. Cap the sample container tightly and place it in a carrier.
7. Replace the bung or place plastic over the drum.
8. Clean or dispose of the bailer as applicable.
9. Log the sample in the field logbook and/or sampling data sheet.
10. Perform hazard categorization or other field screening analyses if included in the project scope.
11. Move the sample to the contamination reduction (decontamination) zone and package it for transport to the analytical laboratory, as necessary. Complete chain of custody records. If the sample is not to be submitted to an analytical laboratory following field screening, the containerized sample may be placed with the original drum or container for later disposal or entered into the site waste stream through some other mechanism. The project manager will determine the appropriate pathway.

6.6.6 Coring Device

A coring device can be used to sample solids in drums, such as solid waste materials or drill cuttings. The sampler consists of a coring device, extension attachments, and T-handle.

Procedure for Use

1. Assemble the sampling equipment.
2. Insert the sampling device to the bottom of the drum. The extensions and the T-handle should extend above the drum.
3. Rotate the sampling device to cut a core of material.
4. Slowly withdraw the sampling device so that as much sample material as possible is retained within it.

5. Transfer the sample to the sample container. A stainless steel spoon or scoop may be used as necessary. If the sample must be composited and/or homogenized, transfer the sample instead to an interim vessel such as a stainless steel bowl.
6. Return the sampling device to the drum and collect material from different areas within the drum to ensure a representative sample. Transfer the additional sample to the sample container or compositing/homogenizing vessel.
7. Composite/homogenize the sample as applicable and transfer it to the sample container.
8. Cap the sample container tightly and place it in a carrier.
9. Replace the drum lid or place plastic over the drum.
10. Clean or dispose of the sampler as applicable.
11. Log the sample in the field logbook and/or sampling data sheet.
12. Perform hazard categorization or other field screening analyses if included in the project scope.
13. Move the sample to the contamination reduction (decontamination) zone and package it for transport to the analytical laboratory, as necessary. Complete chain of custody records. If the sample is not to be submitted to an analytical laboratory following field screening, the containerized sample may be placed with the original drum or container for later disposal or entered into the site waste stream through some other mechanism. The project manager will determine the appropriate pathway.

6.7 Small Container Sampling

Liquids can be poured directly into a sample container or the sample can be transferred with a pipette and bulb or similar device. Solid materials can be poured directly into a sample container or the sample can be transferred with a scoop, trowel, or spoon. Following sample collection, perform the following:

1. Clean or dispose of the sampler as applicable.
2. Replace the cap or lid of the small container or place plastic over it.
3. Log the sample in the field logbook and/or sampling data sheet.
4. Perform hazard categorization or other field screening analyses if included in the project scope.
5. Move the sample to the contamination reduction (decontamination) zone and package it for transport to the analytical laboratory, as necessary. Complete chain of custody records. If the sample is not to be submitted to an analytical laboratory following field screening, the containerized sample may be placed with the original material container for later disposal or entered into the site waste stream through some other mechanism. The project manager will determine the appropriate pathway.

7 Quality Assurance/Quality Control

The program/project manager should identify personnel for the field team who have knowledge, training, and experience in the drum/container sampling activities to be conducted. The program/project manager should also identify additional personnel, as necessary, to complete

ancillary procedures, e.g., field logbook documentation, equipment decontamination, sample shipment, and waste disposal.

Prior to initiating field work, the project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, health and safety plan) will be reviewed by field personnel to understand the procedures that have been specified to result in samples that will meet project DQOs. Project planning documents will define the quality assurance/quality control (QA/QC) procedures necessary to meet project DQOs, including the sampling protocol for QC samples such as trip blanks, field duplicates, equipment rinsate blanks, and other types of field and analytical QC samples. Because the contents of drums and similar types of containers could be non-homogeneous, field duplicates and other types of collocated samples will need to be collected in a way that ensures that the sample pairs are as similar to each other as possible.

8 Health and Safety

Sampling of drums and containers will be performed in accordance with a sampling procedure that is part of, or referenced by, the SHASP. Prior to entering the field, all field personnel will acknowledge in writing that they have read and understand the SHASP. Certain safety procedures inherent to steps in this SOP have been incorporated into those steps in Section 6.

Opening sealed drums and other containers with unknown contents is one of the more hazardous activities that E & E conducts. Unique hazards associated with opening drums and containers with unknown contents include the potential for the release of explosive, pressurized, or hazardous materials and wastes. Unique hazards associated with inventorying, handling, staging, and sampling drums and containers include the potential for exposure to hazardous materials or wastes; crush and pinch hazards from handling heavy objects (a 55-gallon drum containing just water weighs over 450 pounds); and spills due to accidents, inadequate containerization or storage, and material degradation.

Minimum health and safety requirements will likely consist of personal protective equipment and monitoring instrumentation. Employing proper drum opening techniques and equipment, as described in this SOP, will help to safeguard personnel. The use of remote opening and sampling equipment is recommended when applicable. Spill response supplies such as salvage drums, absorbent materials, and berm material should be available during any container handling or sampling operation. When airline respirator systems are used, air lines and connections will be protected from contact with contaminants and positioned where they will not be physically damaged by operations. Fire extinguishers will be available to handle a potential incipient fire.

Drums or containers suspected of containing explosive, shock-sensitive, highly toxic, exotic, or radioactive materials should not be handled, opened, or sampled until their hazard has been assessed; this can include consulting the Regional Safety Coordinator and soliciting expert advice. Containers suspected of containing explosive or shock-sensitive material will not be directly handled by E & E personnel. Should others on site become involved with these containers, E & E personnel will be evacuated from the area. E & E's site safety officer will verify that material handling equipment for these containers is provided, including explosion containment devices or protective shields to protect equipment operators from exploding containers, and that an audible signal is established to inform site personnel of the commencement and completion of container handling activities. E & E or other site command personnel will maintain continuous communications with the personnel conducting explosive or shock-sensitive material handling.

Drums/containers may not be opened using the hand pick/pick axe/spike method without the approval of the Regional Safety Coordinator.

Some drum types have distinct hazards:

- Polyethylene or polyvinyl chloride (PVC)-lined drum – Often contains strong acids or bases. If the lining is punctured, the substance can quickly corrode the steel, resulting in a leak or spill.
- Exotic metal drum (e.g., aluminum, nickel, stainless steel, or other atypical drum metal) – An expensive drum that usually contains an extremely dangerous material.
- Single-walled drums used as a pressure vessel – This type of drum has fittings for both product filling and placement of an inert gas, such as nitrogen. May contain reactive, flammable, or explosive substance.
- Laboratory pack – Used for disposal of used or expired chemicals and process samples from laboratories, hospitals, universities, and similar institutions. Individual containers within the lab pack are often not packed in absorbent material. They may contain incompatible materials, radioisotopes, shock-sensitive, highly volatile, highly corrosive, or very toxic exotic chemicals. Laboratory packs can be an ignition source for fires.

E & E personnel shall not enter a tank or vault without special approval of the Corporate Health and Safety Director in conjunction with E & E SOP HS 5.1, Confined Space Entry. Entry procedures will be described in the SHASP, where applicable.

9 Special Project Requirements

Project-specific requirements will be included with the project planning documents.

10 References

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_____. 1986. *Drum Handling Practices at Hazardous Waste Sites.* EPA/600/2-86/013. PB86-165362. January 1986.

_____. 1994. Drum Sampling. SOP# 2009. Revision # 0.0. November 16, 1994.

_____. 2002. *RCRA Waste Sampling Draft Technical Guidance; Planning, Implementation and Assessment*. EPA530-D-02-002. August 2002.

_____. 2013. Waste Sampling. Operating Procedure Number SESDPROC-302-R2. Region 4. Athens, Georgia.

Appendix A. Drum/Container Data Sheet Project ID: Click here to enter text.

Sample ID#: Click here to enter text. Date Sampled: Click here to enter text.

Drum/Container ID#: Click here to enter text. Time Sampled: Click here to enter text.

Original Grid Location: Click here to enter text. Staging Location: Click here to enter text.

Sampler's Name: Click here to enter text.

Drum/Container Condition and Construction Material: Click here to enter text.

Drum/Container Size: Click here to enter text. Opening Type: Click here to enter text.

Physical Appearance of Drum/Container: Click here to enter text.

Bung Present: Click here to enter text. Drum Leaking: Click here to enter text.

Photograph Taken: Click here to enter text. Photo ID#: Click here to enter text.

Multiple Phases: Click here to enter text.

Estimated Liquid and Solid Quantities: Click here to enter text.

Color of Materials: Click here to enter text. Odor: Click here to enter text.

VOC Screening Results: Click here to enter text. pH: Click here to enter text.

Radiation Screening Results: Click here to enter text.

Compatibility: Click here to enter text. Hazard: Click here to enter text.

Field Analytical Data: Click here to enter text.

Fixed Laboratory Data: Click here to enter text. Date of Analysis: Click here to enter text.

Waste ID: Click here to enter text.

Treatment Disposal Recommendations: Click here to enter text.

Approval

Lab: Click here to enter text. Date: Click here to enter text.

Site Manager: Click here to enter text. Date: Click here to enter text.

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Appendix B. Chemicals That Can Form Peroxides* Project ID: Click here to enter text.

Class A: Chemicals that form explosive levels of peroxides without concentration.

Isopropyl ether	Sodium amide (sodamide)
Butadiene	Tetrafluoroethylene
Chlorobutadiene (chloroprene)	Divinyl acetylene
Potassium amide	Vinylidene chloride
Potassium metal	

Class B: Chemicals that are a peroxide hazard on concentration (distillation/evaporation). A test for peroxide should be performed if concentration is intended or suspected.

Acetal	Dioxane (p-dioxane)
Cumene	Ethylene glycol dimethyl ether (glyme)
Cyclohexene	Furan
Cyclooctene	Methyl acetylene
Cyclopentene	Methyl cyclopentane
Diaacetylene	Methyl-isobutyl ketone
Dicyclopentadiene	Tetrahydrofuran
Diethylene glycol dimethyl ether (diglyme)	Tetrahydronaphthalene
Diethyl ether	Vinyl ethers

Class C: Unsaturated monomers that may autopolymerize as a result of peroxide accumulation if inhibitors have been removed or are depleted.

Acrylic acid	Styrene
Butadiene	Vinyl acetate
Chlorotrifluoroethylene	Vinyl chloride
Ethyl acrylate	Vinyl pyridine
Methyl methacrylate	

*These lists are illustrative, not comprehensive.

Types of compounds known to auto-oxidize to form peroxides:

- Ethers containing primary and secondary alkyl groups (never distill an ether before it has been shown to be free of peroxide),
- Compounds containing benzylic hydrogens,
- Compounds containing allylic hydrogens (C=C—CH),
- Compounds containing a tertiary C—H group (e.g., decalin and 2,5-dimethylhexane,
- Compounds containing conjugated, polyunsaturated alkenes and alkynes (e.g., 1,3-butadiene, vinyl acetylene), and
- Compounds containing secondary or tertiary C—H groups adjacent to an amide (e.g., 1-methyl-2-pyrrolidinone).

Source: National Research Council 2011.

End of Appendix B

END OF SOP

ecology and environment, inc.

STANDARD OPERATING PROCEDURE

BOREHOLE INSTALLATION AND SUBSURFACE SOIL SAMPLING METHODS

SOP NUMBER: GEO 4.7

REVISION DATE: 5/25/2012 **SCHEDULED REVIEW DATE: 5/26/2017**

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1 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures utilized by E & E for collection of unconsolidated and consolidated subsurface samples from boreholes using a subcontract driller. Most subsurface investigations require the drilling of boreholes for one or more purposes: collection of soil samples for lithologic logging and laboratory testing; lithologic and hydrogeologic characterization using borehole geophysical logging; and installation of piezometers or monitoring wells. Drilling methods are selected based on availability and cost; suitability for the type of geologic materials at a site (unconsolidated or consolidated); and potential effects on sample integrity (influence by drilling fluids and potential for cross-contamination between aquifers). Site-specific drilling methods and sampling procedures also vary depending on the data quality objectives (DQOs) identified in program/project planning documents.

Procedures for collecting soil samples for volatile organic compound (VOC) analyses are presented in the E & E VOC Soil and Sediment Sampling SOP ENV 25.

Procedures for collecting surface and shallow subsurface soil sampling SOP are presented in the E & E Borehole Installation Methods SOP ENV 3.13.

Procedures for sample handling are defined in E & E Environmental Sample Handling, Packaging and Shipping SOP ENV 3.16. Site-specific sample handling procedures are dependent on the project DQOs.

Procedures for equipment decontamination are defined in E & E Sampling Equipment Decontamination SOP ENV 3.15. Site-specific equipment decontamination procedures are dependent on the project DQOs.

This is intended for use by personnel who have knowledge, training and experience in the field soil sampling activities being conducted.

2 Definitions and Acronyms

DQO	Data Quality Objective
E & E	Ecology and Environment, Inc.
HSA	hollow-stem auger
SHASP	Site Specific Health and Safety Plan
SOP	Standard Operating Procedure
VOC	Volatile Organic Compound

3 Procedure Summary

A wide variety of drilling methods have been developed that could be suitable for one or more of the purposes described above. Table 1 summarizes information on drilling methods.

Table 1 Summary Information on Drilling Methods

Drill Method	Casing/ Open Hole	Can Drill Fluids Affect Groundwater Quality?	Core Samples?
Hollow-Stem Auger	Open Hole	No	Possible
Direct-Push/Geoprobe®	Either	No	Yes
Open-Hole Rotary Methods			
Direct Air Rotary with Bit	Open Hole	Yes	Possible
Direct Air Rotary with Downhole Hammer	Open Hole	Yes	Possible
Direct Mud Rotary	Open Hole	Yes	Possible
Reverse Rotary (no casing)	Open Hole	Yes	Possible
Cable Tool	Either	No	Possible
Rotary Drill-Through Methods			
Rotary Casing Driver	Casing	Yes	Possible
Dual Rotary Advancement	Casing	Yes	Possible
Other Methods			
Reverse Dual Wall Rotary	Casing	Yes	Possible
Reverse Dual Wall Percussion	Casing	Yes	Possible
Hydraulic Percussion	Casing	Yes	Possible
Downhole Casing Advancers	Casing	Yes	Possible
Jet Percussion	Casing	Possible	Possible
Jetting	Open Hole	Possible	No
Solid-Stem Auger	Open Hole	No	Possible
Bucket Auger	Open Hole	No	Possible
Rotary Diamond	Open Hole	Possible	Yes
Directional Drilling	Either[a]	Possible	Possible[b]
Sonic Drilling	Either	Possible	Yes
Driven Wells	Either	No	No
Cone Penetration	Open Hole	No	Possible[c]

Notes:
[a] EC rig uses casing advancement; other methods may involve open-hole advancement.
[b] Sampling with a device resembling a split spoon may be possible with some directional rigs.
[c] Geoprobe has developed a core sampler for use with a cone penetration testing rig.

Subsurface soil samples are collected from boreholes for chemical and physical analysis and to aid in the definition and tracking of contaminants in the soil. The subsurface soil samples may be either composite or discrete, and either disturbed or undisturbed. The type of sample to be collected depends on the drilling technique and the purpose of the investigation.

4 Cautions

Cautions associated with borehole installation include decontamination procedures, depth control, and health and safety associated with heavy equipment use. All equipment that is brought on site must be clean prior to arrival and all downhole equipment must be decontaminated prior to drilling each boring location. This is an important factor to ensure that off-site contaminants are not introduced to the soils (and groundwater) being collected and that contaminants encountered at one site location are not spread throughout the site.

Depth control is also an important factor to ensure that exact soil horizons, formations, and zones of contamination identified during sampling are accurately documented and will allow for accurate placement of well materials. The oversight geologist should be familiar with the drilling

methodology and independently verify measurements on a regular basis. This will identify any discrepancies between the oversight geologist and the drill rig operator.

As with any heavy equipment operation, proper personal protective equipment is essential. At a minimum, Level-D protection will be required for all drilling operations.

5 Equipment and Supplies

The equipment and supplies required for field work depend on the program/project DQOs. The following is a general list of equipment and supplies. A detailed list of equipment and supplies should be prepared based on the project planning documents. In general, the use of dedicated or disposal equipment is preferred but equipment may be re-used after thorough decontamination between sample locations (refer to E & E Sampling Equipment Decontamination SOP ENV 3.15).

- Stainless-steel or Teflon™ spoons, trowels, or scoops. Other construction material may be acceptable depending upon the program/project planning documents and DQOs
- Soil-coring equipment or augers acceptable depending upon the program/project planning documents and DQOs
- Sampler such as thin-walled tube sampler (e.g., shelby tube sampler), split-spoon sampler, continuous soil core sampler (e.g. Laskey), continuous-flight auger, or direct push soil corer (e.g., Macro-Core®).
- Stainless-steel mixing bowls. Other bowl construction material may be acceptable depending upon the program/project planning documents and DQOs
- Spade(s) and/or shovel(s)
- Liners and/or catchers for augers or core samplers as specified in the project planning documents
- Pipe cutter(s), stainless steel knives(s), or power saw to cut liners
- Survey stakes or flags to mark locations
- Ancillary equipment and supplies, e.g., meter stick or tape measure, aluminum foil, plastic sheeting, disposable gloves.

Supporting equipment and supplies also may be required to address the following:

- Field logbooks and supplies (Refer to project planning documents and the E & E Field Activity Logbooks SOP DOC 2.1 for details)
- Decontamination equipment and supplies (Refer to project planning documents and E & E Sampling Equipment Decontamination SOP ENV 3.15for details)
- Sample containers, preservatives, and shipping equipment and supplies (Refer to project planning documents and the E & E Environmental Sample Handling, Packaging and Shipping SOP ENV 3.16 for details)
- Waste handling supplies (Refer to project planning documents and E & E Handling Investigation-Derived Wastes SOP ENV 3.26 for details)

6 Procedure

The most accurate method for obtaining information on the characteristics of unconsolidated deposits is to collect representative samples of the soil at measured depths and at intervals that will provide a complete lithologic profile of the soils. E & E staff will use the following procedures for completing borehole installation and subsurface soil sampling:

- Review relevant project planning documents, e.g., work plan, sampling and analysis plan, quality assurance project plan, health and safety plan, etc.
- Select the sampling procedure(s) that meet project DQOs.
- Refer to the E & E Field Activity Logbooks SOP DOC 2.1 for guidance on the types of information that should be recorded for each sample.
- Refer to the E & E Environmental Sample Handling, Packaging and Shipping SOP ENV 3.16 for guidance on how samples should be labeled, packaged, and shipped.

6.1 Subsurface Soil Sampling Methods

6.1.1 Disturbed and Undisturbed Overburden Samples

Soil samples from unconsolidated deposits can be collected as disturbed or undisturbed soil samples. Disturbed soil samples are produced by the action of the hollow-stem auger (HSA) and are called drill cuttings. The components of an HSA are shown in Figure 1. Disturbed samples are not representative of the formations penetrated because of the possible sorting and grinding of the cuttings while being carried to the surface. In general, disturbed samples do not contain detailed lithologic information, and the depth that the soil is encountered is less precise.

Mildly disturbed to relatively undisturbed soil samples are collected in a variety of sampling devices, including the split spoon or split-barrel sampler (see Figure 2), and the continuous soil core sampler (see Figure 3). Sonic drilling also provides relatively undisturbed samples. Undisturbed soil samples are collected using the thin-walled tube sampler (see Figure 4).

The collection of undisturbed samples ensures the preservation of detailed lithologic information (such as the degree of consolidation, sorting, bedding, etc.) and a more accurate estimation of sample depth.

6.1.2 Composite and Discrete Overburden Samples

Composite samples are prepared from aliquots of discrete samples. They are useful for obtaining a representative sample from a subsurface interval for analytical purposes. However, composite samples are inadequate for lithologic purposes.

Discrete samples are obtained from a specific depth and are useful when detailed analytical information about the overburden soils is required. Analysis of discrete overburden soil samples provides the more accurate information on the depth of contamination than composite samples.

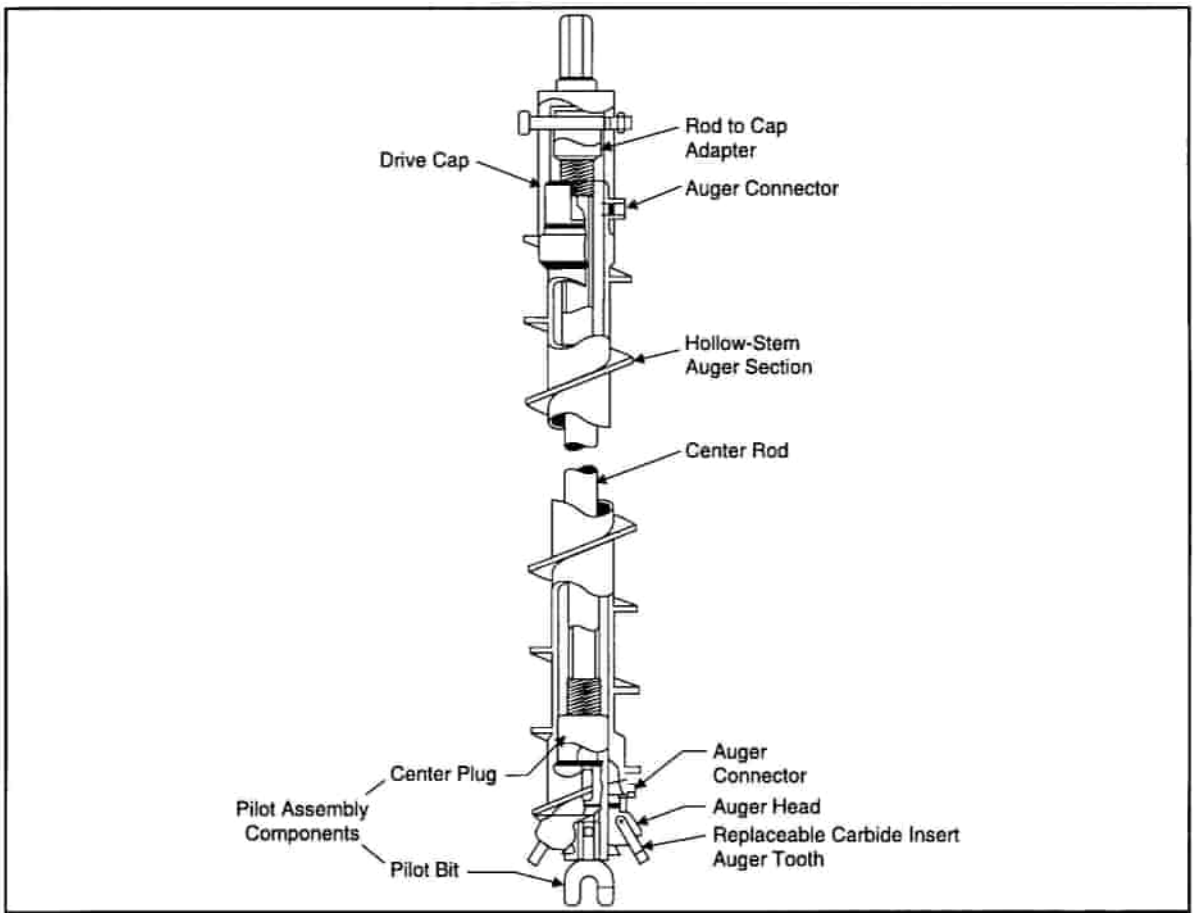

Figure 1 Typical Components of a Hollow-Stem Auger

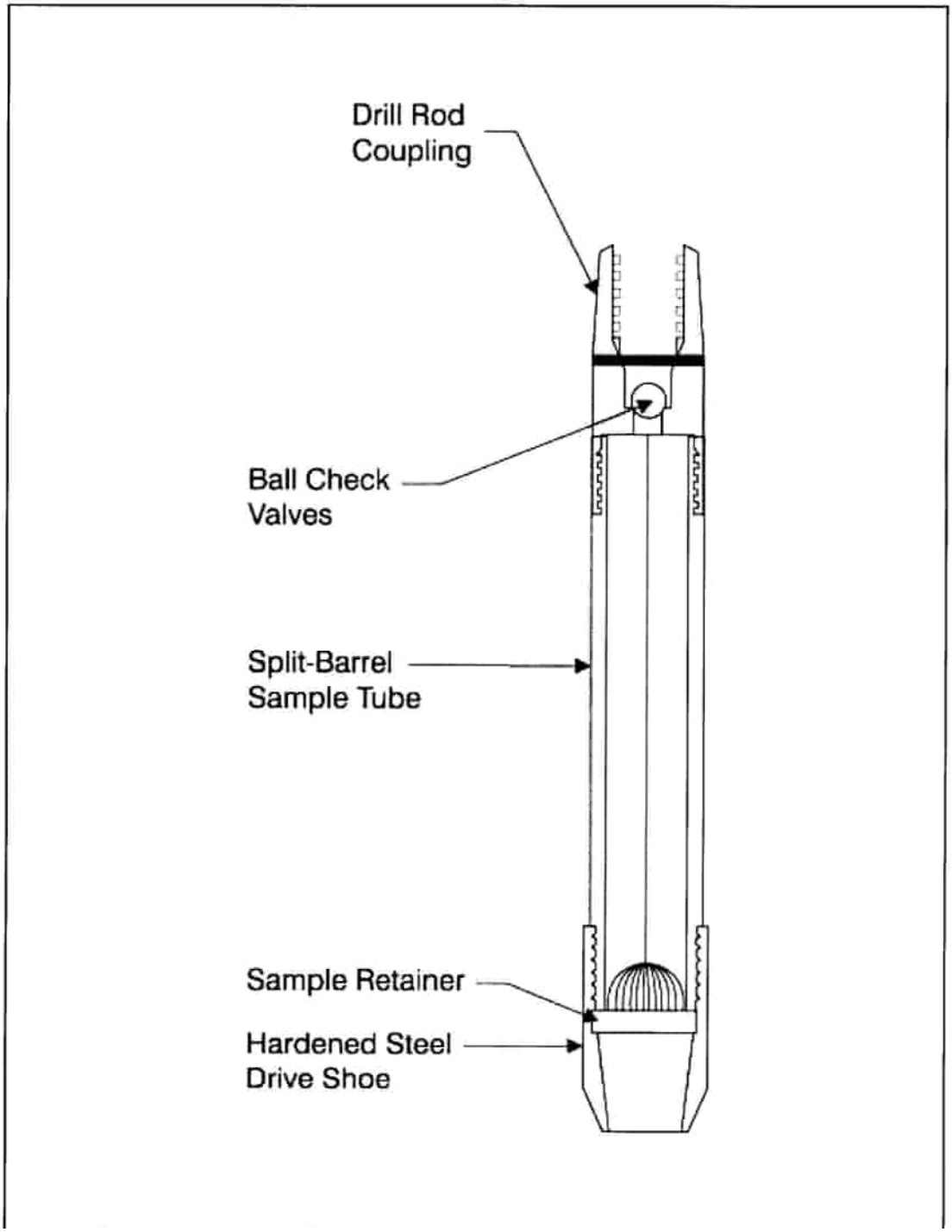

Figure 2 Split-Spoon or Split-Barrel Sampler

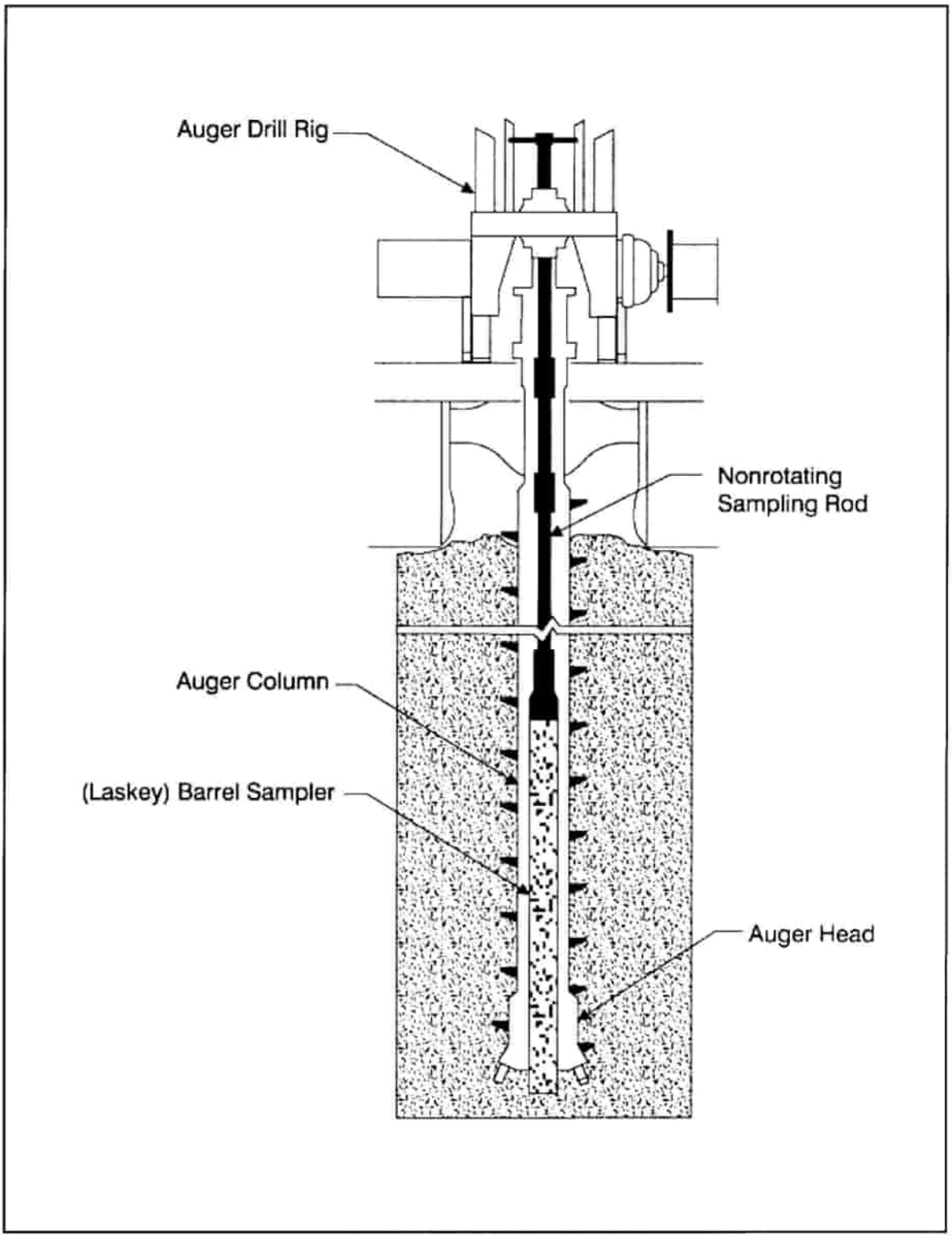

Figure 3 Continuous Sampling Tube System (Laskey)

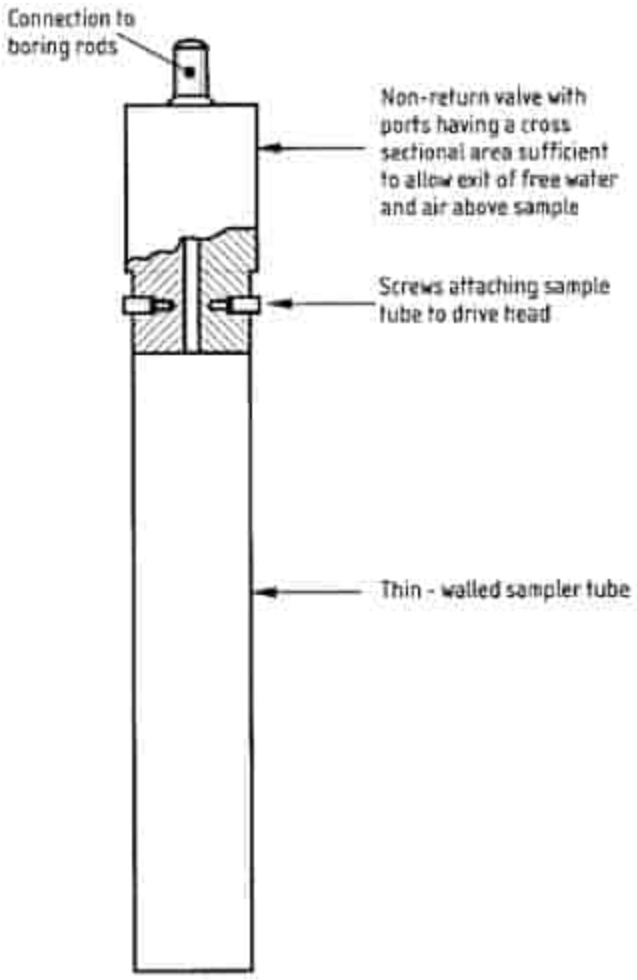

Figure 4 Shelby Tube Sampler

6.1.3 Environmental Sample Collection

Samples for environmental laboratory analysis can be collected from sampling devices described above and in Section 6.2.

1. Samplers should be decontaminated or dedicated for collection of environmental samples.
2. Samplers should be in a perpendicular position on the sample material.
3. Sampling methods should attempt to minimize compression of the sample.
4. Record the length of the tube used to penetrate the material being sampled and the number of blows required to obtain this depth.
5. Once the sample is collected record all length of sample and estimate sample recovery and compression. Project planning documents may indicate acceptability criteria for samples recovery and sample collection. The geologist will need to determine based on site conditions if poor recovery is due to sampling equipment or the geologic formation. The goal is obtain a sample for environmental analysis that is representative of subsurface soil at a specified depth interval and meet the project DQOs. If samples don't meet the DQOs then determine a course of action with the project manager.

6. Soil samples should be collection as soon as possible following extraction of the sampler.
    - Place sampler or liner on clean surface
    - Carefully remove any end caps and/or catchers
    - Evaluate record core length, geologic information, monitoring data, and any visual observations.
    - For transverse sectioning of liners, beginning at the soil surface, measure and mark the sample sections on the outside of the liner
        - Cut the liner with a manual pipe cutter or core liner and core with a decontaminated saw blade into marked sections.
        - Extrude the soil from the cut segments of the liner. If necessary use a plunger cover with aluminum foil to aid in extruding the core.
        - Empty the core segment into a stainless steel bowl (or other type as specified in the project planning documents).
        - Record observations of the soil types.
        - Immediately collect volatile organic analyte and sulfide samples.
    - For longitudinal sectioning of cores, open the split spoon or use a knife to cut the liner and expose the upper half of the soil cylinder.
        - Beginning at the soil surface, measure and mark the sample sections using a tape measure set aside the core.
        - Record observations of the soil types.
        - Immediately collect volatile organic analyte and sulfide samples.
        - Scope the core segment into a stainless steel bowl (or other type as specified in the project planning documents).
    - If multiple core segments are necessary to collect adequate sample volume, they should all be combined in the bowl prior to homogenization
    - Homogenize the sample as thoroughly as possible
    - Transfer sample aliquots to appropriate sample containers and preserve as required in the project planning documents.
7. Return unused soil to the boring or containerize as specific in the project planning documents,
8. Follow proper procedures for sample handling and transportation to the laboratory for analysis.

6.1.4 Geotechnical Sample Collection

Some sampling devices also may be used to collect information for geotechnical analysis such as soil density. Geotechnical sampling should strictly follow standards for sampling based on the type of test performed. This information should be documented in the project planning documents. Detailed procedures are not included here because standards are routinely updated and only the most current standard should be used. Spilt spoon sampling work should be performed in accordance with American Society for Testing and Materials (ASTM) ASTM

D1586 - 11 *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*. If thin-wall tube sampling is used for soil collection, then follow ASTM D1587 - 08 *Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes.*

6.2 Borehole Installation

6.2.1 Inspection and Cleaning of Sampling Equipment

Proper cleaning of the drill rig, downhole equipment, and sampling equipment prior to arriving at the site and between drilling locations is necessary to minimize the potential introduction of contaminants into soil and groundwater samples. A rig should not be allowed to enter a site if the rig appears to be dirty (other than road dirt) from previous use at another site. While operating on site, the drill rig should be checked repeatedly for oil and hydraulic fluid leaks. These precautions are essential to ensure that trace contaminants from the drilling process are not introduced to the samples.

Before drilling begins at a site, and after each boring is completed, all the down-the-hole drill equipment, the rig, and other equipment (as necessary) should be steam cleaned, or cleaned using high-pressure hot water, and rinsed with pressurized potable water to minimize cross contamination. Special attention should be given to the threaded sections of the casings and drill rods. Additional cleaning may be necessary during the drilling of individual holes to minimize the carrying of contaminated materials from shallow to deeper strata by contaminated equipment (e.g., decontamination of split spoon samplers as associated drill rods).

Equipment with porous surfaces, such as rope, cloth hoses, and wooden blocks or tool handles cannot be thoroughly decontaminated. These should be disposed of properly at appropriate intervals. These intervals may be the duration of drilling at the site, between individual wells, or between stages of drilling a single well, depending upon characteristics of the tools, site contamination, and other considerations.

Cleaned equipment should not be handled with soiled gloves. Surgical gloves, new clean cotton work gloves, or other appropriate gloves should be used and disposed of when even slightly soiled. The use of new painted drill bits and tools should be avoided since paint chips can bias soil and groundwater samples.

Upon completion of drilling activities at a particular site, all drilling equipment should be steam cleaned or cleaned using high-pressure hot water to ensure that no contamination is transported off site.

6.2.2 Hollow-Stem Auger Drilling

An HSA column simultaneously rotates and axially advances using a mechanically or hydraulically powered drill rig. The hollow stem of the auger allows use of various methods for continuous or intermittent sampling of subsurface soils. Riser and screen for monitoring wells can be placed in the hollow stem when the desired depth has been reached, and filter pack and grouting emplaced as the auger is gradually withdrawn from the hole. Use of different diameter augers allows use of casings to isolate near-surface contamination and continuation of drilling with a smaller-diameter auger. HSA flights are manufactured in 5-foot lengths and have various inside diameters ranging from 2.25 inches to 10.25 inches.

If a split-barrel soil sampler is used to collect unconsolidated soil samples, a center plug of the same diameter as the HSAs and a section of drilling rod are placed inside the lead flight. The HSAs are advanced through the unconsolidated deposits to the first sampling interval, and the

center plug is then removed from the HSAs. A precleaned split-barrel soil sampler is attached to the end of the drilling rod and lowered into the HSAs. A safety hammer is attached to the top of the drilling rod, and the split-barrel soil sampler driven into the undisturbed soil to a depth of 2 feet. The split-barrel soil sampler is retrieved and opened to remove the soil sample. The center plug is replaced in the HSAs, and another flight of HSAs is attached to the top of the flight already in the ground. The process is repeated until bedrock is encountered or the project depth is reached.

A continuous soil core sampler (i.e., Laskey) is used to collect 5-foot continuous soil core samples while the HSAs are turning. The Laskey soil sampler is used instead of a center plug in 4.25-inch HSAs, and the head of the sampler leads the HSAs by 2 to 6 inches. At the completion of a 5-foot run of HSAs, the Laskey soil sampler is recovered and opened in a manner similar to a split-barrel sampler. Following sample collection and decontamination of the Laskey soil sampler, the sampler is replaced inside the HSAs, and another flight of HSAs is attached to the top of the flight already in the ground.

A Shelby tube sampler is used to collect undisturbed overburden soil samples in a manner similar to a split-barrel soil sampler. Once the HSAs have reached the top of the interval to be sampled, the drilling rods holding the center plug are withdrawn from the HSAs, the Shelby tube is attached to the end of the drilling rod, and the Shelby tube is lowered into the HSAs. The Shelby tube is pushed out the bottom of the HSAs to the prescribed depth, and the tube is retrieved. The Shelby tube is not opened in the field, but is shipped to the laboratory. The process is repeated until bedrock is encountered or the project depth is reached.

6.2.3 Direct-Push/Geoprobe

Installation of boreholes using direct-push/Geoprobe® methods utilizes a hydraulically powered machine to drive rods into the subsurface with both static (downward push) and percussive (hammer) force. Rod widths generally vary from 1.25 inches to 4.25 inches in diameter. This method can be used for continuous or discrete soil sampling in unconsolidated formations only. This method of borehole installation is effective for achieving depths up to 60 feet below ground surface or less, although newer more powerful machines have recently been constructed that have achieved depths in excess of 200 feet below ground surface in certain formations (e.g., 8000 Series Geoprobe®).

There are two soil sampling methods commonly used, macro-core and dual tube. The macro-core sampler does not incorporate the use of casing and utilizes a center rod to hold the core barrel tip in place until the desired depth is reached. The center rod is removed at the desired depth so that soils are allowed to enter the core barrel while it is further driven into the subsurface. The entire assembly is removed to retrieve the soil core and the borehole may collapse at this time. Because the borehole can collapse in between sampling, there are some concerns with slough and cross contamination using this method. A plastic sleeve lines the length of the macro-core barrel to contain the soils and is used to remove the soils. The plastic sleeve should be replaced with a new sleeve for each soil core. This method can be used for continuous or discrete sampling and typically uses a 2.25-inch core barrel and yields a 1.25-inch soil core (other sizes available).

Dual-tube soil sampling utilizes one set of rods that are advanced as an outer casing. A set of inner rods are used to hold a 4- or 5-foot plastic sleeve in the tip of the casing/rod. After each 4- or 5-foot increment, the plastic sleeve is removed using the inner rods and replaced with a new liner before advancing further. Borehole advancement only continues when the soil core barrel is placed back into the borehole and mated with the leading rod of the casing. This method is generally used for continuous soil sampling although it can be utilized for discrete sampling

using a center rod. The typical diameter of tooling using this set up is 4.25-inche casing with a 3-inch soil core. Because the casing remains in place, this method is effective for use in saturated formations and areas where cross contamination is of concern. Given the greater diameter of the tooling, this method typically is more limited in depths of penetration (Geoprobe® 2006).

6.2.4 Direct Mud Rotary

Direct mud rotary bore hole drilling is advanced through rapid rotation of a drill bit (Tri-cone) mounted upon the end of drill rods. The bit cuts and breaks the material at the bottom of the hole into small pieces (cuttings). The cuttings are removed by pumping drilling fluid (water, or water mixed with bentonite or other fluid enhancers) down through the drill rods and bit and up the annulus between the bore hole and the drill rods. The fluid is referred to as drilling mud. Drilling mud is recirculated through the use of a "mud tub" where cuttings are accumulated and drilling mud is pumped back down the drilling rods. The drilling fluid also serves to cool the drill bit and stabilize the bore-hole walls, to prevent the flow of fluids between the bore hole and surrounding earth materials, and to reduce cross contamination between aquifers. Direct mud rotary drilling offers a number of advantages; it is a fast and efficient means of drilling. Efficient rigs can produce several hundred feet of hole per day. The direct mud rotary method can reach to several thousand feet in depth and create hole diameters to greater than 48 inches. The method is adaptable to a wide range of geologic conditions. Only exceptionally large, poorly stabilized boulders, or karst (cavernous) conditions are unsuited for direct mud rotary drilling. Direct mud rotary rigs are widely available throughout the United States. Sediment sampling is broadly supported in direct mud rotary drilling: standard split-barrel and thin-wall sampling are available in poorly lithified materials while a broad range of coring apparatus' are supported for consolidated rock. Hydrologic conditions have little effect upon direct mud rotary drilling; operations are usually unhindered by the presence of ground water. Direct mud rotary drilling readily supports the telescoping of casings to successively smaller sizes to isolate drilled intervals and to protect lower geologic units from contamination by previously drilled, contaminated upper sediments.

The use of direct mud rotary drilling requires careful management of drilling fluids to prevent the buildup of drilling mud (mud cake) in permeable intervals, which can impact the quality of water samples collected from the monitoring well and inhibit flow to the well. A pH neutral bentonite should be used to prevent interference with water quality samples. Additionally, care has to be taken to ensure that organic compounds sometimes added to drilling fluids do not interfere with chemical analysis of water samples. To prevent this, drilling muds will only contain chemically inert substances and the use of petroleum products for fittings and pipe joints will be prohibited. Substitutes for petroleum grease such as vegetable-based oil and lubricants will be utilized.

Direct mud rotary drilling may sometimes be the best available alternative, especially for deep wells or wells completed into well lithified rocks. When direct mud rotary methods are used, hole diameters should be 3 to 5 inches larger than the outer diameter of the well casings to allow effective placement of filter and sealing materials. Two-inch diameter monitoring wells should therefore be installed within 5.5-inch diameter or larger holes.

6.2.5 Direct Air Rotary and Downhole Hammer

The basic rig setup for air rotary with a tri-cone or roller-cone bit is similar to direct mud rotary, except that the circulation medium is air rather than water or mud. Compressed air is circulated down through the drill rods to cool the bit and carry cuttings up the hole to the surface. A cyclone separator slows the air velocity and allows the cuttings to fall into a container. A down-

the-hole hammer, which operates with a pounding action as it rotates, replaces the roller-cone bit.

6.2.6 Sonic Drilling

The sonic drill rig is similar to other drilling rigs in that it is a machine attached to a frame mounted on some type of vehicle. Sonic drilling is the application of high frequency vibration used in conjunction with down pressure and rotation to advance drilling tools through subsurface formations (see Figure 5). The use of high frequency vibration through the drilling tools causes the formation materials to vibrate at their natural frequencies allowing the drilling tool (casing) to advance by fracturing, shearing, or displacing formation material. Most sonic drilling is utilized for drilling in unconsolidated material. However, sonic drilling can also be used for drilling and sampling of rock formations.

During drilling, unconsolidated samples are collected using a sample (or core) barrel. Core barrels are either solid tubes or split barrels of various diameters and lengths generally sized to match the inside diameter of the drill casing being utilized. Typical core barrels are 10 to 20 feet in length and casing sizes range from 0.5 inches to 12 inches, although 4- to 6-inch casing is typical. The core barrel is fitted with a drill bit/cutting shoe, and the sampler is placed within the outer casing material and attached to the rig by drilling rods. As the borehole is advanced, formation material is collected within the core barrel.

Following the sampling run (typically 10 to 20 feet), the core barrel is extracted from the well casing. Formation material is then extracted from the core barrel. Typically, sample material is extracted into a plastic sleeve, which is separated into convenient lengths for logging. The process of sonic drilling and sample collection will cause the sample to be distorted due to vibration, but generally will be intact. In the case of rock drilling, the vibration may create mechanical fractures that can affect the structural analysis for permeability and thereby not reflect the true *in-situ* condition.

The advantages to using sonic drilling technology include reducing the amount of drill cutting generated, providing rapid formation penetration, and the recovery of a continuous core sample.

6.3 Borehole Abandonment

Borehole abandonment is necessary to eliminate potential physical hazards, prevent groundwater contamination, conserve aquifer yield and hydrostatic head, and prevent intermixing of surface water and subsurface water. After the necessary unconsolidated soil samples or consolidated core samples have been collected from the borehole, the HSAs are removed from the borehole and the HSA flights cleaned. A cement/bentonite grout should be tremied into the borehole to the surface. The grout should consist of potable water, bentonite powder, and Type I Portland cement, with 94 pounds of cement and 5 pounds of bentonite per 6.5 gallons of water.

Always determine whether there are applicable regulatory or programmatic specific borehole abandonment procedures or reporting requirements.

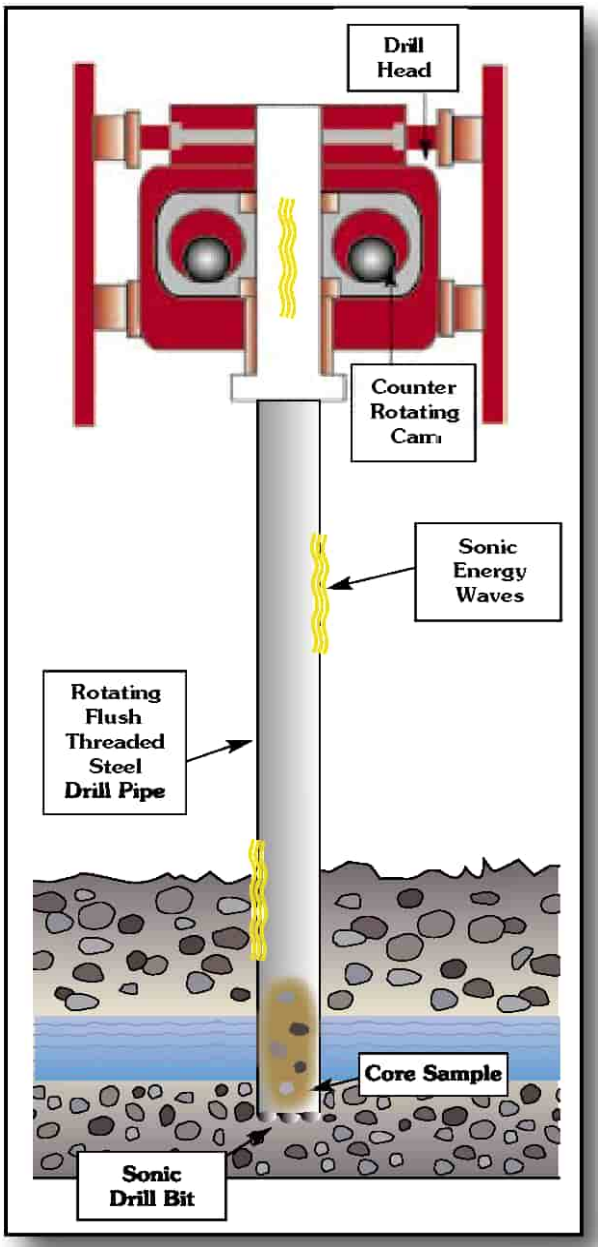

Figure 5 Typical Sonic Drilling Components

7 Quality Assurance/Quality Control

Prior to initiating field work, the project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, SHASP, *et al*) should be reviewed by field personnel to identify sampling procedure(s) that will most likely provide surface and shallow subsurface soil samples that meet project DQOs.

The program/project manager should identify personnel for the field team who have knowledge, training and experience in the borehole installation and subsurface soil sampling activities being conducted typically trained geologist. The geologist should document all borehole sampling and lithological information in E & E's geotechnical logbook. All project personnel, if necessary,

can complete ancillary procedures, e.g., field logbook documentation, equipment decontamination, sample shipment, and waste disposal.

The lead geologist should prepare a detailed equipment checklist before entering the field and verify that sufficient and appropriate equipment and supplies are taken into the field.

Quality assurance/quality control samples (e.g., co-located samples) are collected according to the site quality assurance project plan. Field duplicates are collected from one location and treated as separate samples. Field duplicates are typically collected after the samples have been homogenized. Collocated samples are generally collected from nearby locations and are collected as completely separate samples. Rinsate blanks may be necessary to evaluate the effectiveness of field decontamination procedures (see E & E SOP Env 3.15).

In cases where multiple hand-collected scoop, auger or core samples are required to generate an adequate sample volume, homogenization is important. Field personnel should collect sample aliquots only after mixing has produced soil with textural and color homogeneity.

At sites with known or suspected contamination, samples should be collected moving from least to most contaminated areas.

8 Health and Safety

Prior to entering the field, all field personnel formally acknowledge that they have read and understand the project specific health and safety plan.

Augers and soil core sampling apparatus are inherently dangerous pieces of heavy equipment which a high “pinch” potential. Care should be taken at all times when handling such equipment, not just during sample collection.

Prior to any subsurface work, verify that underground utilities have been located and marked.

9 Special Project Requirements

Project or program-specific requirements that modify this procedure should be entered in this section and included with the project planning documents.

10 References

See E & E SOP Env 3.13 for additional sources of technical information on soil sampling.

Geoprobe®. 2006. Geoprobe® DT 325 Dual Tube Sampling System, Technical Bulletin NO. MK 3138, revised 1/2011.

END OF SOP

Title:	**GEOLOGIC LOGGING**
Category:	GEO 4.8
Revised:	March 1998

STANDARD OPERATING PROCEDURE

GEOLOGIC LOGGING

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CATEGORY:	GEO 4.8
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TITLE:	GEOLOGIC LOGGING		
CATEGORY:	GEO 4.8	REVISED:	March 1998

1. Introduction

Geologic logging involves keeping detailed records during the drilling of boreholes, the installation of monitoring wells, and the excavation of test pits, and entering the geologic descriptions of the soil and rock samples recovered on a standardized form. E & E has adapted a standardized geotechnical logbook (see DOC 2.4 in E & E's Standard Operating Procedures [SOPs]) that contains items deemed important to record when installing monitoring wells, piezometers, and/or soil borings. This document discusses general procedures for completing geologic logs.

2. Drilling Logs

2.1 Basic Documentation

When drilling boreholes, the project geologist should maintain a log that describes each borehole. The E & E Geotechnical Logbook contains records for boreholes. The following basic information should be entered on the heading of each drilling log sheet (see Figure 1):

- Borehole/well number;
- Project name;
- Site location;
- Dates and times that drilling was started and completed;
- Drilling company;
- E & E geologist's name;
- Drill rig type used to drill the borehole;
- Drilling method(s) used to drill the borehole;

DRILLING LOG FOR _____

Project Name _____

Site Location _____

_____

Date Started/Finished _____

Drilling Company _____

Driller's Name _____

Geologist's Name _____

Geologist's Signature _____

Rig Type(s) _____

Drilling Method(s) _____

Bit Size(s) _____ Auger Size(s) _____

Auger/Split Spoon Refusal _____

Total Depth of Borehole is _____

Total Depth of Corehole is _____

Water Level (TOIC)		
Date	Time	Level (Feet)

Well Location Sketch

Depth (Feet)	Sample Number	Blows on Sampler	Soil Components CL SI S GR	Rock Pile	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	HNu/OVA (ppm)	Comments
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											

Figure 1 Drilling Log

- Bit and auger size(s);
- Depth of auger/split barrel sampler refusal;
- Total depth of borehole;
- Total depth of corehole (if applicable);
- Water level at time of completion measured from top of inside casing (TOIC); and
- A well location sketch.

2.2 Technical Information

During the drilling of a borehole, specific technical information about the unconsolidated material and rock encountered should be recorded on the drilling log sheet. The following minimum technical information should be recorded:

- Depth that sample was collected or encountered;
- Sample number assigned (if applicable);
- The number of blow counts required to drive the split barrel sampler 2 feet at 6-inch intervals (see Table 1);
- Description of soil components (see Figure 2);
- Description of rock profile (see Figure 3);
- Rock qualitative designation (RQD) (see Figure 4);
- Rock penetration time;
- Core run number (if applicable) and percent recovery; and
- Organic vapor readings in the sample.

Table 1 Standard Penetration Test for Soil Density

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

3. Soil Classification

Soils should be described using the Unified Soil Classification System (USCS) in the narrative lithologic description section of Figure 5. Figure 6 is a summary of the American Society for Testing and Materials (ASTM) criteria for describing soils. Soil descriptions should be concise, stressing major constituents and characteristics, and should be given in a consistent order and format. The following order is recommended by the ASTM:

1. Soil name. The basic name of the predominant constituent and a single-word modifier indicating the major subordinate constituent.

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

3. Particle size distribution. An estimate of the percentage and grain-size range of each subordinate constituent of the soil. This description may also include a description of angularity (see Figure 7).

4. Color. The basic color of the soil.

SOIL AND SEDIMENT CLASSIFICATION

GRAIN-SIZE SCALE (Modified Wentworth Scale)

phi	mm	inches	U.S. Standard Sieve Series	Grade Name		
-12	4096	161.30				
-11	2048	80.60		very large		
-10	1024	40.30		large	Boulders	
-9	512	20.20		medium		
-8	256	10.10		small		
-7	128	5.00		large	Cobbles	GRAVEL
-6	64	2.52	63.0 mm	small		
-5	32	1.26	31.5 mm	very coarse		
-4	16	0.63	16.0 mm	coarse		
-3	8	0.32	8.0 mm	medium	Pebbles	
-2	4	0.18	No. 5	fine		
-1	2	0.08	No. 10	very fine		
0	1	0.04	No. 18	very coarse		
+1	0.500		No. 35	coarse	Sand	SAND
+2	0.250		No. 60	medium		
+3	0.125		No. 120	fine		
+4	0.062		No. 230	very fine		
+5	0.031			coarse	Silt	
+6	0.016			medium		
+7	0.008			fine		MUD
+8	0.004			very fine		
+9	0.002			coarse		
+10	0.001			medium		
+11	0.0005			fine		CLAY SIZE
+12	0.00025			very fine		

PROPORTIONS USED IN DESCRIBING SOILS

Trace - Particles are present but estimated to be less than 5%
Few - 5 to 10%
Little - 15 to 25%
Some - 30 to 45%
Mostly - 50 to 100%

I.e.: Sand with a trace of silt = 95% Sand, < 5% Silt

(When sampling gravelly soils with a standard split spoon, the true percentage of gravel is often not recovered due to relatively small sample diameter.)

Soil Density from Standard Penetration Test (ASTM D1586)

Granular Soils	Cohesive Soils
0 - 10: Loose	0 - 4: Soft
10 - 30: Medium Dense	4 - 8: Medium Stiff
30 - 50 Dense	8 - 15: Stiff
Over 50: Very Dense	15 - 30: Very Stiff

CLASSIFICATION CHART (United Soil Classification System)

MAJOR DIVISIONS		Symbols	TYPICAL NAMES
Coarse Grained Soils (More than 1/2 of soil > no 200 sieve size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size)	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures little or no fines
		GM	Silty gravels, gravel-sand-silt mixture
		CC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction < No. 4 sieve size)	SW	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand clay mixtures
Fine Grained Soils (More than 1/2 of soil < no 200 sieve size)	SILTS AND CLAYS LL< 50	ML	Inorganic silts, and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays, of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic clays of low plasticity
	SILTS AND CLAYS LL> 50	MH	Inorganic silts, micaceous or diatomaceous, fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils

Figure 2 USCS Soil Classification Chart

ROCK DESCRIPTIVE TERMS

Term		Defining Characteristics	
Hardness	Soft	Scratched by fingernail	
	Moderately Hard	Scratched easily by penknife	
	Hard	Difficult to scratch with a penknife	
	Very Hard	Cannot be scratched by penknife	
Weathering	Unweathered	Rock is unstained. May be fractured, but discontinuities are not stained.	
	Slighty	Rock is unstained. Discontinuities show some staining on the surfaces of rocks, but discoloration does not penetrate rock mass.	
	Moderate	Discontinuity surfaces are stained. Discoloration may extend into rock along discontinuity surfaces.	
	High	Individual rock fragments are thoroughly stained and may be crumbly.	
	Severe	Rock appears to consist of gravel-sized fragments in a "soil" matrix. Individual fragments are thoroughly discolored and can be broken with fingers.	
Bedding Planes	Laminated	< .04 in.	< 1 mm
	Parting	.04 in. - .24 in.	1mm - 6mm
	Banded	.24 in. - 1in.	6 mm - 3 cm
	Thin	1 in. - 4 in.	3 cm - 9.1 cm
	Medium	4 in. - 12 in.	9.1 cm - 30.5 cm
	Thick	12 in.- 36 in.	30.5 cm - 1m
	Massive	> 36 in.	> 1 m
Joints and Fracture Spacing	Very tight	< 2 in.	< 5.1 cm
	Tight	2 in. - 1ft.	5.1 - 30.5 cm
	Moderately tight	1ft. - 3 ft.	30.5 cm - 91.4 cm
	Wide	3 ft. - 10 ft.	91.4 cm - 3 M
	Very wide	> 10 ft.	> 3 M
Voids	Porous	Smaller than a pinhead. Their presence is indicated by the degree of absorbency.	
	Pitted	Pinhead size to a 1/4 inch. If only thin walls separate the individual pits, the core may be described as honeycombed.	
	Vug	1/4 inch to the diameter of the core. The upper limit will vary with core size.	
	Cavity	Larger than the diameter of the core.	

Rock Particle Percent Composition Estimation

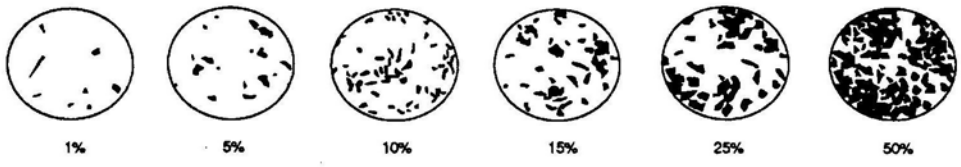


Figure 3 Rock Descriptive Terms

ROCK QUALITY DESIGNATION (RQD) AND FRACTURE FREQUENCY

Core borings are a useful means of obtaining information about the quality of rock mass. The recoverable core indicates the character of the intact rock and the number and character of the natural discontinuities.

Another quantitative index that has proved useful in logging NX core is a rock quality designation (RQD) developed by Deere (1963). The RQD is a modified core recovery percentage in which all the pieces of sound NX core over 4 inches long are counted as recovery. The length of the core run is the distance to the nearest tenth of a foot from the corrected depth of the hole at the end of the previous run to the corrected depth of the hole at the end of subject run. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. The RQD is a more general measure of the core quality than the fracture frequency. Core loss, weathered and soft zones, as well as fractures, are accounted for in this determination. The RQD provides a preliminary estimate of the variation of the in situ rock mass properties from the properties of the "sound" portion of the rock core. Thus, a general estimate of the behavior of the rock mass can be made. An RQD approaching 100 percent denotes an excellent quality rock mass with properties similar to that of an intact specimen. RQD values ranging from 0 to 50 percent are indicative of a poor quality rock mass having a small fraction of the strength and stiffness measured for an intact specimen.

RQD (Rock Quality Designation)

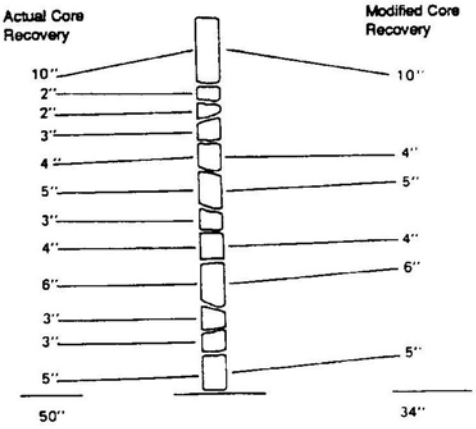
0 - 25	Very Poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

An example of determining the RQD from a core run of 60 inches measured from corrected depth to corrected depth is given in Diagram 1 . For this particular case, the core recovery was 50 inches and the modified core recovery was 34 inches. This yields an RQD of 57 percent, classifying the rock mass in the fair category.

Problems arise in the use of RQD for determining the in situ rock mass quality. The RQD evaluates fractures in the core caused by the drilling process, as well as in natural fractures previously existing in the rock mass. For example, when the core hole penetrates a fault zone or a joint, additional breaks may form that, although not natural fractures, are caused by natural planes of weakness existing in the rock mass. These fresh breaks occur during drilling and handling of the core and are not related to the quality of the rock mass. The skill of the driller will affect the amount of breakage and the core loss that occurs. Poor drilling techniques will "penalize" the rock by lowering its apparent quality. It is difficult to distinguish between drilling breaks and those natural and incipient fractures that reflect the quality of the rock mass. In certain instances, it may be advisable to include all fractures when estimating RQD. Obviously, some judgement is involved in core logging.

Another problem with the use of the RQD index is that the determinations are not sensative to the tightness of the individual joints, whereas in some instances, the in situ deformation modulus may be strongly affected by the average joint opening.

RQD OF A SINGLE CORE RUN *

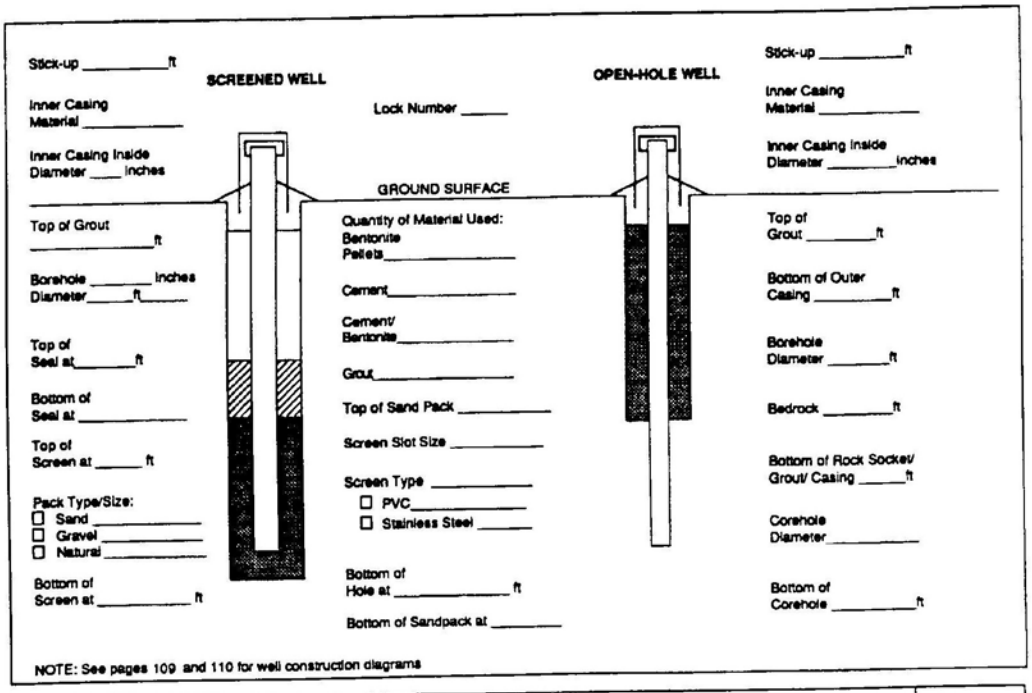


Core Run 60" (Corrected depth to corrected depth)

$\frac{34"}{60"}$ x 100% = 57% = Fair

* Typical calculation of RQD of a single core run. Note that the run is calculated from corrected depth to corrected depth.

Figure 4 Rock Qualitative Designation (RQD)



Depth-ft.	NARRATIVE LITHOLOGIC DESCRIPTION	Moisture Content: Dry	Moist	Wet
1		○	○	○
2		○	○	○
3		○	○	○
4		○	○	○
5		○	○	○
6		○	○	○
7		○	○	○
8		○	○	○
9		○	○	○
10		○	○	○
11		○	○	○
12		○	○	○
13		○	○	○
14		○	○	○

Figure 5 Narrative Lithologic Description

ASTM CRITERIA FOR DESCRIBING SOIL

Criteria for Describing Angularity of Coarse-Grained Particles

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

Criteria for Describing Dilatancy

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

Criteria for Describing Toughness

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

Criteria for Describing Dry Strength

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

Criteria for Describing Structure

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

Figure 6 ASTM Criteria For Describing Soil

CRITERIA FOR DESCRIBING SOIL (Cont.)

Criteria for Describing the Reaction with HCl

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

Criteria for Describing Consistency

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

Criteria for Describing Cementation

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

Criteria for Describing Particle Shape

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

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

Criteria for Describing Plasticity

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

Identification of Inorganic Fine-Grained Soils from Manual Tests

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

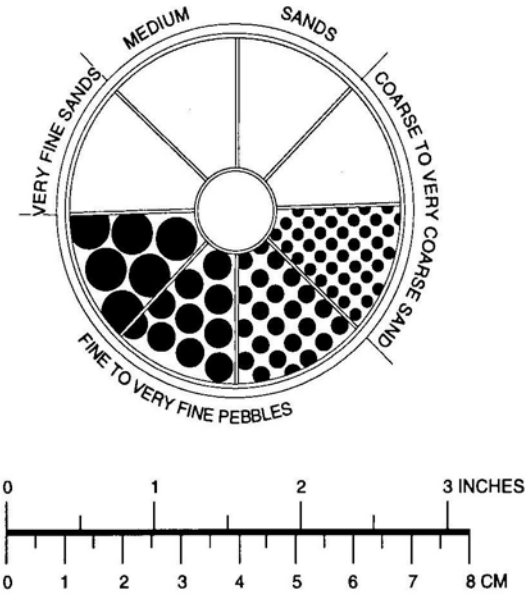
Criteria for Describing Moisture Condition

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

Figure 6 ASTM Criteria for Describing Soil (cont.)

SEDIMENT PARTICLE SIZE AND SHAPE ESTIMATES

GRAPH FOR DETERMINING SIZE OF SEDIMENTARY PARTICLES



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

SEDIMENT PARTICLE SHAPES

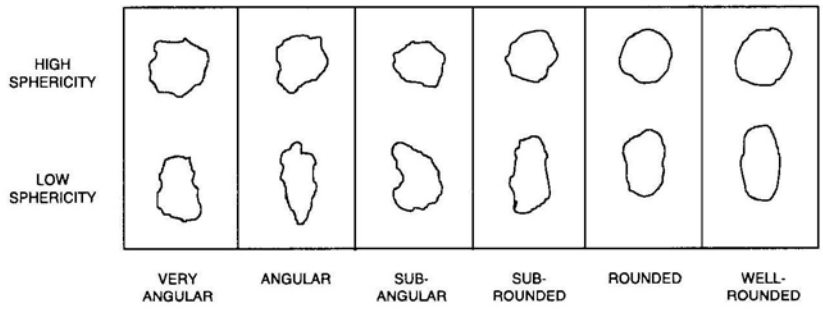


Figure 7 Sediment Particle Size and Shape Estimates

5. Moisture content. The amount of soil moisture (dry, moist, or wet).

6. Relative density or consistency. An estimate of density of a granular soil or consistency of a cohesive soil, usually based on the standard penetration test results (see Table 1).

7. Soil Structure or Mineralogy. Description of discontinuities, inclusions, and structures. Includes joints, fissures, and slickensides.

4. Core Logging

4.1 Handling of Core

After the core has been recovered from the corehole and the core barrel has been opened, the core should be placed in a core box. The top of the core should be placed at the back left corner of the core box, and the remaining core placed to the right of the preceding section (see Figure 8). The core box should be filled in this manner, moving to the front sections of the core box. The beginning of each run should be marked on the core and also noted with a marked wooden block.

4.2 Rock Description

Each stratigraphic unit in the core shall be logged. A line marking the depth of the top and the bottom of the unit shall be drawn horizontally. In classifying the rock, the geologist should avoid being too technical, as the information presented must be used by numerous people with widely divergent backgrounds.

The classification and description of each unit should be given in the following order, as applicable:

1. Unit designation (Miami oolite, Clayton Formation, Chattanooga shale);

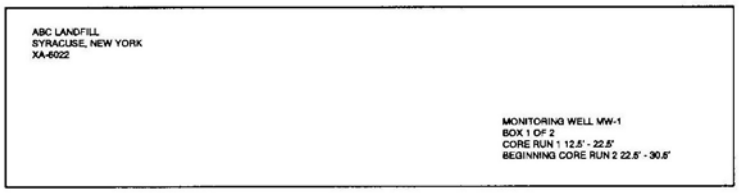
2. Rock type;

3. Hardness;

4. Degree of weathering;

5. Texture;

6. Structure;



EXAMPLE: OUTSIDE CORE BOX COVER

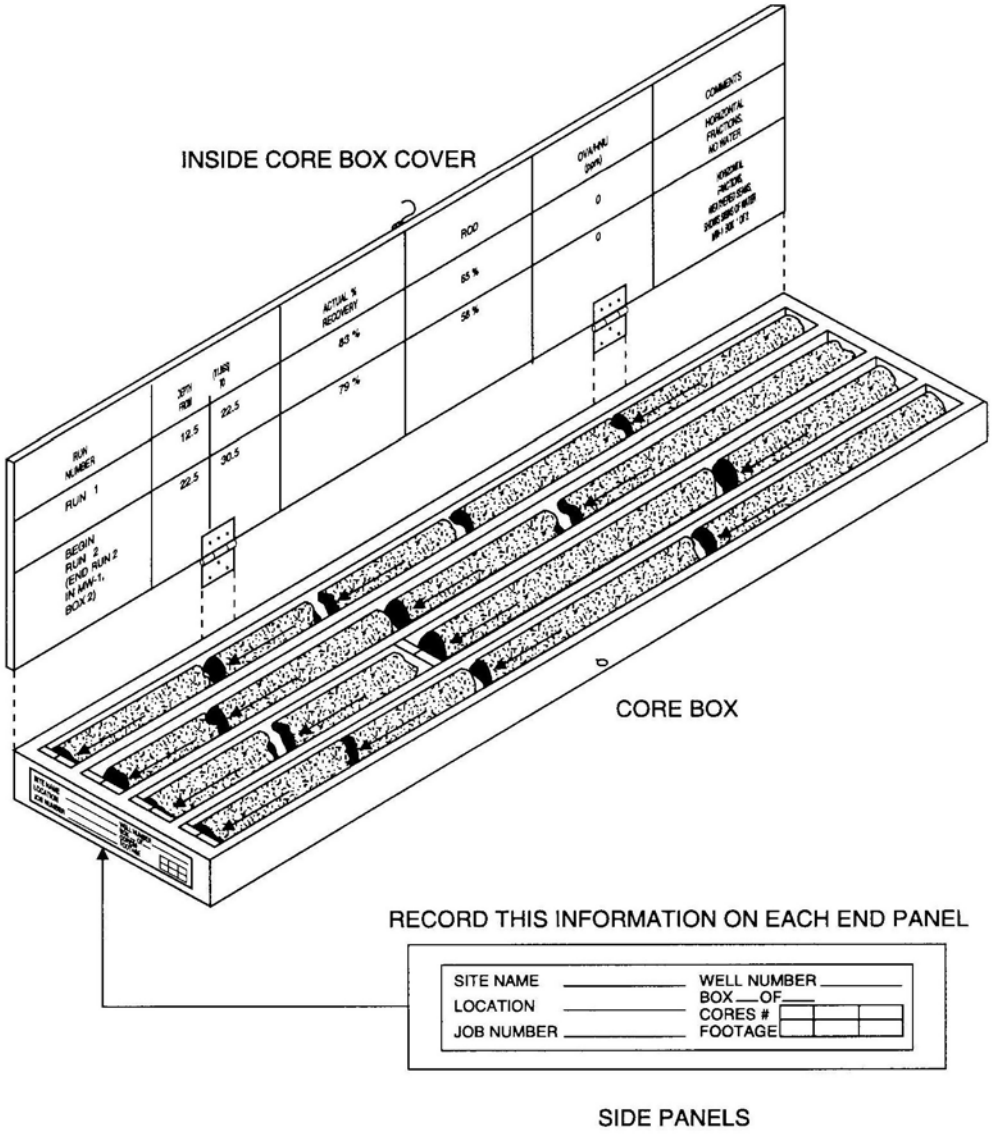


Figure 8 Core Box

7. Color;

8. Solution and void conditions;

9. Swelling properties;

10. Slaking properties; and

11. Additional description, such as mineralization, size, and spacing shale seams, etc.

Variations from the general description of the unit and features not included in the general description shall be indicated by brackets and lines to show the depth and the interval in the core where the feature exists. These variations and features shall be identified by terms that will adequately describe the feature or variation so as to delineate it from the unit. These may be zones or seams of different color, texture, etc., from that of the unit as a whole, such as staining; variations in texture; shale seams, gypsum seams, chert nodules, calcite masses, etc.; mineralized zones; vuggy zones, joints, fractures; open and/or stained bedding planes; faults, shear zones, gouge; cavities' thickness, open or filled, nature of filling, etc.; or any core left in the bottom of the hole after the final pull.

Rock Type and Lithology

1. Rock will be classified according to the following 24 types:

   - Sandstone
   - Conglomerate
   - Coal
   - Compaction Shale
   - Cemented Shale
   - Indurated Clay
   - Limestone
   - Chalk
   - Gneiss
   - Schist

- Graywacke
- Quartzite
- Dolomite
- Marble
- Soapstone and Serpentine
- Slate
- Granite
- Diorite
- Gabbro
- Rhyolite
- Andesite
- Basalt
- Tuff or Tuff Breccia
- Agglomerate or Flow Breccia

2. Lithologic characteristics should be included to differentiate rocks of the same classification. These adjectives should be simple and easily understood, such as shaly, sandy, dolomitic, etc. Inclusions, nodules, and concretions should also be noted here.

3. It is important to maintain a simple but accurate rock classification. The rock type and lithologic characteristics are essentially used to differentiate the rock units encountered.

Hardness

The terms for hardness, as outlined below, were modified to include the use of a rock hammer.

1. **Very soft** or plastic - can be deformed by hand (has a rock-like character but can be broken easily by hand).

2. **Soft** - can be scratched with a fingernail (cannot be crumbled between fingers but can be easily pitted with light blows of a geology hammer).

3. **Moderately hard** - can be scratched easily with a knife; cannot be scratched with a fingernail (can be pitted with moderate blows of a geology hammer).

4. **Hard** - difficult to scratch with a knife (cannot be pitted with a geology hammer but can be chipped with moderate blows of the hammer).

5. **Very hard** - cannot be scratched with a knife (chips can be broken off only with heavy blows of the geology hammer).

Weathering

The degree and depth of weathering is very important and should be accurately detailed in the general description and clearly indicated on the drill log.

1. **Unweathered** - no evidence of any mechanical or chemical alteration.

2. **Slightly weathered** - superficial discoloration, alteration, and/or discoloration along discontinuities; less than 10% of the rock volume is altered; strength is essentially unaffected.

3. **Moderately weathered** - discoloration is evident; surface is pitted and altered, with alterations penetrating well below rock surfaces; 10% to 50% of the rock is altered; strength is noticeably less than unweathered rock.

4. **Highly weathered** - entire section is discolored; alteration is greater than 50%; some areas of slightly weathered rock are present; some minerals are leached away; retains only a fraction of its original strength (wet strength is usually lower than dry strength).

5. **Decomposed** - saprolite; rock is essentially reduced to a soil with a relic rock texture; can be molded or crumbled by hand.

Texture

Texture is used to denote the size of the grains or crystals comprising the rock, as opposed to the arrangement of the grains or crystals, which is considered a structure.

1. **Aphanitic** - grain diameter less than 0.004 inch (0.1 mm); individual grains or crystals are too small to be seen with the naked eye.

2. **Fine-grained, finely crystalline** - grain diameter between 0.004 inch (0.1 mm) and 0.003 (1 mm); grains or crystals can be seen with the naked eye.

3. **Medium-grained, crystalline** - grain diameters between 0.003 foot (1 mm) and 0.0175 foot (5 mm).

4. **Coarse-grained, coarsely crystalline** - grain diameter greater than 0.0175 foot (5 mm).

Structure

The structural character of the rock shall be described in terms of grain or crystal alignment, bedding, and discontinuities, as applicable. The terms may be used singularly or paired.

1. **Foliation and/or lineation** - give approximate dip uniformity, degree of distinctiveness, banding, etc.

2. **Joints:**
   a. Type - bedding, cleavage, foliation, extension, etc.
   b. Degree of openness - tight or open.
   c. Surface or joint plane characteristics - smooth, rough, undulating.
   d. Weathering - degree, staining.
   e. Frequency - see (4).

3. **Fractures, shears, gouge:**
   a. Nature - single plane or zone. (Note thickness.)
   b. Character of materials in plane or zone.
   c. Slickensides.

4. **Frequency:**
   a. Intact - spacing greater than 6 feet (2 m).
   b. Slightly jointed (fractured) - spacing 3 feet (1 m) to 6 feet (2 m).
   c. Moderately jointed (fractured) - spacing 1 foot (0.3 m) to 3 feet (1 m).
   d. Highly jointed (fractured) - spacing 0.3 foot (9.1 cm) to 1 foot (0.3 m).
   e. Intensely jointed (fractured) - spacing less than 0.3 foot (9.1 cm).

5. **Bedding** is used to describe the average thickness of the individual beds within recognized unit, and the terms thick, medium, or thin should not be applied to the individual beds. "Parting" and "band" are used to describe single stratum as outlined below:
   a. Massive - over 3 feet thick (1 m).
   b. Thick - 1 foot (30.5 cm) to 3 feet (1 m) thick.
   c. Medium - 0.3 foot (9.1 cm) to 1 foot (30.5 cm) thick.
   d. Thin - 0.1 foot (3.0 cm) to 0.3 foot (9.1 cm) thick.

e. Band - 0.02 foot (6 mm) to 0.1 foot (3.0 cm) thick, described to the nearest 0.01 foot.
f. Parting - less than 0.02 foot (6 mm).
g. Paper-thin parting.

The terms and descriptions for the structure of the rock are to be used to describe the character of the rock units recognized and are not to be used as a substitute for describing individual discontinuities. Except for areas where the rock is intensely fractured or jointed, each discontinuity should be described on the log as to position, dip, staining, weathering, breccia, gouge, etc.

Color is often valuable in correlating or differentiating samples, but can be misleading or uninformative. The color of a sample should represent the sample in terms of basic hues (i.e., red, blue, gray, black), supplemented with modifying hues as required (i.e., bluish gray, mottled brown). The core should be surface wet when describing the color; if it is dry, the log should indicate "dry color." Subjective colors, such as buff or maroon, should not be used. Specific color charts, such as the Mumsel Color Chart or the Color Index in the Colorado School of Mines, Quarterly, Volume 50, No. 1, are useful in describing color of samples. When such a chart or index is used, it should be noted on the log in the remarks column.

Solution and Void Conditions shall be described in detail, as these features can affect the strength of the rock and can indicate potential seepage paths through the rock. When cavities are detected by drill action, the depth to top and bottom of the cavity should be determined by measuring the stick-up of the drill tools when the cavity is first encountered and again at the bottom, as it is very difficult to reconstruct cavities from the core alone. Filling material, when present and recovered, should be described in detail opposite the cavity. When no material is recovered from the area of the cavity, the inspector should note the probable conditions of the cavity as determined from observing the drilling action and the color of the drill fluid. If the drill action indicated material was present (i.e., slow rod drop, no loss of drill water, noticeable change in color of water return), it should be noted on the log that the cavity was probably filled and the materials should be described as best as possible from the cuttings or traces left on the core. If drill action indicates the cavity was open (i.e., no resistance to the drill tools, loss of drill fluid), this should be noted on the drill log. Partially filled cavities should also be noted. All of these observations require close observation of the drill action and water return by both the inspector and the driller; accurate measurement of stick-ups; and detailed inspection of the core. When possible, filling material should be wrapped in foil if left in the core box. If the material is to be tested or examined in the lab, it should be sealed in a jar with proper labels and a spacer, with a note showing the disposition of the material should be placed in the core box at the point from which the material was taken. Terms to describe voids encountered shall be as follows:

1. **Porous** - voids less than 0.003 foot (1 mm) in diameter.

2. **Pitted** - voids 0.03 foot (1 mm) to 0.02 foot (6 mm) in diameter.

3. **Vug** - voids 0.02 foot (6 mm) to the diameter of the core.

4. **Cavity** - voids greater than diameter of the core.

4.3 Core Labeling

The top of the core should be shown on each piece of core with an arrow written in a black, waterproof marker. The arrow will indicate which end of the core is nearer the ground surface. Other core markings may include locations of mechanical breaks and drilling footages.

4.4 Core Box Labeling

Each core box should be labeled as follows:

- On the top left corner of the outer core box, the project name, site location (city and state), and project number should be written.
- On the lower right corner of the outer core box, the corehole number (e.g., MW1, BH2), core box number (e.g., 1 of 2, 2 of 2), and the interval of the core run contained in the core box should be written.
- The side panels should be marked as indicated in Figure 8.
- The inside of the core box cover should be marked as indicated in Figure 8.

4.5 Core Storage

It is important to use proper-sized (HQ or NQ) wooden core boxes for rock core storage. After labeling the box and before closing the box for final storage or shipment, wooden spacers should be inserted into each compartment that contains rock core. This will prevent lateral movement of the cores, which could damage the rock material during handling.

After properly logging, labelling, and packing the cores, the core boxes should be stored in a dry location, preferably off of the floor on a pallet. The boxes can be stacked to a reasonable height so as not to be unstable, with end labelling facing out.

5. References

American Society for Testing and Materials (ASTM), 1975, Test Method for Classification of Soils for Engineering Purposes, ASTM D2487-69, Philadelphia, Pennsylvania.

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Driscoll, J.T., R.V. Dietrich, and R.M. Foose, 1989, AGI Data Sheets for Geology in the Field, Laboratory, and Office, Third Edition, American Geological Institute, Alexandria, Virginia.

U.S. Army Corps of Engineers, St. Louis District, Inspector's Manual, St. Louis, Missouri.

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ecology and environment, inc.

STANDARD OPERATING PROCEDURE

WELL DEVELOPMENT

SOP NUMBER: GEO 4.11

REVISION DATE: 4/5/2013 **SCHEDULED REVIEW DATE: 4/5/2018**

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1 Scope and Application

The purpose of monitoring well development is to ensure removal of fine materials from the pore spaces in the newly installed filter pack and in the vicinity of the screen; to attain maximum specific capacity and better yield; and to reduce turbidity in water quality samples. This allows free flow of water from the formation into the well, compensates for disturbance done to the formation during drilling, and reduces the turbidity of the water during sampling events. A properly developed monitoring well will then provide a water sample representative of the natural groundwater in the vicinity of the well.

Additionally, during drilling activities, drilling fluids may be lost into the formation or fractures and cavities or may have been used to maintain hydraulic head during drilling activities (such as in flowing sands). Drilling mud may also have been used to seal the wall of the borehole. Drilling fluids must be recovered through development to ensure that samples collected are representative of formation water.

All types of drilling operations alter the hydraulic characteristics of formation material in the vicinity of the borehole. Development is an essential task in the proper completion of a water well. The techniques are applicable for all types of aquifer materials, from unconsolidated sediments to fractured bedrock. The appropriate well development method should be selected to accommodate site conditions and project requirements.

This SOP incorporates guidance found in American Society for Testing and Materials Designation D5521 – 05, *Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers*. Additional sources of information that may be useful include *Groundwater and Wells* (Driscoll 2008) and United States Army Corps of Engineers guidance in *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites* (USACE 1998).

2 Definitions and Acronyms

BGS	below ground surface
Conductivity or Specific Conductance	a measure of the ability to conduct electricity, typically measured in microSiemens per centimeter (µS/cm) or milliSiemens per cm (mS/cm)
DO	dissolved oxygen, which is the amount of oxygen dissolved in solution, typically measured in milligram per liter (mg/L)
pH	a measure of acidity (acidic) or alkalinity (basic) on a scale of 0-14 standard units (SU)
ORP	oxidation-reduction potential which is a measure of determining whether a substance is a strong oxidizing agent or a strong reducing agent, typically measured in volts (V) or millivolts (mV)
NTU	nephelometric turbidity units
SOP	Standard operating procedure
Turbidity	the measure of the degree of which water loses its clarity by the presence of suspended solids, typically measured in nephelometric turbidity units (NTUs)

3 Procedure Summary

This procedure covers monitoring well development. Federal and state regulatory agencies also have standards and guidance for monitoring well development that supersede this SOP if required for the project. Before developing a well, the well must be properly installed, especially the filter pack, seal, and grout, and the seal and grout must be allowed to set and cure for a period of at least 24 hours (see E & E Standard Operating Procedure [SOP] GEO 4.10, *Monitoring Well Installation*). Water levels and total depth should also be properly measured prior to initiating well development procedures (see E & E SOP GEO 4.15, *Measuring Water Level and Well Depth*).

The most common well development methods are bailing, overpumping, mechanical surging, air surging, and jetting. Often, a combination of methods is employed. Withdrawal of water is of primary importance in order to remove fine sediments and drilling fluids. However, proper development includes the induction of flow in two directions, into and out of the well. This aids in development of a proper grain size gradation in the filter pack surrounding the well screen. Well development should be performed until the development water is representative of groundwater conditions (i.e., not diluted from drilling fluids added/lost to the formation) and is free of sediments, or until the turbidity has stabilized at a level considered natural by the on-site geologist. Therefore, at least three times the volume of standing water plus saturated thickness (assuming 30 percent annular porosity), plus three times the volume of water added to the well bore during well construction, and and/or the volume of water lost to the formation from drilling fluids used during drilling must be removed. In addition, at a minimum, development should be continued until pH, temperature, and specific conductivity values have stabilized at values considered by the on-site geologist to be typical for the site conditions. Additional parameter stabilization such as oxidation-reduction potential (ORP) and dissolved oxygen (DO) may be considered on a site-specific basis; refer to project planning documents. Containerize all discharge water from known or suspected contaminated areas (treatment may be an acceptable alternative). Record all measurements in the logbook or on data collection forms. Ideally, dedicated well development equipment may be used for each well. However, dedicated development equipment may not be practical due to the number of wells, depth of wells, and equipment costs. In this case, development equipment should be cleaned prior to and between well locations using the decontamination procedures outlined in E & E's SOP for *Sampling Equipment Decontamination* (ENV 3.15).

4 Cautions

Cautions to be considered during well development include:

- Not waiting the prescribed period following well completion can cause damage to the well if the bentonite seal and grout are not allowed to properly set and cure and is drawn into the filter pack and/or well;
- Removal of an insufficient volume of water may result in groundwater samples that are not representative of the formation; and
- Not using dedicated equipment or not properly decontaminating non-dedicated equipment can cause cross contamination between wells.

5 Equipment and Supplies

The type of equipment used for well development depends on the characteristics of the well (e.g., casing and screen diameter, construction material, and total depth) and of the aquifer

(e.g., expected yield and turbidity of the formation). For example, most rig-mounted pumps and suction-lift pumps can only lift water a maximum of 28 feet. Therefore, if the well's static water level (water table) is greater than 28 feet below ground surface (BGS), or the water level is expected to be drawn down quickly below 28 feet BGS by the pump, then an alternative method must be used (e.g., air lift, centrifugal pump, bailer).

In general, wells could be developed either by the well driller using the drilling equipment or by E & E personnel using purchased or rented equipment. Most drilling companies have air compressors, centrifugal pumps, or submersible pumps that may be used for the development process. Section 6 details the specific equipment necessary for each well development technique.

In addition to development equipment, the following general field equipment and materials will also be required.

- Camera to document procedures and water clarity at the completion of development.
- Field logbook and well development form (see Figure 1 for an example data form or refer to E & E's Geotechnical Logbook);
- Boring log and well completion diagram for the well (Geotechnical Log Book);
- Water quality meters and appropriate sample vials;
- Water level indicator and/or weighted measuring tape; and
- Containers for purged water, if required.

5.1 Reagents

No chemical reagents are used in this procedure. For equipment decontamination and reagents used therein, refer to E & E SOP ENV 3.15, *Sampling Equipment Decontamination*.

6 Procedures

6.1 Development Methods

6.1.1 Bailing

In bailing, a bottom-filling bailer (e.g., polyethylene, polyvinyl chloride [PVC], Teflon, stainless steel, etc.) is used to remove water from the well. Begin by securely tying one end of a nylon or polypropylene rope (typically ¼-inch thickness or less) to the top of the bailer and lower it to the bottom of the monitoring well. Next, cut the rope to a length that allows the bailer to reach the bottom of the well while providing approximately 3 to 5 extra feet of rope. Cut the rope off at the appropriate length and tie the end to the protective casing of the monitoring well or another object to prevent the rope and bailer from being accidently lost down the well. The bailer is then allowed to fall freely down the well until it impacts the surface of the water. The impact of the bailer produces an outward surge of water through the well screen and filter pack. As the bailer fills and is removed, the flow of water reverses and fine particulates migrate into the well and are brought to the surface in the bailer. A series of short rapid strokes with the bailer at the bottom of the well will also remove accumulated sediment.

WELL DEVELOPMENT RECORD

Site Name: _____ Well ID: _____

Project Number: _____ Date: _____

Location: _____ Diameter (inches): _____

Initial Depth to Water (ft below TOIC): _____ Final Water Level (ft below TOIC): _____

Initial Well Depth (ft below TOIC): _____ Final Well Depth (ft below TOIC): _____

Initial Casing Volume (gallons): _____ 3x Static Casing Volume (gallons): _____

Description of development equipment and technique: _____

Time	Total Volume Removed		pH	Temp. (°F / °C)	Conductivity (µS/cm)	Turbidity (NTU)	Depth to Water (ft TOIC)	Comments
	Gallons	Number						

Personnel: _____ Signature: _____

_____ Date: _____

Advantages

The advantages of bailing include:

- No new fluids or air are introduced into the aquifer;
- Fluids introduced during drilling are removed;
- Sediment/fine particulates are removed from the well; and
- Equipment used is relatively inexpensive, easily obtainable, and, if dedicated to the well, can be used for purging and sampling the same well later.

Disadvantages

The disadvantages of bailing are:

- It is time-consuming and physically demanding if done manually; and
- It is not effective in low-yield wells.

6.1.2 Overpumping

In overpumping, the well is pumped at a rate that substantially exceeds the ability of the formation to deliver water. Typically, a submersible centrifugal pump is used. Pump selection must account for the amount of head to be overcome; that is, the anticipated depth to which the water level is expected to be drawn down must be anticipated and considered during pump selection. Backwashing is often used in conjunction with overpumping. If the pump does not have a backflow prevention valve, alternately starting and stopping the pump (sometimes referred to as “rawhiding”) creates a surging effect in which water is driven back into the formation during the off cycle. Alternatively, clean water can be added to the well, but only as a last resort when the well screen appears to be clogged and preventing the groundwater from entering the well. Prior to adding clean water to a well, the field crew must check the applicable regulations and receive permission from the project manager. The volume of all clean water added to the well must recorded in the logbook, and at least 3 to 5 times the volume of water added to the well should be removed during the development process to ensure that representative formation water is being drawn in the well when water quality parameters are being monitored for final stabilization.

Advantages

The advantages of overpumping are:

- With the variety of pumps available, It is relatively convenient and is applicable to a variety of well sizes;
- Minimal time and effort are required;
- Generally, no new fluids are introduced; and
- Fluids introduced during drilling and some fine sediment are removed.

Disadvantages

The disadvantages of overpumping are:

- Can result in a large volume of water to be contained, treated, and disposed of;

- May not develop maximum efficiency in a well because it may not effectively develop and set the grains within the filter pack and surrounding formation unless bidirectional flow can be sufficiently induced, such as if combined with mechanical surging;
- May cause "bridging" within the filter pack or formation. This is caused by small particles forming a "bridge" across the pore space between larger particles and impeding hydraulic conductivity. This may be avoided by inducing bidirectional flow into and out of the well; and
- Excessive pumping rates can cause well collapse, especially in deep wells.

6.1.3 Mechanical Surging

Mechanical surging forces water into and out of the well screen by operating a plunger, called a surge block, which is attached to a rod or wire line (see Figure 2). There are multiple configurations for surge blocks. Surge blocks should be close fitting to the interior side walls of the well, but should allow for the passage of some water to avoid creating excessive pressure on the up or down stroke and potentially damaging the well screen. The surge block is lowered to the top of the well screen and operated in a pumping action with strokes typically about 3 feet in length and is gradually worked downward throughout the screened interval. The surge block can be constructed of any materials (e.g., sand-filled PVC pipe) that will not alter the water chemistry. Periodically, the surge block is removed and fines that have entered the well are removed by pumping or bailing. This method is equally applicable to small- and large-diameter wells and is among the most effective methods for small-diameter wells.

Advantages

The advantages of mechanical surging include:

- Low cost and easy to implement;
- Effectively arranges particles within the filter pack;
- Has greater suction action and surging than backwashing or bailing;
- No new fluids are introduced into the well; and
- The quantity of water to treat and dispose of is minimized;

Disadvantages

The disadvantages of mechanical surging are:

- It must be combined with pumping or bailing to remove drilling fluids and sediments;
- If screen becomes plugged with fines (clay), the well casing or screen can collapse;
- It tends to push fine-grained sediments into the filter pack;
- The well bentonite seal could be disturbed; and
- Excessive sand can result in sand-locking of the surge block within the well.

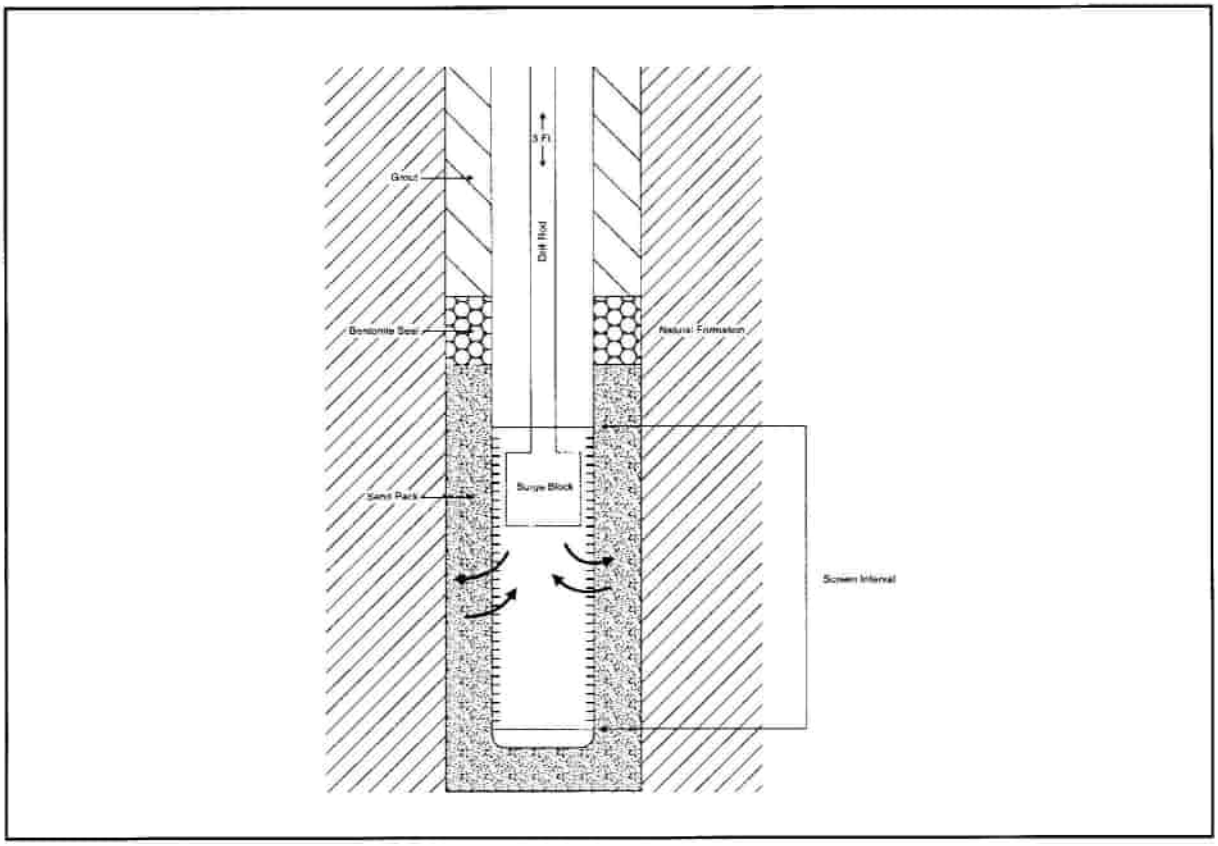

Figure 2 Mechanical Surging

6.1.4 Air Surging and Air-Lift Pumping

Compressed air can be used to surge and air-lift pump a well. In air surging, air injected through a pipe lifts the water column until it reaches the top of the well casing. Then the air is shut off, causing an outward surging action in the well's screened interval. Alternatively, sufficient air pressure can be used to lift water out of the well (see Figure 3). Air surging is not recommended for monitoring wells (but may be used successfully in production and supply wells). Injecting air into a monitoring well may force air into contact with the formation, altering the oxidation-reduction potential of the formation water and changing the groundwater chemistry. Air bubbles may also become entrapped within the screen, filter pack, or formation causing a decrease in well yield. Air bubbles may be difficult to remove.

A more suitable alternative is air-lift pumping combined with bailing or pumping to remove fine sediment. In air-lift pumping, air is not forced into the filter pack or formation. An airline is inserted inside a pipe known as an educator pipe and the assembly is lowered into the screen interval. The airline should not extend below the educator. The flow of air down the airline causes a reduction in specific gravity of the water at the bottom of the educator and the water flows up and out of the educator (see Figure 3). Air-lift pumping may remove some fine sediment, but should be supplemented with bailing or pumping to remove fines.

In either case, air injected into a well should be verified to be oil free.

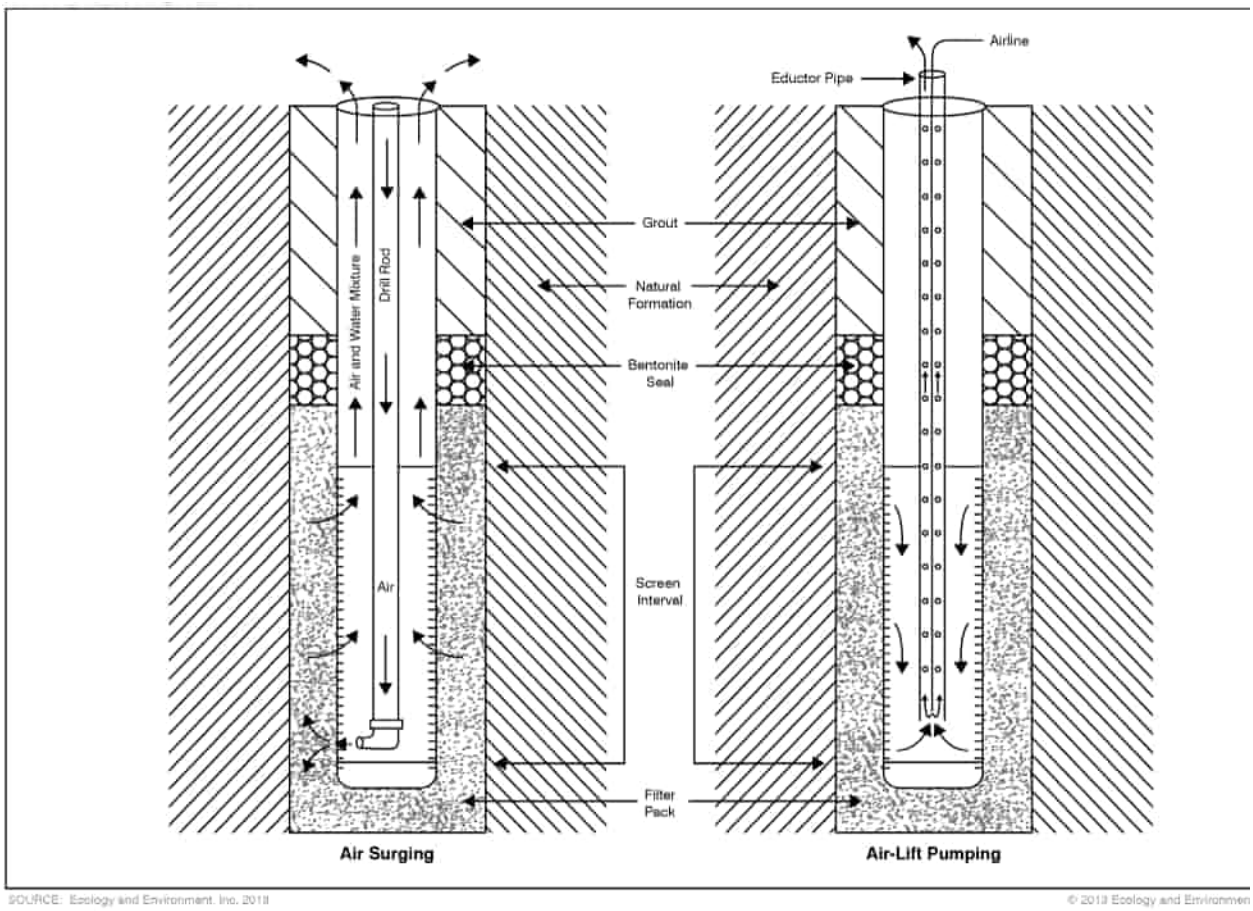

Figure 3 Air Surging and Air-Lift Pumping

Advantages

The advantages of air surging and air-lift pumping are:

- They are rapid methods for development;
- They are effective in a variety of well sizes and depths; and
- They are relatively easy to implement with minimal equipment needs (compressed air tanks or oil-free compressor, airline, and pipe).

Disadvantages

The disadvantages of air surging are:

- Air can become entrained in the screen or filter pack and reduce well yield;
- Air can be impure (contaminated with oil products) from the air compressor;
- Introduction of air can alter water chemistry and biology (iron bacteria) near the well (this can be mitigated by using nitrogen instead of compressed air); and
- Fine sediment is not removed unless combined with bailing or pumping.

The disadvantages of air-lift pumping include the following:

- Air impurities may contaminate groundwater near the well;
- Some fine sediment may be removed, but heavier coarse-grained particles may not be and bailing may be needed to remove additional particles.
- Significant volumes of groundwater may need to be contained, treated, and disposed of.

6.1.5 High-Velocity Jetting

In high-velocity jetting, a single or multiple-nozzle device is used to direct a horizontal stream of water against the well screen. The jetting tool is placed near the bottom of the screen and slowly rotated while being pulled upward. Material that enters the screen in the backwash of the jet stream is then removed by pumping or bailing. Air-lift pumping is typically combined with jetting because it can remove particulates without damage to pump impellers and can fit into a well with the jetting device. If the pumping rate can be maintained at approximately twice the injection rate of the jetting tool, then minimal water loss can be expected. Water pumped out during jetting may be recycled by reinjection for jetting water.

Advantages

The advantages of high-velocity jetting are:

- It is simple to use,
- It effectively rearranges and breaks down bridging in filter pack, and
- It effectively removes mud cake around screen.

Disadvantages

The disadvantages of high-velocity jetting are:

- Foreign water is introduced to the aquifer;
- It does not remove drilling fluids unless combined with pumping or bailing; and
- Jetting with simultaneous pumping is not always practicable because of the limited space available within the well.

6.2 Operation

Well development should be performed as soon as is practical after the well is installed, but no sooner than 24 hours after grouting is completed. Dispersing agents, acids, or disinfectants should not be used to enhance development of the well.

1. Assemble necessary equipment on a plastic sheet around the well.
2. Record pertinent information (e.g., personnel, date, time, location identification, etc.) in the field logbook and/or data forms.
3. Open the monitoring well and measure organic vapors or other gases within the headspace at the top of casing and in the breathing zone, as specified in project planning documents, and record readings and observations.
4. Measure the depth to water and the total depth of the well, and calculate the volume of water in the well. Depth measurements are described in E & E SOP GEO 4.15, *Measuring Water Level and Well Depth*. Calculations are in Section 6.3.

5. Begin development using the method specified in the project planning documents. If mechanical surging is performed prior to extracting water from the well, obtain a sample of the undeveloped water using a bailer or equivalent prior to initiating development.
6. Note the initial color and clarity of the water. Measure the initial water quality parameters required for the project. In the absence of site-specific requirements, obtain measurements of pH, temperature, specific conductance, and turbidity in addition the physical characteristics noted above.
7. Develop the well until the minimum volume of water is removed (i.e., three times the following volumes: standing water in the well including water in the annular space of the saturated thickness plus the volume of water added during well construction plus the volume of water lost to the formation during well drilling); the required water quality parameters have stabilized after three consecutive readings; and the turbidity is below the required threshold. In the absence of site-specific requirements described in the project planning documents, the target turbidity threshold is 50 nephelometric turbidity units (NTU). If this threshold cannot be achieved due to formation characteristics but the turbidity stabilizes, development may be considered complete after consultation with the project geologist and project manager. If not specified in project planning documents, guidance for the stabilization of water quality parameters is as follows:
    - ± 0.1 standard unit for pH;
    - ± 3% for temperature;
    - ± 3% for specific conductance; and
    - ± 10% for turbidity.

    If utilized at a specific site, the following stabilization guidance may also apply:
    - ± 10 millivolts for oxidation-reduction potential (ORP);± 10% for dissolved oxygen (DO).
8. All water produced by development in contaminated or suspected contaminated areas must be containerized and/or treated prior to proper disposal. Each container must be clearly labeled with the location identification, including site name, date, and monitoring well number. Determination of the appropriate disposal method should be specified in the project planning documents and may be based on the first round of analytical results from each well.
9. No water shall be added to the well to assist development without prior approval of the project geologist. If a well cannot be cleaned of mud to produce formation water (i.e., if the yield is insufficient), small amounts of potable water may be introduced, possibly via hydraulic jetting. At least three times the amount of water injected must be recovered from the well after injection to ensure that all injected water is removed from the formation. Minimize the amount of water injected. Once the well boring is cleared of drilling mud and formation water flows into the well, continue development with formation water only.
10. Measure the final pH, temperature, specific conductance, and turbidity of the water and record the measurements and the final color and visual clarity in the field logbook and/or data forms.

The following data shall be recorded in the field logbook:

- Site name and location;

- Well designation (location identifier);
- Date(s) and time of well development;
- Static water level and total depth before and after development;
- Water quality parameter measurements before and after development and at least every one well volume (static volume of water within the well casing prior to development);
- Type and size or capacity of pump and bailer used;
- Description of well development techniques used,
- Total quantity of water removed; and
- Storage location of development water.

Although not required, obtaining a photograph of the initial and final development water in a clear glass jar is recommended to verify changes made to the turbidity of the water during development.

Following completion of development, decontaminate all reusable equipment in accordance with project planning documents or E & E SOP ENV 3.15, *Sampling Equipment Decontamination.*

Store containers of water produced during development in a safe and secure area. Treat and/or dispose of wastewater in accordance with project planning documents or E & E SOP ENV 3.26, *Handling Investigation-derived Wastes*.

6.3 Calculations

To calculate the volume of the well, use the following equation:

$$V = \pi {r_i}^2 h_w + \pi({r_b}^2 - {r_o}^2) h_f n$$

where:

V = total volume (well casing plus saturated filter pack);

r_i^2 = inside radius of well casing;

r_b = radius of the well boring;

r_o = outside radius of well casing;

h_w = height of water in the well;

h_f = height of water in the well or height of filter pack, whichever is less;

n = porosity of the filter pack

If the radius of the well casing is measured in inches and the volume is measured in gallons, the following conversion factors may be used to calculate the volume of water within the well by multiplying the height of water measured in feet:

Well diameter (inches):	1	2	4	6
Linear Volume (gallons per foot):	0.041	0.163	0.653	1.47

Similarly, using the same units of measurement, the following conversion factors may be used to calculate the volume of water within the annular space of the filter pack by multiplying the saturated height of the filter pack measured in feet and assuming a porosity of 35%:

Borehole Diameter (inches):	2 ¼	8 ½	10 ½	12 ½
Well diameter (inches):	1	2	4	6
Linear Volume (gallons per foot):	0.050	0.959	1.17	1.67

7 Quality Assurance Quality Control

There are no specific quality assurance (QA) activities that apply to the implementation of these procedures. However, the following general QA procedures apply:

1. All data must be documented on field data sheets, and field/site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the project planning documents. Equipment checkout and calibration activities must occur prior to or operation, and they must be documented.
3. All deliverables will receive peer review prior to release.

8 Health and Safety

Depending on the site-specific contaminants, various protective programs must be implemented prior to opening a well, taking water level measurements, or removing groundwater. The site-specific Health and Safety Plan (HASP) should be reviewed with specific emphasis placed on the protection program planned for well development tasks. Standard safe-operating practices, such as minimizing contact with potential contaminants in both the vapor phase and liquid matrix through the use of the respirators and personal protective clothing, should be followed.

9 Special Project Requirements

Project or program-specific requirements that modify this procedure should be entered in this section and included with the project planning documents.

10 References

American Society for Testing and Materials (ASTM), Designation D5521 - 05 *Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers*.

Driscoll, F.G., 2008, *Groundwater and Wells*, (3rd edition), Johnson Division, VOP, Inc., St. Paul, Minnesota.

Ecology and Environment, Inc., 2012, Standard Operating Procedure ENV 3.15, *Sampling Equipment Decontamination*.

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_____, 2013, Standard Operating Procedure GEO 4.15, *Measuring Water Level and Well Depth*.

United States Army Corps of Engineers (USACE), 1998, "Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites, Engineer Manual 1110-1-4000, Washington, DC.

END OF SOP

ecology and environment, inc.

STANDARD OPERATING PROCEDURE

MEASURING WATER LEVEL AND WELL DEPTH

SOP NUMBER: GEO 4.15

REVISION DATE: 4/3/2013 **SCHEDULED REVIEW DATE: 4/3/2018**

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1 Scope and Application

Most subsurface investigations require measurement and monitoring of groundwater levels to characterize contaminant movement and aquifer conditions as they relate to specific investigation sites. This document describes E & E's standard operating procedure (SOP) for measuring water level and well depth in monitoring wells and piezometers.

2 Definitions and Acronyms

BGS	below ground surface
DNAPL	dense non-aqueous phase liquid
LNAPL	light non-aqueous phase liquid
MSL	mean sea level
SOP	Standard Operating Procedure
TOC	top of casing
TOIC	top of inner casing (i.e., top of the well casing inside the outer protective casing)

3 Procedure Summary

Water level and total well depth measurements in monitoring wells are performed by using a water level indicator that has a graduated cable, typically to the nearest 0.01 foot. The precision of the device selected for measurement should be determined at the time of data quality objective development for the specific project. Water level and total depth measurements must be referenced to a consistent, repeatable, and known reference point. Typically, this is the top of (TOC) of the well or piezometer, which in many cases is more specifically the top of inner casing (TOIC) of the well or piezometer because most wells have an outer protective casing. The measurement reference point may also be ground surface, especially if the well is completed with a flush-mount cover. Measurements referenced to ground surface are typically reported in feet or meters below ground surface (BGS). Measurements of groundwater head elevation are typically required to determine flow gradients and other hydraulic properties. Therefore, the elevation of the measurement reference point may be determined via vertical surveying of the reference point. The resulting elevation of the reference point and groundwater level must reference the appropriate datum used to develop the elevations. This may be a local site datum of an assumed value or mean sea level (MSL) referenced to an ellipsoid such as the World Geodetic System 1984 or a geoid such as the North American Vertical Datum 1988. The water level indicator must be decontaminated according to E & E SOP for Equipment Decontamination (ENV 3.15) between each use in different well.

4 Cautions

If a noticeably anomalous depth to water or well depth is encountered (based on previous measurement, well logs, or comparison of data to other nearby wells of similar construction), re-measure and verify the measurements before leaving the site.

Because some casings have rough or sharp edges, use caution when lowering and retrieving the water level cable from within the well casing. These edges can cut and scrape the cable,

obscuring the calibrated markings on the cable, and can eventually lead to failure (shorting out) of the electronic cable.

The top of well casings may not be level (due to imperfections when the casing was cut to length at the time of well installation). Therefore, a mark should be placed on the top of the casing to be used as a reference point for measuring. If a mark is not present, assume the measurement was taken at the highest point on the top of the well casing, because this is likely the point surveyed.

Always use caution when opening capped wells, because escaping (venting) headspace gases may be hazardous.

Changes in atmospheric pressure may cause the monitoring well to be under pressure or under vacuum if a gas-tight cap is present. This can result in a temporarily high or low water level within the well. Often the sound of air escaping from the well can be heard from the well when the cap is removed. If a sealed, gas-tight cap or plug is present, the water level within the well should be allowed to equalize to atmospheric pressure before collecting a depth to water measurement. Only stabilized measurements should be recorded.

5 Equipment and Supplies

The following is a list of equipment and items typically used for measuring water levels and well depths:

- Electronic water level indicator or oil/water interface probe with graduated cable;
- Extra batteries for water level indicator or oil/water interface probe;
- Detergent solution (laboratory grade, phosphate-free detergent such as Liquinox);
- Deionized or distilled water;
- Sterile gloves (nitrile or other material suitable to site conditions);
- Paper towels;
- Logbook and other site documentation; and
- Folding ruler or pocket steel tape.

6 Procedures

6.1 Preliminary Steps

1. Locate the well or piezometer and verify its position on the site map. Record whether positive identification was obtained, including the well number and any identifying marks or codes contained on the well casing or protective casing. Gain access to the top of the well casing and note the date and time the well was opened. If specified in the work plan or site health and safety plan, use monitoring equipment to measure or take readings of the well headspace. Record all measurements and observations (e.g., organic vapor readings, release of pressure when cap is removed, odor, etc.).
2. Locate and record the specified benchmark or survey point for the well or piezometer, which may be a mark at the top of the casing or a surveyor's pin embedded in the protective structure. Determine the elevation of this point from the records (if available) and record in the notebook. Measure and record the vertical distance from the benchmark to the top of the well casing to the nearest 0.01 foot. Measure and record

the metal casing stickup (i.e., the distance between the top of the casing and nominal ground level).

3. Record any observations and remarks regarding the completion characteristics and well condition, including evidence of cracked casing or surface seals, security of the well (locked cap), and evidence of tampering.
4. Decontaminate all portions of the equipment that will enter the well according to E & E SOP ENV 3.15. Keep all equipment and supplies protected from contamination when not in use.
5. If free product is suspected to be present in a monitoring well, an oil/water interface probe will be used to measure the thickness of light non-aqueous phase liquid (LNAPL), which floats on top of the water table, or Dense Non-Aqueous Phase Liquid (DNAPL), which will collect in the bottom of the well. Procedures for operating an oil/water interface probe are described below.

6.2 Operation

1. Remove the water level indicator probe from the case (if so equipped), turn on the sounder, and test the battery and audio-visual indicator by pushing the test button. Adjust the sensitivity scale until you can see and/or hear the indicator. Release the test button if successful. If the indicator does not sound or illuminate, turn up the sensitivity until it does. If the indicator still fails to sound or illuminate, check and replace the batteries as needed.
2. Slowly lower the probe into the well, allowing the cable reel to unwind slowly and do not allow the cable to rub on any sharp casing edges. Continue lowering the probe until the indicator sounds and/or illuminates. Raise and lower the probe very slowly at least two additional times until the indicator sounds/illuminates at a consistent depth. False signals may be encountered by moisture in the inside walls of the well casing above the level of groundwater. Make note of the depth reading on the cable at the reference point on the well casing or mark the spot on the cable by grasping it with the thumb and forefinger at the top of the casing and withdrawing the cable to note the measurement. Record the depth measurement in the logbook or other site documentation. Be careful to read the tape properly from bottom to top (e.g., a water depth of 11.50 feet could be mistaken for 12.50 feet if the operator looks at the tape from the top down rather from the bottom up).
3. Use of an oil/water interface probe is similar to that of an electronic water level indicator in that the probe has a graduated reel tape, typically also in increments of 0.01 foot. Lower the probe into the well slowly so as not to disperse an LNAPL on the water surface. When the probe comes in contact with LNAPL, it will emit a solid tone. Record the depth at which this is encountered as described in Number 2 above. Next, continue to lower the probe slowly to the depth at which the probe emits a beeping or non-continuous tone. This is the interface between the LNAPL and water table. Record this measurement as described above. The difference between these two measurements is the LNAPL thickness within the well. Similarly, DNAPL may be encountered at the bottom of a well at some project sites. In this case, the beeping tone will change to a solid tone within the water column of the well. Record this depth and the total depth of the well to determine the DNAPL thickness. Use caution when sounding the total depth of the well so as not to damage the probe sensors.

4. To measure the total well or piezometer depth, lower the probe until slack is felt in the cable. The indicator on the probe may be turned off prior to taking this measurement. Very slowly raise and lower the cable until the bottom of the well is detected and no more slack is felt in the cable. If there is soft sediment on the bottom of the well, it may be difficult to determine the exact depth. Note this condition in the site logbook. As described above, note the measurement on the cable at the reference point or grasp the cable with the thumb and forefinger at the top of the casing and note the depth. IMPORTANT: the “zero” reference point on the probe may not be at the bottom of the probe (e.g., Solinst Model 101 probes have a weighted stainless steel tip that extends 0.28 feet or 8.53 centimeters beyond the calibrated "zero" point of the measuring cable). If this is the case, use the cable to accurately measure the distance from the end of the weight to the water level sensor and add this length to the measurement noted above. Record the sum of these two lengths as the total depth of the well.
5. Withdraw the cable and probe, and decontaminate according to the SOP for Equipment Decontamination (ENV 3.15).

6.3 Data Recording and Manipulation

Record the following computations, first ensuring that all measurements are in the same units:

- Measurement reference point (e.g., TOC) elevation, as determined by site survey or from site documentation
- Water level elevation = [TOC elevation] - [depth to water]
- Total well depth = [cable-measured depth from top of casing] + [correction factor (as described above) for length of probe below the water sensor]
- Well bottom elevation = [TOC elevation] - [total well depth]
- If an oil/water interface probe is used, record readings as described in Section 6.2 (3).

In the presence of LNAPL, groundwater elevations need to be corrected to account for displacement caused by the product. To make the corrections, perform the following computation:

- Corrected water level elevation = [LNAPL thickness] x [LNAPL specific gravity] + [calculated groundwater level elevation (as described above)]

6.4 Calibration

No calibration is needed for the electronic water level indicator; however, a check of the responsiveness of the indicator must be performed.

7 Quality Assurance / Quality Control

Check functionality of the water level indicator or oil/water interface probe by pressing the test button, and if necessary, by dipping the probe in a jar or bucket of water to check responsiveness. Note condition of measuring cable/tape (i.e., make sure the numbers are readable. Lastly, if a noticeably anomalous depth to water or total depth is encountered (based on previous measurements, well logs, or comparison of data collected from other nearby wells of similar construction), re-measure before leaving the site.

8 Health and Safety

Comply with the general and site-specific health and safety protocols described in the site-specific health and safety plan. Wells may be located in a variety of settings each with their own safety concerns, such as traffic, animals, etc. Be wary of the presence of insects (e.g., ants, bees, wasps) that may be in the well via holes or cracks in the riser or riser cap. Additionally, be prepared for the presence of gases that may have built up in the well while it was sealed. If gases from the well are expected or detected, keep a safe distance once the riser cap is removed and allow the well to degas before continuing with water level measurements.

9 Special Project Requirements

Project or program-specific requirements that modify this procedure should be included with the project planning documents.

10 References

None.

END OF SOP

Do you know what to do if there's a work-related injury or illness?

Either/Or

Step 1: Injury Emergency
For life threatening injury or illness, immediately call 911

Step 1: Injury Non-Emergency
For non-emergency work-related injury or illness, call WorkCare (844) 268-1852

Step 2: All - Notify
Notify Supervisors / Project Manager / HSE Manager within two hours of incident

Step 3: All - iSMS
Enter the incident into iSMS within 24 hours

WorkCare™
WORK MATTERS. HEALTH COUNTS.

(844) 268-1852
24/7 Telehealth Consultations

WorkCare is our new trusted occupational health services provider

Scan QR code to add WorkCare to your contacts

WSP USA
Earth & Environment
and
Energy
Procedure
Overhead and Underground Utilities
SA 313

EFFECTIVE DATE: December 2022

REVISION HISTORY

REV	EFFECTIVE DATE	DESCRIPTION OF CHANGE	DATE OF MCC REVIEW	ISSUING PROCESS	PROCESS OWNER
Initial Issue	12/22	Initial Issue. Based on Environment's Field Standard Operating Procedure 2 (Utility Locating), updated for use by E&E and Energy, added controls, included underground and overhead utilities.	12/22	HSE	Renee Weaver, E&E HSE Director

OVERHEAD AND UNDERGROUND UTILITIES

INTRODUCTION

Striking overhead or underground services or assets, such as, but not limited to electrical, gas, chemical, telecommunication, and water can occur during ground disturbance and other field activities if the appropriate controls are not implemented. These activities have the potential to result in fatal outcomes and significant environmental or financial impact.

Operation of heavy equipment and cranes in areas with overhead power lines represents a significant hazard to all personnel on the job site. Accidental contact with an energized line or arcing between a high power line and grounded equipment can cause electrocution of equipment operators or nearby ground personnel, and damage to power transmission and operating equipment.

PURPOSE

The purpose of this procedure is to provide the requirements to locate and mark underground utilities before initiating any ground disturbing field activities and identifying any overhead utilities that could be impacted by our work.

Additional supporting information on various technologies for locating underground utilities can be found in the associated toolkits.

SCOPE

This Procedure applies to Earth & Environment and Energy employees at WSP USA Inc. who conduct activities involving field work where equipment may contact overhead utilities, disturb the ground surface, or conducting utility locates. Any persons undertaking these activities will locate utilities to prevent damage and to reduce the risk of a serious incident.

Ground disturbance is defined as an activity on or under the existing surface resulting in a disturbance or displacement of the soil or ground cover below 6 inches (in). Ground disturbance also encompasses concrete and pavement coring for any depth. Activities may include, but are not limited to, drilling, horizontal or directional drilling, dynamic or static probing, concrete or asphalt coring, excavation, hydro-excavation (or hydro-vacuuming), trenching, test pitting, and hand augering.

This document is not intended to supersede legislation. Where local regulatory requirements prescribe a higher standard than those contained in this procedure, the regulatory requirements take precedence.

Utility locating is an early phase of site investigation and allowances must be made at the proposal stage for required schedule, efforts, and costs.

ROLES AND RESPONSIBILITIES

Roles and responsibilities of various personnel under WSP's Health and Safety Program are established in WSP's US Occupational Safety and Health Management System (OSHMS) procedure, SA 200. Additional specific responsibilities under this procedure are as follows:

All Employees:

- Before conducting activities involving field work where equipment may contact overhead utilities, disturb the ground surface, or conducting utility locates, you must have proper training and knowledge of the procedures and other requirements.
- Wear the appropriate PPE for duties performed.
- Review the ground disturbance plan, prior to activities.
- Comply with the directions provided and escalate changes (e.g., moving the borehole) or inconsistent information to the Project Manager for resolution.
- Cease activities if a subcontractor has not completed utility clearances to the company's satisfaction; if sufficient information is not available or if onsite reconcilliation identifies inconsistencies in the findings of utility locators. In these instances, field personnel must notify the Project Manager or the Site Safety Supervisor, or their designee, before proceeding with the proposed work.

Project Manager/Supervisor:

- As with any risk, it is the Project Manager's responsibility to manage project H&S, including identifying hazards, implementing appropriate controls, and ensuring that each individual or group is competent to perform their role. Training can include e-learning or classroom instruction, procedure review, and/or on-the-job training.
- Verify subcontractor responsibilities are established in agreements where subcontractors will be conducting the ground disturbance activities.
- Verify public and/or private utility locates are conducted.
- When private locates are required, ensure a competent service locator is engaged to identify services in the vicinity of investigation locations.
- Verify site reconciliation has been performed to confirm the accuracy of plans before ground disturbance occurs.
- Ensure data regarding investigation location is updated and verification activities performed on changes to investigation locations.

- Verify non-destructive digging has been performed where high-risk services are likely to be present at the location or where there is inconsistent information regarding underground services.
- Communicate emergency controls to workers on site.
- Notify all affected workers, including subcontractors or equipment operators of an energized overhead power line before work commences or equipment is operated in the vicinity of the power line in proximity to the safe limit of approach distances and coordinate the activities of the work crew.
- Verify necessary safety equipment (such as signs and barriers) is provided and used, as needed.
- If any ground disturbance activities deviate from this procedure, obtain approval from the District Business Leader (or designee) before the work commences.

PROCESS

GENERAL

The Project Safety Plan (PSP) must identify specific hazards and mitigation measures associated with activities where equipment may contact overhead utilities, disturb the ground surface, or while conducting utility locates onsite. Prior to the start of work activities, employees shall review the site-specific PSP.

Additionally, prior to the work activities and/or in the event of any site or scope of work changes, employees and subcontractors shall conduct a safety meeting (i.e. toolbox meeting) and review the risks and the controls for the planned tasks.

Following WSP's Life Saving Actions, locate and control all buried and overhead services before starting work.

UNDERGROUND UTILITIES

Project tasks that involve ground disturbance shall be planned and designed to control the hazard.

Any persons undertaking ground disturbance activities, unless hand digging, will locate all buried utilities to prevent damage and to reduce the risk of a serious incident. When the company is self-performing ground disturbance activities, the company is responsible for completing the clearance activities. When others are performing the ground disturbance activities, follow Client and Subcontractor contract agreements and State-specific legal requirements on site responsibilities.

Ground Disturbance Plan

Every project involving ground disturbance activities is required to have a ground disturbance plan. (see WSP Ground Disturbance Plan/Uility Locates Form). Even if the Subcontractor or Client is conducting the ground disturbance, a ground disturbance plan is still required and will include verification of Subcontractor/Client clearance activities. Do not start work until you are satisfied that up to date and quality locates were conducted and appropriate controls are in place.

The WSP Ground Disturbance Plan/Utility Locates Form (see Forms) includes:

- Emergency Response Plan
- Utility Locates Form/Locates Log (public, private)
- Site reconciliation, verification, additional information
- Deviation approval, if applicable.
- Overhead utilities log

Utility Locates

Utility strikes occur even when utility locates are performed. Recognize situations that can lead to inaccurate locates. It is recommended that the utility locator sweep a relatively large area (e.g., a 20-foot circle around a proposed drilling location) to provide room for adjustment should the proposed drilling or excavation area need to be moved to avoid a buried utility. If the markings of utility locations are destroyed or removed before excavation commences or is completed, stop work. notify the utility company, utility protection service, or the utility locating service to inform them that the markings are no longer visible. Do not continue work until the utilities have been re-marked.

Public Locates

Public utility service providers will mark their underground lines within the public right-of-way up to the private property boundary. The first step in this process is notifying the state public utility locating service of the planned work. These services provide a link between the entities performing the work and the various utility operators (e.g., the water company, the electric company, etc.). The public utility locating service call centers in the United States have been streamlined under a single “Call

Before You Dig" phone number: 811. Some State laws require that the person who will be conducting the intrusive work must be the person who places the call to the public utility locating service. This means that the company cannot make this call on the subcontractor's behalf; the contractor must place the call in those states where required or otherwise has this responsibility (e.g., contract agreements). If there is any doubt about the requirements for the state where a project is located, the relevant state authority should be contacted (http://call811.com/811-your-state).

When the appropriate call center is contacted, information regarding the site (e.g., location, nearest cross street, etc.) and work activity (e.g., drilling, excavation) will need to be provided to the operator to aid in locating the likely utilities at the work site. The information provided on the Ground Disturbance Plan/Utility Locates Form (See forms) must be recorded (by the subcontractor or the company) and a completed copy of this form must be maintained as part of the project file. Be aware that several states require that the proposed drilling locations be marked with white spray paint before contacting the locating services.

The following information must always accompany the field team during the field project:

- The utility clearance ticket number
    - The ticket number serves as a point of reference for both the utility service providers and for the company or subcontractor.
- The ticket's legal dig date
    - The legal dig and expiration dates reflect the times when it will be legal to perform the proposed work. Recognize that the legal dig date reflects the lead time necessary, typically between 48 and 72 hours after your call, for the utility service providers to mark the utilities in you work area.
    - Ground disturbance work may NOT be done before the legal dig date provided by the state utility locating service.
- The ticket's expiration date
    - Most utility clearance tickets expire about 2 weeks after the legal dig date. If your work is delayed beyond the expiration date, the 811 utility locating service will need to be called again and the ticket renewed. The renewed ticket will have a new legal dig date that incorporates the same lead-time (48 to 72 hours) as the original ticket.
- Utility providers that were contacted
    - The locating service will also provide the caller with a list of utility companies that will be notified. Compare this list with utilities generally expected at all sites (e.g., sewer, water, gas, communication, and electric). Some utilities (e.g., sewer, water, cable television) may not be included. If any expected utilities are absent from the contact list, the utilities MUST be contacted directly for clearance before the start of intrusive

activities. All contacts should be recorded on the Ground Disturbance Plan/Utility Locates Form.

- No digging, drilling, or other ground-breaking activities may begin until all utilities on the list have been marked and visually verified in the work area. It is NOT ACCEPTABLE to rely solely on as-built drawings or verbal utility clearances from the site contact (these should be used as guides only).

Private Locates

If your work is to be conducted on private property, a private utility locating service MUST be used to clear the work area. These companies typically use a variety of methods (e.g., electromagnetic detectors, ground-penetrating radar, acoustic plastic pipe locator, trace wire) to locate utilities in the work area, including those that may be buried beneath onsite buildings. When the company is self-performing ground disturbance activities, the company is responsible for completing the private locates. When others are performing the ground disturbance activities, follow Client and Subcontractor contract agreements and State-specific legal requirements on site responsibilities.

- Contract an approved subcontractor private locator company
- Discuss and determine what type of locates technology are required with the private locate subcontractor. Understand the locating technology limitations.
- Provide private locators with all available relevant information.
- Best practice is to also determine an alternate location, prior to conducting private locates, in the event that utilities may be impacted by the original plan.
- If feasible, schedule a competent employee to be present during the private locate process to monitor and understand the capability of the chosen technology, the quality of the locates, and verify the correct work locations.
- The employee shall re-review all available information and update the ground disturbance plan, as needed.
- Present the utility locations to the Client for further verification.

A private locator may not be necessary in rare instances, such as greenfields in rural areas. However, approval to deviate from this requirement must be given by the project manager and a District Business Leader (or designee). Alternatively, hand digging will be required.

Data Collection

- Identify a site contact familiar with the utilities on the property (e.g., plant manager, facility engineer, maintenance supervisor), and provide proposed locations of all soil borings, monitoring wells, test pits, and other areas where intrusive activities will be conducted. These individuals often have knowledge of buried structures or process-specific utilities that may not be identified by the public or private utility locator. This is particularly important for work performed inside industrial

buildings where reinforced concrete and other metallic components of the structure may interfere with the scanning devices used by the private utility locator.

- Request historical site data such as: as-built drawings and site plans detailing utilities on the site, fire insurance drawings, engineering drawings, and aerials (e.g., Google Earth images). Where buildings are present, both interior and exterior information should be provided.
- Identify locations of in-service or closed in-place underground storage tanks and associated buried piping. Construction or preliminary/engineering drawings or other surveys of site should also be requested.
- Consider activities and what underground (and overhead) assets may be encountered transecting your work site from adjacent properties.
- Consider multiple owners, subdivided properties, the presences of easements or right of ways that may require alternative locating strategies (highways, pipelines, access roads, etc.).

Site Reconciliation

The objective of Site Reconciliation is to make sure the utilities marked in the field and on-site plans and locate reports correlate. Site Reconciliation includes a site walk around, review of desktop data, locates data, and surrounding infrastructure. This reconciliation is critical to make sure all data sources are aligned. Even if Subcontractors or Clients conduct the utility clearance, it is important to conduct the Site Reconciliation.

- Locate all the proposed drilling and trenching locations and mark them with (white) spray paint, stakes, or other appropriate markers (if not already done). This will help you judge distances from marked drilling and trenching locations to underground and overhead utilities and minimizes any potential misunderstandings regarding the locations between you, the subcontractors (drillers, excavators), and the site contact.
- Once you have the proposed work areas marked, verify that ALL utility companies listed by the state public utility locating service, and any contacted directly by the company or the contractor, have either marked the underground lines in the specified work areas or have responded (via telephone, facsimile, or e-mail) with “no conflict.” Document on the Ground Disturbance Plan/Utility Locates Form as each utility mark is visually confirmed.
- Review the information collected, including the locates data even if the subcontractor or Client performs the ground disturbance and are responsible for locating utilities, or the client is locating utilities.
- The Project Manager and Site Supervisor will review the locate information to confirm that potential data sources have been collected and reviewed.
    - It is essential during this site visit that you confirm electrical and gas fixtures, stormwater/sewer drains, manholes, catch basins, and water fixtures have identified sources. Look for linear depressions in the ground, cuts in concrete or asphalt, and old road cuts as potential evidence of an underground structure. Know where everything

is and where everything is not with enough redundancy (locates, as-builts, surface features, etc.) to be confident.

- Mark all overhead utilities in the plan.
- While work is in progress, look for signs or marker layers as you dig (pea gravel, sand, insulation, and other backfill material). On roadway jobs, inspect new road cuts for possible service trenches.

If there are inconsistencies:

- Stop, contact the Project Manager and discuss the path forward.
- Contact utility companies to verify unmarked/located services, as needed.
- If feasible, conduct a second set of alternative private locates (i.e. using a different).
- Change the location of the work so it does not impact the known or suspected utilities, if possible.
- Daylight by softdigging (hydro-vac/Air knife) or hand dig.
- De-energize, Lock Out / Tag Out and/or re-route any live utilities, as feasible.

Daylighting

The safe exposure of underground utilities is essential to damage prevention. Daylighting can have two functions. The first is to verify clearance of underground utilities around an area of planned ground disturbance. The other is to expose known utilities in instances of inspection, repair, or site investigation. If hand digging is unable to penetrate the subsurface soils, soft dig (e.g., air knife/ vacuum extraction) service providers may be retained to clear the location.

When hand digging, do not use sharp tools like pickaxes, pry bars, or pointed spades, or sharp augers, as they may puncture lines. Use a rounded or blunt-edged tool with a wood or fiberglass handle. If an auger is used for shallow digging, do not force the auger if hit an obstruction. Remove the auger and inspect the borehole to verify no underground utilities are present.

Excavating using heavy machinery is NOT a means of daylighting.

The following areas have complex and historical underground utilities and MUST always be daylighted and any deviation carefully considered:

- When working in areas with a high density of utilities such as downtown or other densely populated areas of cities or facilities.
- When working on oil and gas facility sites even when it is not a client or regulatory requirement.
- If the property owner has known private underground utilities in the work area, but cannot be located by the private locator.
- If conducting ground disturbance activities within 5ft of a known or suspected utility of parallel to a known existing utility.

Concrete/Asphalt Coring

In addition to following the general procedures above-

- Review known information and visually scan for signs of buried utilities. These may include:
    - Signage, valves, markers, mechanical equipment, utility structures, lights, camera poles, meters, utility vaults, catch basins, conduit leading into or emerging from a slab.
    - Pavement or cement "scars" where previous ground disturbance may have taken place.
    - Look for different colored / textured concrete, asphalt repairs, and / or linear deflections as evidence.
- The utility locate approach needs to consider the technology appropriate for the subsurface.
- When coring concrete achieving 'Zero Energy' is equivalent in protection to daylighting in soils.
    - Company, client, and utility owner should use a shared Lock Out / Tag Out (LO/TO) plan.
    - Lines containing hazardous gases/chemicals shall be blocked, blanked and purged, if feasible.
- When coring, evaluate other possible hazards such as dust (silica) and chemicals, ergonomics, noise.

Safe Work Distances

Activity	**Distance**
Ground Disturbance	Maintain 5 ft of distance between known or suspected utilities and proposed ground disturbance location (unless daylighting is performed, then tolerance zone distance is 2ft, or regulatory limit)
Daylighting	Conduct if within 5 ft of a known or suspected utility location. Utility must be exposed if digging in the tolerance zone.
	Daylighting depth is a minimum of 5ft bgs, or to depth of boring or visible utility (if less), or to known depth of utility
	If activities are parallel to an existing linear utility, the utility shall be exposed by daylighting at a minimum of every 100ft within 5ft of the utility
	When coring concrete achieving 'Zero Energy' is equivalent in protection to daylighting in soils
Utility search area	20 feet around the ground disturbance area

Be aware that some clients, states and localities (e.g., New York City, Long Island) may require greater minimum working distances and/or daylighting.

Deviations

If any clearance activities deviate from this procedure, obtain approval from the Project Manager and District Business Leader (or designee) before the work commences and documented in the Ground Disturbance Plan/Utilities Locates Form. Deviations may include, but not limited to:

- When working with subcontractors, the company assumes subcontractor's (or Client's) utility clearance responsibilities established in the agreement
- Not conducting public and/or private locates
- Not conducting daylighting when required
- When there are unresolved inconsistencies in the ground disturbance plan and daylighting or hand digging are not feasible.

OVERHEAD UTILITIES

General Overhead Utility Requirements

If work must be performed near overhead lines, the lines shall be de-energized and grounded (if feasible). If electrical lines are to be de-energized, arrangements shall be made with the person or organization that operates or controls the electric circuits. Verification must be obtained. Lockout Tagout requirements apply. Effective temporary grounding techniques shall only be performed by qualified (electrical workers) who utilize a combination of grounding and bonding; grounding to clear accidental re-energization and minimize potential; bonding to ensure workers are not subjected to hazardous potential difference during energized situations.

If lines cannot be de-energized, other protective measures shall be provided before work is started.

- Protective measures such as guarding, isolating, or insulating help to prevent employees from contacting such electrical lines directly with any part of their body or indirectly through conductive materials, tools or equipment.
- Maintain minimum clearance distances between equipment and power lines (see below).

Safe working distance is the minimum distance that must be maintained by non-qualified electrical workers between any energized electrical line and any part of the operating equipment or personnel to maintain adequate safety margins and is based on the line voltage of the power line.

To maintain minimum safe clearances:

- Inform all on-site staff with the on-site clearances required, and
- Watch for atmospheric conditions, such as temperature, humidity, and wind, which may dictate more stringent safety procedures.
- Install one or more of the following:
    - warning devices and signs (hang a sign from and mark all guy wires to warn traffic of low clearance; provide warning signage for overhead services).

- Install telescopic, nonconductive posts and flagging across right-of-way at the minimum allowable clearance as allowed by regulations for the line voltage.
- Position signs or other devices to determine the "Danger Zone".

Clearance between Equipment and Power Lines

Unless deenergized, grounded, or insulated to prevent physical contact with the lines, equipment shall maintain the minimum clearance distances in accordance with the table below. Unless verified, it will be assumed that all lines are energized.

If the voltage is unknown, employees must contact the power line operator before work is done or before equipment is operated within 20ft for an energized overhead distribution power line and 50ft for an energized overhead transmission power line. If the voltage remains undetermined, the most stringent assumption should be applied.

Equipment Type	Voltage	Minimum Distance
Mobile Equipment[1]: • Drill rigs • Power shovels • Excavators • Wheel loaders • Backhoes • Loader backhoes • Track loaders • Boom platforms • Aerial lifts • Articulating boom platforms • Vertical towers	Less than 50kV	• 10ft • If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4ft for less than or equal to 50kV.
	More than 50kV	• 10ft plus 4 inches for every 10kV over 50kV* • If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4ft plus 4 inches for every 10kV over 50kV.
Scaffolds[2]: • Any temporary elevated platform (supported or suspended) and its supporting structure (including points of anchorage), used for supporting employees or materials or both.	Less than 300V	3ft (Insulated lines only)
	300V to 50kV	10ft
	More than 50kV	• 10ft plus 0.4 inches for every 1kV over 50kV • Alternative: 2 times the length of line insulator, but never less than 10ft)
Cranes/Derricks[3]: • Cranes and derricks • Dedicated pile drivers • Service/mechanic trucks with a hoisting device	Up to 50kV	10ft
	50kV to 200kV	15ft
	200kV to 350kV	20ft
	350kV to 500kV	25ft
	500kV to 750kV	35ft
	750kV to 1000kV	45ft
	More than 1000kV	Established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution

[1]OSHA 29 CFR 1910.333(c)(3)(i)(A) and (B). Local utility companies may have more stringent offset requirements. Note for work in California, CALOSHA has different minimum requirements for clearance from power lines. See 8 CCR 2946 (subchapter 5, group 2, article 37 (formerly article 86)).

[2]OSHA 29 CFR 1926.451(f)(6)

[3]OSHA 29 CFR 1926.1408, Table A (Per OSHA Standard 29 CFR 1926.1400(c), drill rigs, power shovels, excavators, wheel loaders, backhoes, loader backhoes, and track loaders are exempt from the power line safety requirements in the table above for Cranes and Derricks in Construction. Therefore, General Industry, 29 CFR 1910.333, electrical safety work practices apply. See Clearance Between Mobile Equipment and Power Lines above.

Line Spotter/Safety Watch

A line spotter/safety watch is a person who is assigned to observe equipment or personal work activity in proximity to the safe approach distance for energized electrical conductors, with the specific duty of assisting the equipment operator/personnel to ensure no part of the equipment or materials get too close to an energized, unprotected electrical conductor. The line spotter/safety watch is responsible to warn employees working in proximity to the specific operation of the electrical hazard, notify persons not involved in the operation from entering the work area, and to ensure safety precautions and procedures are complied with. Employees should not otherwise perform the role of Line Spotter/Safety Watch unless competent and approved by the Project Manager, or designee.

Employees assigned to act as line spotters/safety watch must be knowledgeable of their responsibilities and of the hazards involved in the work, trained, and instructed in the procedures to follow in the event of an emergency and authorized to stop immediately any part of the work that they consider dangerous.

Where the work involves heavy equipment operation, the line spotter/safety watch will have a radio or other direct means of communicating with the equipment operator at all times. The line spotter/safety watch will be positioned at a right angle to the equipment operator's line of sight to maximize the sight angles between the personnel and will wear high visibility clothing.

Mobile equipment with obstructed views to the driver, must have a spotter to observe the approach distances and provide timely warning to the operator, if approach distances are compromised or the equipment must be equipped with a reverse signal alarm audible above the surrounding noise level to prevent striking overhead or nearby energized lines with equipment.

EMERGENCY RESPONSE

- Review the emergency procedures, prior to field activities.
- Identify the location and operation of emergency shut off switches and review location of emergency response equipment.
- If any sign of a utility or asset is discovered during ground disturbance activities, stop, call the Project Manager, and discuss how to proceed.
- If an underground utility is damaged:
    - Stop all work activities immediately.

- Do not move the equipment. Shut down the equipment, if possible and if safe to do so.
- Avoid contact with escaping liquids, live wires, and open flames.
- Abandon the equipment, evacuate the personnel from the area (preferably upwind from a suspected leak), and maintain a safe perimeter.
- If a fiber optic cable is damaged, do not handle the cable or look into the end of the cable as serious eye damage may occur.
- The excavator must immediately notify emergency responders, including 911 services, 811, and the facility operator if the damage to a facility results in any the following:
  - Discharge of electricity
  - Escape of any flammable, toxic, or corrosive gas or liquid
  - Endangers life, health, or property
  - Notify the Project Manager.

- After any strike (live or not) of an underground utility, new locates must be completed prior to work recommencing.
- If an electrical power line is hit or an electrical arc occurs:
  - All ground personnel must evacuate IMMEDIATELY to a distance of at least 50ft.
  - DO NOT attempt to rescue any injured person until the line can be de-energized.
  - The operator should remain in the cab until the line can be de-energized and should carefully try to extricate the equipment from the power line. This may not be possible where melting of insulator material or metal has occurred.
  - Contact the line owner to report the line contact and request that the line be de-energized immediately. Once the line has been confirmed to be de-energized, the operator can safely evacuate the cab and rescue can commence for any injured personnel.
  - If the operator must evacuate while the line is still energized (because of fire or other life-threatening condition), they should jump clear of the equipment (making sure to avoid touching the equipment and the ground simultaneously) and land upright and with feet together. Once on the ground, proceed in a direct line away from the equipment using a short, shuffling gait (feet touching, sliding each foot no more than 1ft forward at a time) to minimize shock hazard from electrical energy being transmitted through the ground.
- A live strike will require work to be suspended pending completion of an investigation.
- Report incident in the iSMS.

PERSONAL PROTECTIVE EQUIPMENT

- Hard hat
- Work boot (with steel toe as required)

- High visibility safety vest
- Safety glasses
- Glove (type determined by task specific hazard)
- Hearing protection, as needed based on task specific hazard
- Other task-specific personal protective equipment or clothing as needed (respiratory protection, flame resistant clothing, etc.)

TRAINING

Training at a minimum should cover, but not limited to this procedure and informed of hazards and safety controls. Competency shall be evaluated through observation of practical field skills and knowledge of work history.

Additional training may be required based on local legislation or client specific requirements.

RECORDS

Record Identification	Storage/Protection Location	Record Media Type	Minimum Retention Period	Disposition of record after minimum retention period
Training	My Learning Portal/Other	Electronic /Other	5 years	Archive

REFERENCES

OSHA: 29 CFR 1910.333 Subpart S "Electrical – Selection and Use of Work Practices"

OSHA: 29 CFR 1926.451 Subpart L "Scaffolds – General Requirements"

- OSHA: 29 CFR 1926.1408 Subpart CC "Cranes and Derricks in Construction – Power Line Safety Equipment Operations"
- Concrete Asphalt Coring Toolkit
- Hydro-Vacuuming Toolkit
- Utility Locate Technologies Toolkit

FORMS

Ground Disturbance Plan/Utility Locates Form

Ground Disturbance Plan (GDP)/Utility Locates Form

This form is for all intrusive work, regardless of who is responsible for the public and/or private locates
HS-EE&EG-PRO-SA 313 Overhead and Underground Utilities

Completion Checklist:

☐ Collect/review Site data for potential utilities
☐ Public underground utility locates (complete below)
☐ Private underground utility locates (complete below)
☐ Complete Site Plan (proposed boring locations, identified utilities)
☐ Conduct site reconciliation
☐ Deviation approval (as needed) (documented below)
☐ Identify overhead utilities (hazard assessment below)
☐ Communicate Emergency Procedures to onsite workers

Project Information			
Project Name and Number		**Client**	**Site Location**
Project Manager	**Site Supervisor**	**Subcontractor (s)**	**Date(s) of Work**
Description of ground disturbance activities (including who will be conducting the activities (WSP? Sub?))			
Project Manager Notified of any conflicts, changes to boring locations, issues, etc.? Describe			

Emergency Response	
Stop Work and follow the project Emergency Response Plan. -Take measures to protect the health and safety of others. -If risk to life, health, or property, Notify emergency responders and 811 -Notify the Project Manager and facility owner -Do not resume work until authorized -Enter incident in iSMS	**Additional Instructions:**

Ground Disturbance Plan (GDP)/Utility Locates Form

This form is for all intrusive work, regardless of who is responsible for the public and/or private locates
HS-EE&EG-PRO-SA 313 Overhead and Underground Utilities

Underground Utilities

Public Utility One - Call

Service name/contact info		Notification Made By (Name, Title and Company)		Date & Time of Call/Web Notification
Ticket No.	Legal Dig Date	Ticket Expiration Date		Ticket Renewal Date
Utilities Notified	Responded?	Utilities Present?	Emergency Number	Tolerance Zone Distance/other special instructions (e.g., daylighting required)

Private Utility Locator Information

Locator Company/Contact info	Contracted by	Date of service	Type of locate conducted (EM-Tracing, High-Resolution GPR)
Utilities Identified	Tolerance Zone	Other special instructions (e.g., daylighting required)	

Notes

Underground Utilities Verification

Ground Disturbance Plan (GDP)/Utility Locates Form

This form is for all intrusive work, regardless of who is responsible for the public and/or private locates
HS-EE&EG-PRO-SA 313 Overhead and Underground Utilities

Onsite Visual Confirmation of Utilities			
Marking Color	**Utility Type and Potential Visual Clues**	**Cleared/ marked?**	**No markings - comments**
Blue	Potable water: fire hydrant, manholes; water meter, AST, interior connections, hose bib, valve box		
Yellow	Gas, oil steam, petroleum: gas meter, manholes; yellow bollards, interior connections, valve box		
Red	Electric power lines, lighting cables, parking lot lights, overhead lines (telephone poles), conduits: interior connections, underground vaults, manholes, transformers/switchgear, conduit on buildings		
Green	Sewer and drain lines: underground vaults, manholes, drain grates, leach field, sand mound, no evidence of sanitary sewer (for septic system)		
Orange	Communication, alarm or signal lines, cables or conduits: red/orange bollards, telephone poles, interior connections; manholes; conduit on buildings		
Purple	Reclaimed water, irrigation, and slurry lines: sprinkler heads, hose bibs		
Pink	Survey markings		
White/ Black	Proposed locations for excavation and drilling (black can be used for snow conditions)		

Deviation	
If any activities deviate from this procedure, obtain approval from the Project Manager and District Business Leader (or designee) before the work commences. Deviations may include, but not limited to: - When working with subcontractors, the company assumes subcontractor's (or Client's) utility clearance responsibilities established in the agreement -Not conducting public and/or private locates -Not conducting daylighting when required or there are unresolved inconsistencies	**Describe any deviations:**
Deviation Approval:	**Date:**

Verification	
Ground Disturbance Plan verified by:	**Date:**

Overhead Utilities

Ground Disturbance Plan (GDP)/Utility Locates Form

This form is for all intrusive work, regardless of who is responsible for the public and/or private locates

HS-EE&EG-PRO-SA 313 Overhead and Underground Utilities

Survey your work area and identify any overhead utilities within 20ft (50ft for transmission lines)

Overhead Utilities Identified (type/voltage)	**Location**	**Required clearance distance (varies for type of equipment operated)**	**Controls** (e.g., move/change the activity, isolate, use barrier protection (insulated sleeves), use a competent line spotter/safety watch, have the utility de-energize or move power line, use warning lines with flags/post warning sign, use non-conductive tools)

Notes

APPENDIX E

PHYSICAL AND BIOLOGICAL HAZARD EVALUATION AND CONTROL

1. Complete the following table of potential physical and biological hazards and control measures associated with site activities.
2. Delete all non-applicable rows (shade them only until reviewed) and add rows as needed.
3. For each hazard, assign a risk level (i.e., likelihood - high, medium, low) for each task as applicable.
4. Edit specific hazard control measures based on tasks and site conditions.
5. **SOPs and attachments pertinent to the physical and biological hazards referenced below shall be attached to this Health and Safety Plan. Health and Safety SOPs are located on The Point.**
6. Be sure to edit information in columns as appropriate for the site work (additions and deletions). Hazard control measures listed for each hazard are for guidance only.

Physical and Biological Hazard Evaluation and Control

Hazard	Source or Contributing Factor(s)	Risk Level by Task (H = High; M = Medium; L = Low)	Hazard Control Measures
Physical Hazards			
Cold Stress	Low ambient temperatures with: ▪ High wind conditions ▪ Lack of adequate warm clothing ▪ Wet clothing	Task 1: M	▪ Provide warm break area and adequate breaks. ▪ See WSP SOP for Cold Stress. ▪ Provide warm non-caffeinated beverages. ▪ Promote cold stress awareness. ▪ Wear layered wind & water resistant clothing. ▪ Other:
Compressed Gas Cylinders	X Calibration gases ☐ Helium cylinder ☐ Hydrogen cylinder ☐ Other (specify):	Task 1: L	▪ Use caution when moving or storing cylinders. ▪ Store away from heat or area where physical damage may occur. ▪ A cylinder is a projectile hazard if it is damaged or its valve stem is broken. ▪ Store cylinders upright and secure them by chains or other means. ▪ Calibration gas cylinders should be stored to protect from physical damage and temperatures above 125°F. ▪ Other:
Cut/puncture	Sharp/pointed objects (nails sticking out of lumber, liner cutters, broken glass in windows, sharp edges on metal, jagged edges - on broken concrete, etc.) Abrasions and skin irritations are also attributed to a variety of causes during large-scale emergencies.	Task 1: M	▪ Watch your step, especially in areas with large amounts of debris. ▪ Bring adequate lighting if entering structures. ▪ Wear proper foot and hand protection. ▪ Flatten or remove any nails that might cause puncture wounds. ▪ Other:

Physical and Biological Hazard Evaluation and Control

Hazard	Source or Contributing Factor(s)	Risk Level by Task (H = High; M = Medium; L = Low)	Hazard Control Measures
Drilling/Sonic rig	Physical injury and noise exposure - pinch points, unguarded moving parts, extended boom instability, buried utilities, etc. List drilling equipment (including Geoprobe): Geoprobe and hollow stem auger drill rig Driller: ☐ WSP X WSP subcontractor ☐ Other:	Task 1: M	▪ Landfill caps will not be penetrated without prior discussions with corporate health and safety staff. ▪ Establish exclusion zone around the rig or Geoprobe. ▪ Wear appropriate hearing protection. ▪ Ensure that the local underground utilities protection agency has been contacted and markings are confirmed. ▪ Other:
Driving (general)	Accidents with injuries caused by: ▪ Driving while tired ▪ Cell phone use (including texting) and other distractions ▪ Congested roads ▪ Not wearing seat belts ▪ Not sitting on a proper car seat ▪ Aggressive driving ▪ Improperly maintained vehicle ▪ Distractions within or outside the vehicle	Task 1: L	▪ Conduct vehicle inspection before use (e.g., the tires appear properly inflated; the spare tire and jack are located; head and tail lights, turn signal, and brake lights work; windshield solvent tank is full, and there is an ice scraper if it is winter). ▪ Do not drive when tired (i.e., check into a hotel, if necessary). ▪ Company policy forbids talking on phone or texting (including hands-free) while driving. ▪ Drive within the speed limit. ▪ Wear seatbelt at all times (driver and all passengers). ▪ Sit only on a seat (not coolers, boxes, etc.). ▪ Avoid aggressive driving. ▪ Refrain from non-essential activities that can distract the driver. ▪ Other:
Drums and Containers	Drums, tanks, or other containers that may contain flammable materials or other hazardous materials and may have special storage, handling, and opening requirements. ☐ Fuel storage: ☒ Waste storage: IDW ☐ Abandoned drums/ containers:	Task 1: L	▪ Refer to 29 CFR 1910.120(j) for further guidance associated with this hazard. ▪ See WSP SOP for drum and container sampling. ▪ Consider unlabeled drums or containers to contain hazardous substances and handle accordingly until the contents are identified. ▪ Inspect drums or containers and assure integrity prior to handling. ▪ Move drums or containers only as necessary; use caution and warn nearby personnel of potential hazards. ▪ Open, sample, and/or move drums or containers in accordance with established procedures; use approved drum/container-handling equipment. ▪ Other:

Physical and Biological Hazard Evaluation and Control

Hazard	Source or Contributing Factor(s)	Risk Level by Task (H = High; M = Medium; L = Low)	Hazard Control Measures
Excavation and Trenching	Will WSP staff be entering an excavation/trench? ☐ Yes ☒ No Potential for: ☐ Risk of cave-in and engulfment of personnel within trenches and excavations ☐ Fall hazard near excavation edges ☐ Hazardous atmosphere <u>Personnel will not enter test pits.</u>	Task 1: N/A	▪ Refer to 29 CFR 1926 Subpart P for further guidance associated with this hazard. ▪ See WSP SOP for Excavation and Trenching. ▪ Identify special personal protective equipment (PPE) (see Section 7) and monitoring (see Section 8) needs if personnel are required and approved to enter excavated areas or trenches. ▪ Maintain line of sight between equipment operators and personnel in excavations/trenches. Such personnel are prohibited from working in close proximity to operating machinery. ▪ Suspend or shut down operations at signs of cave in, excessive water, defective shoring, changing weather, or unacceptable monitoring results. ▪ Do not stand within 2 feet of leading edge. ▪ Place a visual (banner guard) or physical (construction fencing) barrier around the excavation. ▪ Other:
Fire and Explosion	Possible fuel and ignition sources: ▪ Vehicles ▪ Fuels ▪ Dry vegetation ▪ Equipment ▪ Propane use	Task 1: L	▪ Inform personnel of the location(s) of potential fire/explosion hazards. ▪ Establish site-specific procedures for working around flammables. ▪ Ensure that appropriate fire suppression equipment and systems are available and in good working order. ▪ Define requirements for intrinsically safe equipment. ▪ Identify special monitoring needs (see Section 8). ▪ Remove ignition sources from flammable atmospheres. ▪ Coordinate with local fire-fighting groups regarding potential fire/explosion situations. ▪ Establish contingency plans and review daily with team members. ▪ Periodically monitor boreholes and vicinity of drilling and excavation sites for combustible gases. ▪ Other:
Heat Stress	Contributing factors: ▪ High ambient temperatures ▪ Heavy work load ▪ High humidity with low wind ▪ PPE use ▪ Being near radiant heat source ▪ Poor physical condition ▪ Certain medications ▪ Not acclimatized	Task 1: L	▪ Provide cool break area and adequate breaks. ▪ See WSP SOP for Heat Stress ▪ Provide cool non-caffeinated beverages. ▪ Promote heat stress awareness. ▪ Use active cooling devices (e.g., cooling vests) where specified. ▪ Other:

Physical and Biological Hazard Evaluation and Control

Hazard	Source or Contributing Factor(s)	Risk Level by Task (H = High; M = Medium; L = Low)	Hazard Control Measures
Heavy Equipment (working near)	Equipment operating on site: ☒ Drill Rig ☐ Track hoe ☐ Skid loader ☐ Front-end loader ☐ Grader ☐ Crane ☐ Dump truck (standard) ☐ Potential for: ▪ Being struck by equipment ▪ Being injured by falling suspended loads	Task 1: M	▪ Define equipment routes, traffic patterns, and site-specific safety measures. ▪ Never cross the path of a piece of equipment without getting acknowledgement from the operator, that he/she sees you (i.e., nod or wave). ▪ Wear high visibility gear when working near heavy equipment. ▪ Stay out of the 'equipment's swing radius. ▪ Confirm that operators are properly trained and equipment has been properly inspected and maintained. Verify back-up alarms. ▪ Discuss proper hand signals and communication protocols between ground spotters and operators. ▪ Identify special PPE (Section 7) and monitoring (Section 8) needs. ▪ Avoid working in close proximity to operating equipment. ▪ Discuss lifting capacities, load limits, etc., based on expected work each day. ▪ Avoid being under suspended loads. ▪ Other:
Noise	Potential hearing damage caused by: (List sources of noise) Drill rig	Task 1: L	▪ Use earplugs or muffs. ▪ Establish noise level standards for on-site equipment/operations. ▪ Inform personnel of hearing protection requirements (Section 7). ▪ Define site-specific requirements for noise monitoring (Section 8). ▪ Other:
Sunburn (skin and eyes)	Exposure to sunlight, either direct or reflected (i.e., by water or snow).	Task 1: L	▪ Apply sunscreen. ▪ Wear hats/caps and long sleeves. ▪ Wear sunglasses. ▪ Monitor the 'day's UV index forecast on 'EPA's Sunwise website or using the Sunwise smart phone app. Risk of sunburn is moderate to high when the UV index ≥ 5 ▪ Other:
Slips, Trips, & Falls	▪ Uneven surfaces ▪ Debris/clutter ▪ Plastic sheeting (especially slippery when wet) ▪ Wet, icy, oily, muddy, or moss-covered surfaces ▪ Tangles of vegetation ▪ Steep slopes ▪ Mired footing ▪ Nighttime/darkness ▪ Inattentiveness ▪	Task 1: M	▪ Stay in good physical condition. ▪ See WSP SOP for Housekeeping for slip, trip and fall prevention. ▪ Wear appropriate and properly fitted footwear ▪ Stay well hydrated ▪ 'Don't be in a hurry ▪ Use handrails. ▪ Be attentive; constantly scan the way ahead when walking ▪ Avoid walking in dark places without portable lighting. ▪ Other:

Physical and Biological Hazard Evaluation and Control

Hazard	Source or Contributing Factor(s)	Risk Level by Task (H = High; M = Medium; L = Low)	Hazard Control Measures
Utility Lines	▪ Excavations and trenching work ▪ Damaged buildings ▪ Downed lines caused by high winds ▪ Heavy equipment activities during demolition ▪ Soil boring/drilling operations ▪ Raised boom during delivery and pick-up of roll off boxes ▪ Tree removal operations ▪	Task 1: L	▪ Contact utilities to confirm underground locations. ▪ Complete the WSP E&E SA 313 Ground Disturbance Form. The WSP USA E&E Procedure Overhead and Underground Utilities SA 313 SOP is presented in Appendix D. ▪ Identify/locate existing underground utilities prior to work. Call 811 or otherwise contact the state utility protection organization for utility location identification and contract with a private locator for private facilities. Have lines de-energized as necessary. ▪ Verify that overhead utility lines are at least 25 feet away from project activities and 10 feet from heavy equipment for electrical lines. ▪ Other:
Weather Extremes	Potential hazards: ☐ High winds ☐ Tornados X Lightning ☐ Blizzard X Heavy rain	Task 1: L	▪ Establish site-specific contingencies for severe weather situations. ▪ Provide for frequent weather broadcasts. ▪ Do not work outdoors when lightning is present. Follow the **30-30 Rule**: ***If it takes less than 30 seconds to hear thunder after seeing the flash, lightning is near enough to pose a threat; after the storm ends, wait 30 minutes before resuming outdoor activities.*** ▪ Weatherize safety gear, as necessary (e.g., ensure eyewash units cannot freeze, etc.). ▪ Identify special PPE (Section 7) needs. ▪ Discontinue work during severe weather. ▪ Other:
Other:		Task 1: Task 2: Task 3:	▪ ▪

Physical and Biological Hazard Evaluation and Control

Hazard	Source or Contributing Factor(s)	Risk Level by Task (H = High; M = Medium; L = Low)	Hazard Control Measures
Biological Hazards			
Biting and stinging insects and ticks	Outdoor areas where the following exist: X Mosquitos - can carry West Nile and other diseases) X Ticks – can cause Lyme disease, Rocky Mountain Spotted Fever and other diseases ☒ Bees, wasps, hornets ☐ Chiggers ☐ Fire ants	Task 1: L	▪ Wear insect repellent on clothing that contains Permethrin, DEET or Picaridin. ▪ Wear light-colored long pants, socks, and long-sleeved shirts. Use head nets in high mosquito and tick areas. ▪ Perform tick checks throughout the day. ▪ Carry EpiPen or equivalent if needed. Inform other team members of its presence. ▪ Treat bites and stings with over-the-counter products that relieve pain and prevent infection. ▪ Avoid fire ants; their bites are painful and cause blisters. ▪ Other:
Poisonous plants	Contact w/vegetation. Site is within range of the following: ☒ Poison ivy ☐ Poison oak ☐ Poison sumac ☐ Poison hemlock ☐ Wild parsnip ☐ Giant Hogweed	Task 1: L	▪ Wear appropriate PPE when walking in areas where these plants may grow. If potentially poisonous plants are encountered, alert other team member of their proximity. If contacted: ▪ Wash clothing and shoes with soap and hot water. Oil can linger on them. Use Technu® products to remove poisonous plant oil. ▪ DO NOT touch skin or clothing that still has the oil. ▪ DO NOT burn poisonous plants for any reason. The oil can be spread via smoke. ▪ Other:
Other:		Task 1: Task 2: Task 3:	▪ ▪

Key:

CHSD = Corporate Health and Safety Director; **EPA** = Environmental Protection Agency; **DEET** = N,N-Diethyl-meta-toluamide; **DOT** = Department of Transportation; **GFCI** = Ground fault circuit interrupter; **N/A** = Not applicable; **NIOSH** = National Institute for Occupational Safety and Health ; **PFD** = Personal flotation device; **PM** = Project Manager; **PPE** = Personal protective equipment; **ROW** = Right-of-way; **SOP** = Standard operating procedure; **USCG** = U.S. Coast Guard; **UV** = Ultraviolet

APPENDIX F

SAFETY DATA SHEET

Creation Date 10-Dec-2009 **Revision Date** 28-Dec-2021 **Revision Number** 6

1. Identification

Product Name **Tetrachloroethylene**

Cat No. : **AC445690000; ACR445690010; AC445690025; AC445691000**

CAS No 127-18-4
Synonyms Perchloroethylene

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company

Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/Irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Carcinogenicity	Category 1B
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause drowsiness or dizziness
May cause cancer
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Toxic to aquatic life with long lasting effects
WARNING. Cancer - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Tetrachloroethylene	127-18-4	>95

4. First-aid measures

General Advice If symptoms persist, call a physician.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.
Inhalation	Remove to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.
Ingestion	Clean mouth with water and drink afterwards plenty of water.
Most important symptoms and effects	None reasonably foreseeable. May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray, carbon dioxide (CO2), dry chemical, alcohol-resistant foam.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. Containers may explode when heated.

Hazardous Combustion Products
Chlorine. Phosgene. Hydrogen chloride gas.
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment as required. Ensure adequate ventilation.
Environmental Precautions	Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment/face protection. Do not get in eyes, on skin, or on clothing. Ensure adequate ventilation. Avoid ingestion and inhalation.
Storage.	Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from sunlight. Incompatible Materials. Strong acids. Strong oxidizing agents. Strong bases. Metals. Zinc.

Amines. Aluminium.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Tetrachloroethylene	TWA: 25 ppm STEL: 100 ppm	(Vacated) TWA: 25 ppm (Vacated) TWA: 170 mg/m³ Ceiling: 200 ppm TWA: 100 ppm	IDLH: 150 ppm	TWA: 25 ppm STEL: 100 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: NIOSH - National Institute for Occupational Safety and Health

Engineering Measures Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic, sweet
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-22 °C / -7.6 °F
Boiling Point/Range	120 - 122 °C / 248 - 251.6 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	6.0 (Ether = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	18 mbar @ 20 °C
Vapor Density	No information available
Density	1.619
Specific Gravity	1.625
Solubility	0.15 g/L water (20°C)
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	> 150°C
Viscosity	0.89 mPa s at 20 °C
Molecular Formula	C2 Cl4

Molecular Weight 165.83

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Excess heat. Exposure to moist air or water.

Incompatible Materials Strong acids, Strong oxidizing agents, Strong bases, Metals, Zinc, Amines, Aluminium

Hazardous Decomposition Products Chlorine, Phosgene, Hydrogen chloride gas

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Tetrachloroethylene	LD50 = 2629 mg/kg (Rat)	LD50 > 10000 mg/kg (Rat)	LC50 = 27.8 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes and skin

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
Tetrachloroethylene	127-18-4	Group 2A	Reasonably Anticipated	A3	X	A3

IARC (International Agency for Research on Cancer)

IARC (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

NTP: (National Toxicity Program)

NTP: (National Toxicity Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)

Mexico - Occupational Exposure Limits - Carcinogens

Mexico - Occupational Exposure Limits - Carcinogens
A1 - Confirmed Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Confirmed Animal Carcinogen
A4 - Not Classifiable as a Human Carcinogen
A5 - Not Suspected as a Human Carcinogen

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Central nervous system (CNS)
STOT - repeated exposure Kidney Liver Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Endocrine Disruptor Information

Component	EU - Endocrine Disrupters Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Tetrachloroethylene	Group II Chemical	Not applicable	Not applicable

Other Adverse Effects Tumorigenic effects have been reported in experimental animals.

12. Ecological information

Ecotoxicity

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Tetrachloroethylene	EC50: > 500 mg/L, 96h (Pseudokirchneriella subcapitata)	LC50: 12.4 - 14.4 mg/L, 96h flow-through (Pimephales promelas) LC50: 8.6 - 13.5 mg/L, 96h static (Pimephales promelas) LC50: 11.0 - 15.0 mg/L, 96h static (Lepomis macrochirus) LC50: 4.73 - 5.27 mg/L, 96h flow-through (Oncorhynchus mykiss)	EC50 = 100 mg/L 24 h EC50 = 112 mg/L 24 h EC50 = 120.0 mg/L 30 min	EC50: 6.1 - 9.0 mg/L, 48h Static (Daphnia magna)

Persistence and Degradability Insoluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility . Is not likely mobile in the environment due its low water solubility. Will likely be mobile in the environment due to its volatility.

Component	log Pow
Tetrachloroethylene	2.88

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Tetrachloroethylene - 127-18-4	U210	-

14. Transport information

DOT

UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE

Hazard Class 6.1
Packing Group III

TDG
UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

IATA
UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

IMDG/IMO
UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
Tetrachloroethylene	127-18-4	X	ACTIVE	-

Legend:
TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
Tetrachloroethylene	127-18-4	X	-	204-825-9	X	X	X	X	X	KE-33294

KECL - NIER number or KE number (http://ncis.nier.go.kr/en/main.do)

U.S. Federal Regulations

SARA 313

Component	CAS No	Weight %	SARA 313 - Threshold Values %
Tetrachloroethylene	127-18-4	>95	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Tetrachloroethylene	-	-	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Tetrachloroethylene	X		-

OSHA - Occupational Safety and Health Administration: Not applicable

CERCLA: This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Tetrachloroethylene	100 lb 1 lb	-

California Proposition 65: This product contains the following Proposition 65 chemicals.

Component	CAS No	California Prop. 65	Prop 65 NSRL	Category
Tetrachloroethylene	127-18-4	Carcinogen	14 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Tetrachloroethylene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant Y
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security: This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade: No information available

Authorisation/Restrictions according to EU REACH

Component	REACH (1907/2006) - Annex XIV - Substances Subject to Authorization	REACH (1907/2006) - Annex XVII - Restrictions on Certain Dangerous Substances	REACH Regulation (EC 1907/2006) article 59 - Candidate List of Substances of Very High Concern (SVHC)
Tetrachloroethylene	-	Use restricted. See item 75. (see link for restriction details)	-

https://echa.europa.eu/substances-restricted-under-reach

Safety, health and environmental regulations/legislation specific for the substance or mixture

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Tetrachloroethylene	127-18-4	Listed	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)
Tetrachloroethylene	127-18-4	Not applicable	Not applicable	Not applicable	Annex I - Y45

16. Other information

Prepared By: Regulatory Affairs
Thermo Fisher Scientific

Email: EMSDS.RA@thermofisher.com

Creation Date	10-Dec-2009
Revision Date	28-Dec-2021
Print Date	28-Dec-2021
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

SDS ID NO.: 0130MAR019
Revision Date: 05/14/2015

1. IDENTIFICATION

Product Name: Marathon Petroleum Regular Unleaded Gasoline With Ethanol

Synonym: Regular Unleaded Gasoline With Alcohol
Chemical Family: Complex Hydrocarbon Substance

Recommended Use: Fuel.
Use Restrictions: All others.

Supplier Name and Address:

MARATHON PETROLEUM COMPANY LP
539 South Main Street
Findlay, OH 45840

SDS information: 1-419-421-3070

Emergency Telephone: 1-877-627-5463

2. HAZARD IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous according to the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 1
Skin corrosion/irritation	Category 2
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1B
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Aspiration toxicity	Category 1
Acute aquatic toxicity	Category 2
Chronic aquatic toxicity	Category 2

Hazards Not Otherwise Classified (HNOC)
Static accumulating flammable liquid

Label elements

EMERGENCY OVERVIEW

Danger

EXTREMELY FLAMMABLE LIQUID AND VAPOR
May accumulate electrostatic charge and ignite or explode

May be fatal if swallowed and enters airways
Causes skin irritation
May cause respiratory irritation
May cause drowsiness or dizziness
May cause genetic defects
May cause cancer
Suspected of damaging fertility or the unborn child
Toxic to aquatic life with long lasting effects

Appearance Clear or Colored Liquid **Physical State** Liquid **Odor** Strong Hydrocarbon

Precautionary Statements - Prevention
Keep away from heat/sparks/open flames/hot surfaces. — No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Wear protective gloves/protective clothing/eye protection/face protection
Do not eat, drink or smoke when using this product
Do not breathe mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wash hands thoroughly after handling
Avoid release to the environment

Precautionary Statements - Response
IF exposed or concerned: Get medical attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical attention
Wash contaminated clothing before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor if you feel unwell
IF SWALLOWED: Immediately call a POISON CENTER or doctor
Do NOT induce vomiting
In case of fire: Use water spray, fog or regular foam for extinction
Collect spillage

Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Keep cool
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container at an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Gasoline is a complex combination of hydrocarbons consisting of paraffins, cycloparaffins, aromatic and olefinic hydrocarbons having molecular chains ranging in length from four to ten carbons. May contain small amounts of dye and other additives (>0.02%) which are not considered hazardous at the concentrations used.

Composition Information:

Name	CAS Number	Weight %
Gasoline	86290-81-5	100
Toluene	108-88-3	0.9-13.5
Ethyl Alcohol	64-17-5	5.7-10
Xylene (mixed isomers)	1330-20-7	1.8-9
1,2,4 Trimethylbenzene	95-63-6	0.9-4.5
Benzene	71-43-2	0.45-3.2
n-Hexane	110-54-3	0-2.7
Ethylbenzene	100-41-4	0.45-1.8
Naphthalene	91-20-3	0.1-0.5

4. FIRST AID MEASURES

First Aid Measures

General advice In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

Inhalation: Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Skin Contact: Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. May be absorbed through the skin in harmful amounts. Get medical attention if irritation persists. Any injection injury from high pressure equipment should be evaluated immediately by a physician as potentially serious (See NOTES TO PHYSICIAN).

Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties. Destroy contaminated, non-chemical resistant footwear.

Eye Contact: Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

Ingestion: Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Most important signs and symptoms, both short-term and delayed with overexposure

Adverse Effects: Acute: Headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue.
Delayed: Dry skin and possible irritation with repeated or prolonged exposure.

Indication of any immediate medical attention and special treatment needed

NOTES TO PHYSICIAN:

INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

SKIN: Leaks or accidents involving high-pressure equipment may inject a stream of material through the skin and initially produce an injury that may not appear serious. Only a small puncture wound may appear on the skin surface but, without proper treatment and depending on the nature, original pressure, volume, and location of the injected material, can compromise blood supply to an affected body part. Prompt surgical debridement of the wound may be necessary to prevent irreversible loss of function and/or the affected body part. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Unsuitable extinguishing media
Do not use straight water streams to avoid spreading fire.

Specific hazards arising from the chemical
This product has been determined to be an extremely flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. May accumulate electrostatic charge and ignite or explode. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the North American Emergency Response Guide 128.

Hazardous combustion products
Smoke, carbon monoxide, and other products of incomplete combustion.

Explosion data
Sensitivity to Mechanical Impact No.
Sensitivity to Static Discharge Yes.

Special protective equipment and precautions for firefighters
Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

NFPA:	Health 1	Flammability 3	Instability 0	Special Hazards -

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.

Protective Equipment: Use personal protection measures as recommended in Section 8.

Emergency Procedures: Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.

Environmental precautions:	Ethanol in gasoline phase seperates in contact with water. Monitor downstream for dissolved ethanol or other appropriate indicators. Avoid release to the environment. Avoid subsoil penetration.
Methods and materials for containment:	Contain liquid with sand or soil.
Methods and materials for cleaning up:	Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

7. HANDLING AND STORAGE

Safe Handling Precautions:

NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Use only non-sparking tools. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Portable containers should never be filled while in or on a motor vehicle or marine craft. Containers should be placed on the ground. Static electric discharge can ignite fuel vapors when filling non-grounded containers or vehicles on trailers. The nozzle spout must be kept in contact with the container before and during the entire filling operation. Use only approved containers.

A buildup of static electricity can occur upon re-entry into a vehicle during fueling especially in cold or dry climate conditions. The charge is generated by the action of dissimilar fabrics (i.e., clothing and upholstery) rubbing across each other as a person enters/exits the vehicle. A flash fire can result from this discharge if sufficient flammable vapors are present. Therefore, do not get back in your vehicle while refueling.

Cellular phones and other electronic devices may have the potential to emit electrical charges (sparks). Sparks in potentially explosive atmospheres (including fueling areas such as gas stations) could cause an explosion if sufficient flammable vapors are present. Therefore, turn off cellular phones and other electronic devices when working in potentially explosive atmospheres or keep devices inside your vehicle during refueling.

High-pressure injection of any material through the skin is a serious medical emergency even though the small entrance wound at the injection site may not initially appear serious. These injection injuries can occur from high-pressure equipment such as paint spray or grease or guns, fuel injectors, or pinhole leaks in hoses or hydraulic lines and should all be considered serious. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES (See First Aid Section 4).

Storage Conditions:	Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area.
Incompatible materials	Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Name	ACGIH TLV	OSHA PELS:	OSHA - Vacated PELs	NIOSH IDLH
Gasoline 86290-81-5	300 ppm TWA 500 ppm STEL	-	300 ppm TWA 900 mg/m³ TWA 500 ppm STEL 1500 mg/m³ STEL	-
Toluene 108-88-3	20 ppm TWA	TWA: 200 ppm Ceiling: 300 ppm	100 ppm TWA 375 mg/m³ TWA 150 ppm STEL 560 mg/m³ STEL	500 ppm
Ethyl Alcohol 64-17-5	1000 ppm STEL	TWA: 1000 ppm TWA: 1900 mg/m³	1000 ppm TWA 1900 mg/m³ TWA	3300 ppm
Xylene (mixed isomers) 1330-20-7	100 ppm TWA 150 ppm STEL	TWA: 100 ppm TWA: 435 mg/m³	100 ppm TWA 435 mg/m³ TWA 150 ppm STEL 655 mg/m³ STEL	900 ppm
1,2,4 Trimethylbenzene 95-63-6	25 ppm TWA	-	25 ppm TWA 125 mg/m³ TWA	-
Benzene 71-43-2	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm (applies to industry segments exempt from the benzene standard at 29 CFR 1910.1028) TWA: 1 ppm STEL: 5 ppm (see 29 CFR 1910.1028)	25 ppm Ceiling 1 ppm TWA 5 ppm STEL	500 ppm
n-Hexane 110-54-3	50 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 500 ppm TWA: 1800 mg/m³	50 ppm TWA 180 mg/m³ TWA	1100 ppm
Ethylbenzene 100-41-4	20 ppm TWA	TWA: 100 ppm TWA: 435 mg/m³	100 ppm TWA 435 mg/m³ TWA 125 ppm STEL 545 mg/m³ STEL	800 ppm
Naphthalene 91-20-3	10 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm TWA: 50 mg/m³	10 ppm TWA 50 mg/m³ TWA 15 ppm STEL 75 mg/m³ STEL	250 ppm

Notes: The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

Engineering measures: Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

Personal protective equipment

Eye protection: Use goggles or face-shield if the potential for splashing exists.

Skin and body protection: Use nitrile rubber, viton or PVA gloves for repeated or prolonged skin exposure. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.

Respiratory protection: Approved organic vapor chemical cartridge or supplied air respirators should be worn for exposures to any components exceeding the established exposure limits. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Liquid
Appearance	Clear or Colored Liquid
Color	Clear or Colored
Odor	Strong Hydrocarbon
Odor Threshold	No available data.

Property	**Values (Method)**
Melting Point / Freezing Point	No available data.
Initial Boiling Point / Boiling Range	32-225 °C / 90-437 °F
Flash Point	-45.5 °C / -50 °F
Evaporation Rate	No available data.
Flammability (solid, gas)	Not applicable.
Flammability Limit in Air (%)	
Upper Flammability Limit:	7.6
Lower Flammability Limit:	1.4
Vapor Pressure	403-776 mm Hg@ 100°F
Vapor Density	3-4
Specific Gravity / Relative Density	0.70-0.77
Water Solubility	Negligible
Solubility in other solvents	No available data.
Partition Coefficient	2.13-4.5
Decomposition temperature:	No available data.
pH:	Not applicable
Autoignition Temperature	C.A. 257 °C / 495 °F
Kinematic Viscosity	No available data.
Dynamic Viscosity	No available data.
Explosive Properties	No available data.
Softening Point	No available data.
VOC Content (%)	100%
Density	5.9-6.3 lbs/gal
Bulk Density	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity	The product is non-reactive under normal conditions.
Chemical stability	The material is stable at 70°F, 760 mmHg pressure.
Possibility of hazardous reactions	None under normal processing.
Hazardous polymerization	Will not occur.
Conditions to avoid	Excessive heat, sources of ignition, open flame.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	None known under normal conditions of use.

11. TOXICOLOGICAL INFORMATION

Potential short-term adverse effects from overexposures

Inhalation Irritating to the respiratory system. May cause drowsiness or dizziness. Breathing high concentrations of this material in a confined space or by intentional abuse can cause irregular heartbeats which can cause death.

Eye contact Causes mild eye irritation.

Skin contact Causes skin irritation. Effects may become more serious with repeated or prolonged contact. May be absorbed through the skin in harmful amounts.

Ingestion May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

Acute Toxicological data

Name	Oral LD50	Dermal LD50	Inhalation LC50
Gasoline 86290-81-5	14000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.2 mg/L (Rat) 4 h
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h
Ethyl Alcohol 64-17-5	> 5000 mg/kg (Rat)	-	124.7 mg/L (Rat) 4 h
Xylene (mixed isomers) 1330-20-7	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.04 mg/L (Rat) 4 h
1,2,4 Trimethylbenzene 95-63-6	3280 mg/kg (Rat)	> 3160 mg/kg (Rabbit)	18,000 mg/m^3 (Rat) 4 h
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h
n-Hexane 110-54-3	15000 mg/kg (Rat)	3000 mg/kg (Rabbit)	48000 ppm (Rat) 4 h
Ethylbenzene 100-41-4	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h
Naphthalene 91-20-3	490 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 340 mg/m^3 (Rat) 1 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

BENZENE: Studies of workers exposed to benzene show clear evidence that overexposure can cause cancer and other diseases of the blood forming organs including Acute Myelogenous Leukemia (AML), and Aplastic Anemia (AA), an often fatal disease. Some studies suggest overexposure to benzene may also be associated with Myelodysplastic Syndrome (MDS). Findings from a case control study of workers exposed to benzene was reported during the 2009 Benzene Symposium in Munich included an increase in Acute Myeloid Leukemias and Non-Hodgkins Lymphoid Neoplasms (NHLN) of the subtype follicular lymphoma (FL) in some occupational categories. Some studies of workers exposed to benzene have shown an association with increased rates of chromosome aberrations in circulating lymphocytes. One study of women workers exposed to benzene suggested a weak association with irregular menstruation. However, other studies of workers exposed to benzene have not demonstrated clear evidence of an effect on fertility or reproductive outcome in humans. Benzene can cross the placenta and affect the developing fetus. Cases of AA have been reported in the offspring of persons severely overexposed to benzene. Studies in laboratory animals indicate that prolonged, repeated exposure to high levels of benzene vapor can cause bone marrow suppression and cancer in multiple organ systems. Studies in laboratory animals show evidence of adverse effects on male reproductive organs following high levels of exposure but no significant effects on reproduction have been observed. Embryotoxicity has been reported in studies of laboratory animals but effects were limited to reduced fetal weight and minor skeletal variations. Benzene has been classified as a proven human carcinogen by OSHA and a Group 1 (Carcinogenic to Humans) material by IARC. The current proposed IARC classification for benzene is summarized as follows: Sufficient evidence for Acute Myeloid Leukemia; limited evidence for Acute Lymphatic Leukemia, Chronic Lymphatic Leukemia, Non-Hodgkin Lymphoma, and Multiple Myeloma.

NAPHTHAS: In a large epidemiological study on over 15,000 employees at several petroleum refineries and amongst residents located near these refineries, no increased risk of kidney cancer was observed in association with gasoline exposures (a similar material). In a similar study, no increased risk of kidney cancer was observed among petroleum refinery workers, but there was a slight trend in the incidence of kidney cancers among service station employees, especially after a 30-year latency period. Altered mental state, drowsiness, peripheral motor neuropathy, irreversible brain damage (so-called Petrol Sniffer's Encephalopathy), delirium, seizures, and sudden death have been reported from repeated overexposure to some hydrocarbon solvents, naphthas, and gasoline.

ISOPARAFFINS: Studies in laboratory animals have shown that long-term exposure to similar materials (isoparaffins) can cause kidney damage and kidney cancer in male laboratory rats. However, in-depth research indicates that these findings are unique to the male rat, and that these effects are not relevant to humans.

TOLUENE: Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Abuse of toluene at high concentrations (e.g., glue sniffing and solvent abuse) has been associated with adverse effects on the liver, kidney and nervous system, and can cause CNS depression, cardiac arrhythmias, and death. Studies of workers indicate longterm exposure may be related to impaired color vision and hearing. Some studies of workers suggest longterm exposure may be related to neurobehavioral and cognitive changes. Some of these effects have been observed in laboratory animals following repeated exposure to high levels of toluene. Several studies of workers suggest longterm exposure may be related to small increases in spontaneous abortions and changes in some gonadotropic hormones. However, the weight of evidence does not indicate toluene is a reproductive hazard to humans. Studies in laboratory animals indicate some changes in reproductive organs following high levels of exposure, but no significant effects on mating performance or reproduction were observed. Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Findings in laboratory animals have been largely negative. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following very high levels of maternal exposure. Studies of workers indicate long-term exposure may be related to effects on the liver, kidney and blood, but these appear to be limited to changes in serum enzymes and decreased leukocyte counts. Adverse effects on the liver, kidney, thymus and nervous system were observed in animal

studies following very high levels of exposure. The relevance of these findings to humans is not clear at this time.

ETHYLBENZENE: Findings from a 2-year inhalation study in rodents conducted by NTP were as follows: Effects were observed only at the highest exposure level (750 ppm). At this level the incidence of renal tumors was elevated in male rats (tubular carcinomas) and female rats (tubular adenomas). The incidence of tumors was also elevated in male mice (alveolar and bronchiolar carcinomas) and female mice (hepatocellular carcinomas). IARC has classified ethyl benzene as "possibly carcinogenic to humans" (Group 2B). Studies in laboratory animals indicate some evidence of post-implantation deaths following high levels of maternal exposure. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals indicate limited evidence of renal malformations, resorptions, and developmental delays following high levels of maternal exposure with evidence of maternal toxicity. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals have demonstrated evidence of ototoxicity (hearing loss) following exposure levels as low as 300 ppm for 5 days. Studies in laboratory animals indicate some evidence of adverse effects on the liver, kidney, thyroid, and pituitary gland.

XYLENES, ALL ISOMERS: Overexposure to xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, nervous system damage and narcosis. Effects may be increased by the use of alcoholic beverages. Evidence of liver and kidney impairment were reported in workers recovering from a gross overexposure. Effects from Prolonged or Repeated Exposure: Impaired neurological function was reported in workers exposed to solvents including xylene. Studies in laboratory animals have shown evidence of impaired hearing following high levels of exposure. Studies in laboratory animals suggest some changes in reproductive organs following high levels of exposure but no significant effects on reproduction were observed. Studies in laboratory animals indicate skeletal and visceral malformations, developmental delays, and increased fetal resorptions following extremely high levels of maternal exposure with evidence of maternal toxicity. The relevance of these observations to humans is not clear at this time. Adverse effects on the liver, kidney, bone marrow (changes in blood cell parameters) were observed in laboratory animals following high levels of exposure. The relevance of these observations to humans is not clear at this time.

C9 AROMATIC HYDROCARBONS: A developmental inhalation study was conducted in laboratory mice. Increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate were observed at the highest exposure level (1,500 ppm). This exposure level was extremely toxic to pregnant female mice (44% mortality). Reduced fetal body weights were also observed at 500 ppm. A multi-generation reproduction inhalation study was conducted in laboratory rats. Reductions in pup weights, pup weight gain, litter size, and pup survival were observed at 1,500 ppm, an exposure level at which significant maternal toxicity was observed. Reduced pup weight gain was also observed at 500 ppm.

NAPHTHALENE: Severe jaundice, neurotoxicity (kernicterus) and fatalities have been reported in young children and infants as a result of hemolytic anemia from overexposure to naphthalene. Persons with glucose 6-phosphate dehydrogenase (G6PD) deficiency are more prone to the hemolytic effects of naphthalene. Adverse effects on the kidney have been reported in persons overexposed to naphthalene but these effects are believed to be a consequence of hemolytic anemia, and not a direct effect. Hemolytic anemia has been observed in laboratory animals exposed to naphthalene. Laboratory rodents exposed to naphthalene vapor for 2 years (lifetime studies) developed non-neoplastic and neoplastic tumors and inflammatory lesions of the nasal and respiratory tract. Cataracts and other adverse effects on the eye have been observed in laboratory animals exposed to high levels of naphthalene. Findings from a large number of bacterial and mammalian cell mutation assays have been negative. A few studies have shown chromosomal effects (elevated levels of Sister Chromatid Exchange or chromosomal aberrations) in vitro. Naphthalene has been classified as Possibly Carcinogenic to Humans (2B) by IARC, based on findings from studies in laboratory animals.

N-HEXANE: Long-term or repeated exposure to n-hexane can cause peripheral nerve

damage. Initial symptoms are numbness of the fingers and toes. Also, motor weakness can occur in the digits, but may also involve muscles of the arms, thighs and forearms. The onset of these symptoms may be delayed for several months to a year after the beginning of exposure. Testicular atrophy and partial to full loss of the germ cell line were observed in sub-chronic high-dose inhalation studies of laboratory rodents. These effects appeared irreversible. Rodent reproduction studies have shown evidence of reduced fetal weight but no frank malformations.

PENTANES: Studies of pentane isomers in laboratory animals indicate exposure to extremely high levels (roughly 10 vol.%) may induce cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

ETHANOL: Repeated ingestion of ethanol can result in alcohol abuse, causing behavioral changes, memory loss, impaired judgement, decreased appetite, irregular heartbeats, and decreased fertility. Prolonged and repeated ingestion of ethanol has also been associated with cancers of the mouth, pharynx, esophagus and liver. Ethanol ingestion by pregnant women can cause miscarriage, low birth weight, premature birth and fetal alcohol syndrome. In males, acute and chronic alcohol ingestion may affect gonadal hormone levels. It may also affect the liver, kidney, brain, blood and cardiovascular system.

CARBON MONOXIDE: is a chemical asphyxiant with no warning properties (such as odor). At 400-500 ppm for 1 hour headache and dyspnea may occur. If activity is increased, symptoms of overexposure may include nausea, irritability, increased respiration, tinnitus, sweating, chest pain, confusion, impaired judgement, dizziness, weakness, drowsiness, ataxia, irregular heart beat, cyanosis and pallor. Levels in excess of 1000 ppm can result in collapse, loss of conciousness, respiratory failure and death. Extremely high concentrations (12,800 ppm) can cause immediate unconsciousness and death in 1-3 minutes. Repeated anoxia can lead to central nervous system damage and peripheral neuropathy, with loss of sensation in the fingers, amnesia, and mental deterioration and possible congestive heart failure. Damage may also occur to the fetus, lung, liver, kidney, spleen, cardiovascular system and other organs.

COMBUSTION ENGINE EXHAUST: Chronic inhalation studies of gasoline engine exhaust in mice, rats and hamsters did not produce any carcinogenic effects. Condensates/extracts of gasoline engine exhaust produced an increase in tumors compared to controls when testing by skin painting, subcutaneous injection, intratracheal instillation or implantation into the lungs.

Adverse effects related to the physical, chemical and toxicological characteristics

Signs & Symptoms Nausea, vomiting, signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue.

Sensitization Not expected to be a skin or respiratory sensitizer.

Mutagenic effects May cause genetic defects.

Carcinogenicity Cancer designations are listed in the table below.

Name	ACGIH (Class)	IARC (Class)	NTP	OSHA
Gasoline 86290-81-5	Confirmed animal carcinogen (A3)	Possibly Carcinogenic (2B)	Not Listed	Not Listed
Toluene 108-88-3	Not Classifiable (A4)	Not Classifiable (3)	Not Listed	Not Listed
Ethyl Alcohol 64-17-5	Confirmed animal carcinogen (A3)	Carcinogenic (1) Alcoholic Beverages	Known to be human carcinogen - Alcoholic Beverage Consumption	Not Listed
Xylene (mixed isomers) 1330-20-7	Not Classifiable (A4)	Not Classifiable (3)	Not Listed	Not Listed
1,2,4 Trimethylbenzene 95-63-6	Not Listed	Not Listed	Not Listed	Not Listed

Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen
n-Hexane 110-54-3	Not Listed	Not Listed	Not Listed	Not Listed
Ethylbenzene 100-41-4	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Naphthalene 91-20-3	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed

Reproductive toxicity Suspected of damaging fertility or the unborn child.

Specific Target Organ Toxicity (STOT) - single exposure Respiratory system. Central nervous system.

Specific Target Organ Toxicity (STOT) - repeated exposure Not classified.

Aspiration hazard May be fatal if swallowed or vomited and enters airways.

12. ECOLOGICAL INFORMATION

Ecotoxicity This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Algae/aquatic plants	Fish	Toxicity to Microorganisms	Crustacea
Gasoline 86290-81-5	72-hr EC50 = 56 mg/l Algae	96-hr LC50 = 11 mg/l Rainbow trout (static)	-	48-hr LC50 = 7.6 mg/l Daphnia magna
Toluene 108-88-3	72-hr EC50 = 12.5 mg/l Algae	96-hr LC50 <= 10 mg/l Rainbow trout	-	48-hr EC50 = 5.46-9.83 mg/l Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)
Ethyl Alcohol 64-17-5	-	96-hr LC50 >1,000 mg/l Rainbow Trout (static) 96-hr LC50 >100 mg/l Fathead minnow (static)	-	48-hr LC50 >1,000 mg/l Daphnia magna
Xylene (mixed isomers) 1330-20-7	72-hr EC50 = 11 mg/l Algae	96-hr LC50 = 8 mg/l Rainbow trout	-	48-hr LC50 = 3.82 mg/l Daphnia magna
1,2,4 Trimethylbenzene 95-63-6	-	96-hr LC50 = 7.19-8.28 mg/l Fathead minnow (flow-through)	-	48-hr EC50 = 6.14 mg/L Daphnia magna
Benzene 71-43-2	72-hr EC50 = 29 mg/l Algae	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	-	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)
n-Hexane 110-54-3	-	96-hr LC50 = 2.5 mg/l Fathead minnow	-	-
Ethylbenzene 100-41-4	72-hr EC50 = 1.7-7.6 mg/l Algae	96-hr LC50 = 4 mg/L Rainbow trout	-	48-hr EC50 = 1-4 mg/L Daphnia magna
Naphthalene 91-20-3	-	96-hr LC50 = 0.91-2.82 mg/l Rainbow trout (static) 96-hr LC50 = 1.99 mg/l Fathead minnow (static)	-	48-hr LC50 = 1.6 mg/l Daphnia magna

Persistence and degradability Expected to be inherently biodegradable. The presence of ethanol in this product may impede the biodegradation of benzene, toluene, ethylbenzene and xylene in groundwater, resulting in elongated plumes of these constituents.

Bioaccummulation Has the potential to bioaccumulate.

Mobility in soil May partition into air, soil and water.

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Description of Waste Residues
This material may be a flammable liquid waste.

Safe Handling of Wastes
Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

Disposal of Wastes / Methods of Disposal
The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

Methods of Contaminated Packaging Disposal
Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (49 CFR 172.101):

UN Proper shipping name:	Gasoline
UN/Identification No:	UN 1203
Transport Hazard Class(es):	3
Packing group:	II

TDG (Canada):

UN Proper shipping name:	Gasoline
UN/Identification No:	UN 1203
Transport Hazard Class(es):	3
Packing group:	II

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List.

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Gasoline	NA
Toluene	NA
Ethyl Alcohol	NA
Xylene (mixed isomers)	NA
1,2,4 Trimethylbenzene	NA
Benzene	NA
n-Hexane	NA
Ethylbenzene	NA
Naphthalene	NA

SARA Section 304: This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	CERCLA/SARA - Hazardous Substances and their Reportable Quantities
Gasoline	NA
Toluene	1000 lb final RQ 454 kg final RQ
Ethyl Alcohol	NA
Xylene (mixed isomers)	100 lb final RQ 45.4 kg final RQ
1,2,4 Trimethylbenzene	NA
Benzene	10 lb final RQ 4.54 kg final RQ
n-Hexane	5000 lb final RQ 2270 kg final RQ
Ethylbenzene	1000 lb final RQ 454 kg final RQ
Naphthalene	100 lb final RQ 45.4 kg final RQ

SARA: The following EPA hazard categories apply to this product:

Acute Health Hazard
Chronic Health Hazard
Fire Hazard

SARA Section 313: This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting:
Gasoline	None
Toluene	1.0 % de minimis concentration
Ethyl Alcohol	None
Xylene (mixed isomers)	1.0 % de minimis concentration
1,2,4 Trimethylbenzene	None
Benzene	0.1 % de minimis concentration
n-Hexane	1.0 % de minimis concentration
Ethylbenzene	0.1 % de minimis concentration
Naphthalene	0.1 % de minimis concentration

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Gasoline

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Not Listed.
New Jersey Right-To-Know:	SN 0957
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed.
Michigan Critical Materials Register List:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0957 TPQ: 10000 lb (Under N.J.A.C. 7:1G, environmental hazardous substances in mixtures such as gasoline or new and used petroleum oil may be reported under these categories)
Illinois - Toxic Air Contaminants	Present

New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed.

Toluene

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Developmental toxicity, initial date 1/1/91 Female reproductive toxicity, initial date 8/7/09
New Jersey Right-To-Know:	SN 1866
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Flammable - third degree; Teratogen
New Jersey - Environmental Hazardous Substances List:	SN 1866 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Ethyl Alcohol

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Carcinogen, initial date 4/29/11 (in alcoholic beverages) Carcinogen, initial date 7/1/88 (when associated with alcohol abuse) Developmental toxicity, initial date 10/1/87 (in alcoholic beverages)
New Jersey Right-To-Know:	SN 0844
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Teratogen
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree; Mutagen; Teratogen
New Jersey - Environmental Hazardous Substances List:	Not Listed.
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed.

Xylene (mixed isomers)

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Not Listed.
New Jersey Right-To-Know:	SN 2014
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold all isomers
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 2014 TPQ: 500 lb

Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

1,2,4 Trimethylbenzene

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Not Listed.
New Jersey Right-To-Know:	SN 1929
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic
Michigan Critical Materials Register List:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Not Listed.
New Jersey - Environmental Hazardous Substances List:	Not Listed.
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed.

Benzene

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Carcinogen, initial date 2/27/87 Developmental toxicity, initial date 12/26/97 Male reproductive toxicity, initial date 12/26/97
New Jersey Right-To-Know:	SN 0197
Pennsylvania Right-To-Know:	Environmental hazard; Special hazardous substance
Massachusetts Right-To Know:	Carcinogen; Extraordinarily hazardous
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin); Carcinogen (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Carcinogen; Extraordinarily hazardous
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Present
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree; Mutagen
New Jersey - Environmental Hazardous Substances List:	SN 0197 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	10 lb RQ (air); 1 lb RQ (land/water)

n-Hexane

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Not Listed.
New Jersey Right-To-Know:	SN 1340
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 1340 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present

New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1 lb RQ (air); 1 lb RQ (land/water)

Ethylbenzene

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Carcinogen, initial date 6/11/04
New Jersey Right-To-Know:	SN 0851
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Carcinogen; flammable - Third degree
New Jersey - Environmental Hazardous Substances List:	SN 0851 TPQ: 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

Naphthalene

Louisiana Right-To-Know:	Not Listed.
California Proposition 65:	Carcinogen, initial date 4/19/02
New Jersey Right-To-Know:	SN 1322 SN 3758
Pennsylvania Right-To-Know:	Environmental hazard Present (particulate)
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed.
California - Regulated Carcinogens:	Not Listed.
Pennsylvania RTK - Special Hazardous Substances:	Not Listed.
New Jersey - Special Hazardous Substances:	Carcinogen
New Jersey - Environmental Hazardous Substances List:	SN 1322 TPQ: 500 lb (Reportable at the de minimis quantity of >0.1%)
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	100 lb RQ (air); 1 lb RQ (land/water)

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Canadian Regulatory Information: "This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations."

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
Gasoline	B2,D2A,D2B	0.1%
Toluene	B2,D2A,D2B	0.1%
Ethyl Alcohol	B2,D2B	0.1%
Xylene (mixed isomers)	B2,D2A,D2B	m-, o-isomers 1.0%; p-isomer 0.1%
1,2,4 Trimethylbenzene	B3	1
Benzene	B2,D2A,D2B	0.1%
n-Hexane	B2,D2A,D2B	1%
Ethylbenzene	B2,D2A,D2B	0.1%
Naphthalene	B4,D2A	0.1%

NOTE: Not Applicable.

16. OTHER INFORMATION

Prepared By Toxicology and Product Safety
Revision Date: 05/14/2015

Revision Note:

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

1. IDENTIFICATION

Product Identifier: Diesel Fuel

Synonyms: Diesel Fuel, Motor Vehicle Diesel Fuel, Dyed Diesel, * DieselOne®, * DieselOne® w/Platinum Plus DFX, Low Sulfur Diesel (LSD), Ultra Low Sulfur Diesel (ULSD)

Intended use of the product: Fuel

Contact:
Global Companies LLC
Water Mill Center
800 South St.
Waltham, MA 02454-9161
www.globalp.com

Contact Information: EMERGENCY TELEPHONE NUMBER (24 hrs): CHEMTREC (800) 424-9300
COMPANY CONTACT (business hours): 800-542-0778

2. HAZARD IDENTIFICATION

According to OSHA 29 CFR 1910.1200 HCS

Classification of the Substance or Mixture

Classification (GHS-US):

Flam. Liquid	Category 3	H226
Skin Corrosion/Irritation	Category 2	H315
Aspiration Hazard	Category 1	H304
STOT SE	Category 3	H336
Carcinogenicity	Category 2	H350
Aquatic Chronic	Category 2	H411
Serious Eye Damage/ Irritation	Category 2B	H319

Labeling Elements

Signal Word (GHS-US): **Danger**

Hazard Statements (GHS-US):
H226 – Flammable liquid and vapor.
H315 – Causes Skin irritation.
H304 – May be fatal if swallowed and enters airways.
H336 – May cause drowsiness or dizziness.
H350 – May cause cancer.
H411 – Toxic to aquatic life with long lasting effects.
H319 – May cause eye damage/irritation.

Precautionary Statements (GHS-US):
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 pursuant to applicable electrical code.
P242 – Use only non-sparking tools.
P243 – Take precautionary measures against static discharge.
P261 – Avoid breathing dust/fume/gas/mist/vapors/spray.
P264 – Wash skin thoroughly after handling.
P271 – Use only outdoors or in a well-ventilated area.
P273 – Avoid release to the environment.
P280 - Wear protective gloves/protective clothing/eye protection/face protection.
P303+361+353 - If on skin (or hair): Take off immediately all contaminated clothing. Rinse with water/shower.
P308+311 - If exposed or concerned: Get medical advice/attention.
P301+310 - If swallowed: Immediately call a poison center/doctor/…
P331 - Do NOT induce vomiting.
P370+P378 – In case of fire use firefighting foam or other appropriate media for Class B fires to extinguish.
P403+235 - Store in a well-ventilated place. Keep cool.
P405 - Store locked up.
P501 – Dispose of contents/container in accordance with local/regional/national/international regulation.

Other information:

NFPA 704
Health: 1
Fire: 2
Reactivity: 0

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Composition Information
Mixture

Name	Product Identifier (CAS#)	% (w/w)	Classification
Diesel Fuel	68476-34-6	100	Flam Liq. 3, H226; Skin Irrit. 2, H315; Aspiration 1, H304; STOT SE 3, H336; Carc.2. H350; Aquatic chronic 2, H411
Naphthalene	91-20-3	<0.1	Carc. 2, H351; Acute Tox. 4, H302; Aquatic Acute 1, H400; Aquatic Chronic 1, H410

Additional Formulation Information:
Diesel Fuel consists of C9+ hydrocarbons resulting from distillation of crude oil.

Low Sulfur Diesel Fuel typically contains less than 500 ppm of sulfur

Ultra Low Sulfur Diesel Fuel typically contains less than 15 ppm of sulfur

4. FIRST AID MEASURES

Route	Measures
Inhalation	Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

Route	Measures
Ingestion	Aspiration Hazard: DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Ingestion may cause gastrointestinal disturbances including irritation, nausea, vomiting, and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory failure, and death.
Eye Contact	In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention. In case of contact lenses, remove immediately.
Skin Contact	Remove contaminated clothing and shoes. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops. Thermal burns require immediate medical attention depending on the severity and of the area of the body burned.

Most Important Symptoms
Contact with eyes and face may cause irritation. Long-term exposure may cause dermatitis (itching, irritation, pain and swelling).

Inhalation may cause irritation and significant or long term exposure could cause respiratory insufficiency and pulmonary edema.

Ingestion may cause aspiration, gastrointestinal disturbance, and CNS effects.

Immediate Medical Attention and Special Treatment
For contact with skin or eyes, immediately wash or flush contaminated eyes with gently flowing water. If possible, irrigate each eye continuously with 0.9% saline (NS). If ingested, rinse mouth. Do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs).

If inhaled, administer oxygen or establish a patent airway if breathing is labored. Suction if necessary. Monitor closely, anticipate seizures. Consider orotracheal or nostracheal intubation of airway control if patient is unconscious or is in severe respiratory distress.

Discard any clothing or shoes contaminated as they may be flammable.

5. FIRE-FIGHTING MEASURES

Extinguishing Media
Foam, carbon dioxide, dry chemical are most suitable

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, C02, water spray, firefighting foam, or Halon. Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other firefighting equipment.

LARGE FIRES: Foam, carbon dioxide, dry chemical. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Specific Hazards / Products of Combustion
Moderate fire hazard when exposed to heat or flame with a very low flash point. Product is flammable and easily ignited when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

Combustion may produce smoke, carbon monoxide and other products of incomplete combustion.

Special Precautions and Protective Equipment for Firefighters
Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied firefighting foam.

Fighting Equipment/Instructions
Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH- approved pressure-demand self-contained breathing apparatus with full face piece and protective clothing.

Refer to Section 9 for fire properties of this chemical including flash point, auto ignition temperature, and explosive limits.

6. ACCIDENTAL RELEASE MEASURES

ACTIVATE FACILITY SPCC, SPILL CONTINGENCY or EMERGENCY PLAN.

Personal Precautions
Due to high vapor density, flammable / toxic vapors may be present in low lying areas, dikes, pits, drains, or trenches. Vapors may accumulate in low lying areas and reach ignitable concentrations. Ventilate the area. Use of non-sparking tools and intrinsically safe equipment is recommended. Potential for flammable atmosphere should be monitored using a combustible gas indicator positioned downwind of the spill area. Refer to Sections 2 and 7 for further hazard warnings and handling instructions.

Use appropriate personal protective equipment to prevent eye/skin contact and absorption. Use NIOSH approved respiratory protection, if warranted, to prevent exposures above permissible limits. Refer to Section 8. Contaminated clothing should not be near sources of ignition.

Emergency Measures
As an immediate precautionary measure, isolate spill or leak area for at least 50 meters (150 feet) in all directions. Consider wind direction. Secure all ignition sources (flame, spark, hot work, hot metal, etc.) from area. Evaluate the direction of product travel, diking sewers, etc. to confirm spill areas. Do not touch or walk-through spilled material. For large spills, isolate initial action distance downwind 1,000 ft. (300 m).

Environmental Precautions
Stop the spill to prevent environmental release if it can be done safely. Product is toxic to aquatic life. Take action to isolate environmental receptors including drains, storm sewers and natural water bodies. Keep on impervious surface if at all possible. Use water sparingly to prevent product from spreading. Foam and absorbents may be used to reduce / prevent airborne release.

Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Follow federal, state or local requirements for reporting environmental release where necessary. Refer to Section 15 for further information.

Containment and Clean-Up Methods
Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of firefighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with dry earth, sand or other non-combustible, inert oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container with clean, non-sparking tools for reclamation or disposal. Response and cleanup crews must be properly trained and must utilize proper protective equipment. Refer to Section 8 for appropriate protective equipment.

7. HANDLING AND STORAGE

USE ONLY AS A FUEL.
DO NOT SIPHON BY MOUTH.

Handling Precautions
Handle as a flammable liquid. Keep away from heat, sparks, and open flame. No smoking. Electrical equipment should be approved for classified area. Bond and ground containers during product transfer pursuant to NFPA 70 and API RP 2003 to reduce the possibility of static-initiated fire or explosion. Follow precautions to prevent static initiated fire.

Use good personal hygiene practices. Use only with protective equipment specified in Section 8. Avoid repeated and/or prolonged skin exposure. Use only outdoors or in well ventilated areas. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this

product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves. Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API RP 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents."

Storage

Large quantities of diesel fuel are stored in tanks or portable containers at an ambient storage temperature. Separate from incompatible chemicals (Refer to Section 10) by distance or secondary containment. Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers that are clearly labeled. Label all secondary containers that this material is transferred into with the chemical name and associated hazard(s). Empty product containers or vessels may contain flammable vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Storage tanks should have a venting system. If stored in small containers, the area should be well ventilated, away from ignition sources and protected from potential damage or vehicular traffic. Post “No Smoking” signs in product storage areas. This storage area should comply with NFPA 30 “Flammable and Combustible Liquid Code” or applicable building code. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 “Cleaning Mobile Tanks in Flammable and Combustible Liquid Service” and API RP 2015 “Safe Entry and Cleaning of Petroleum Storage Tanks”.

Incompatibles

Keep away from strong oxidizers, ignition sources and heat.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Limits

Component	CAS #	List	Value
Diesel Fuel	68476-34-6	ACGIH TLV-TWA	100 mg/m3*
Naphthalene	91-20-3	ACGIH TLV-TWA OSHA PEL ACGIH STEL	10 ppm 10 ppm 15 ppm

*Critical effects; Skin; A3; CNS impairment.

Engineering Controls

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Intrinsically safe equipment and non-sparking tools shall be used in circumstances where concentrations may exceed lower flammable limits. Grounding and bonding shall be used to prevent accumulation and discharge of static electricity. Emergency shower and eyewash should be provided in proximity to handling areas in the event of exposure to decontaminate.

Personal Protective Equipment

Exposure	Equipment
Eye / Face	Wear appropriate chemical protective glasses or goggles or face shields to prevent skin and eye contact especially caused from splashing.
Skin	Wear appropriate personal protective clothing to prevent skin contact. Gloves constructed of nitrile, neoprene or PVC are recommended when handling this material. Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure.

Exposure	Equipment
Respiratory	A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, ANSI Z88.2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations. Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.
Thermal	Product is stored at ambient temperature. No thermal protection is required except for emergency operations involving actual or potential for fire. Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

9. PHYSICAL AND CHEMICAL PROPERTIES

Property	Value	
Appearance	Clear or straw-colored liquid. May be dyed red for distribution.	
Odor	Mild characteristic petroleum distillate odor.	
Odor Threshold	<1 ppm	
pH	Not available	
Melting Point	-22 to -0.4 ˚F (-30 to -18 ˚C)	
Boiling Point Range	320 to 690 ˚F (160 to 366 ˚C)	
Flash Point	> 125.6 ˚F (52 ˚C) PMCC	
Evaporation Rate	Slow, varies with conditions	
Flammability	Flammable liquid (OSHA defined)	
Flammable Limits	0.6 % - 6.5%	
Vapor Pressure	0.009 psia @ 70 ˚F	
Vapor Density	> 1	(air=1)
Specific Gravity	0.83-0.86 @ 60 ˚F (16 ˚C)	(water=1)
Solubility	Insoluble in water; miscible with other petroleum solvents.	
Partition Coefficient (N-octanol/water)	Log Kow range of 3.3 to >.6.0	
Autoignition Temperature	494 ˚F (257 ˚C)	
Decomposition Temperature	When heated it emits acrid smoke and irritating vapors.	
Viscosity	<3 cSt	
Percent Volatiles	100	

10. STABILITY AND REACTIVITY

Stability
This is a stable material that is flammable liquid (OSHA/GHS hazard category 3). Stable during transport.

Reactivity
Material is not self-reacting. Flammable concentrations may be present in air. Compound can react with oxidizing materials.

Possibility of Hazardous Reactions
Hazardous polymerization will not occur.

Incompatibility
Keep away from strong oxidizers such as nitric and sulfuric acids.

Conditions to Avoid
Avoid high temperatures, open flames, sparks, static electricity, welding, smoking and other ignition sources.

Hazardous Decomposition Products
Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

11. TOXICOLOGICAL INFORMATION

Acute Toxicity:
Acute Toxicity (Inhalation LC50)
Diesel Fuel (68476-34-6)
LC50 Inhalation Rat >6 mg/l/4h

Acute Toxicity (Dermal LD50)
Diesel Fuel (68476-34-6)
LD50 Dermal Rabbit >5000 mg/kg

Acute Toxicity (Oral LD50)
Diesel Fuel (68476-34-6)
LD50 Oral Rabbit >5000 mg/kg

Skin Corrosion/Irritation: Prolonged and repeated contact may cause skin irritation leading to dermatitis. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

Serious Eye Damage/Irritation: Causes serious eye irritation.

Respiratory or Skin Sensitization: Not classified

Germ Cell Mutagenicity: Not classified

Teratogenicity: Not available

Carcinogenicity: OSHA: NO, IARC: Group 3, NTP: NO, ACGIH: NOIC:A3, NIOSH: NO

IARC: Group 3 – Not classifiable as to their carcinogenicity to humans ACGIH: A3 – Confirmed animal carcinogen with unknown relevance to humans

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

IARC classifies whole diesel fuel exhaust particulates (byproduct of combustion of this material) carcinogenic to humans (Group 1) and NIOSH regards diesel fuel exhaust particulate as a potential occupational carcinogen.

Reproductive Toxicity: Not classified

Specific Target Organ Toxicity (Repeated Exposure): Not classified

Specific Target Organ Toxicity (Single Exposure): Inhalation exposure may cause drowsiness or dizziness by inhalation exposure.

Aspiration Hazard: The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Potential Health Effects: Vapor irritating to skin, eyes, nose, and throat. Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

WARNING: The burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of

combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

12. ECOLOGICAL INFORMATION

Toxicity:
This material is expected to be toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment.

Data for Component: Diesel Fuel (68476-34-6)

Material is toxic to aquatic organisms based on an acute basis (LC50/EC50 >1 but ≤ 10 mg/L in the most sensitive species tested).

Material is a long-term aquatic hazard based on a chronic basis (LC50/EC50 >1 but ≤ 10 mg/L in the most sensitive species tested).

Persistence and Degradation: This material is not expected to be readily biodegradable.

Bioaccumulative Potential: Not available

Mobility in Soil: Not available

Other Adverse Effects: None known

Other Information: Avoid release to the environment.

13. DISPOSAL CONSIDERATIONS

Consult federal, state and local waste regulations to determine appropriate disposal options. May be considered a hazardous waste if disposed. Direct solid waste (landfill) or incineration at a solid waste facility is not permissible. Do not discharge to sanitary or storm sewer. Personnel handling waste containers should follow precautions provided in this document.

Shipping containers must be DOT authorized packages. Follow licensure and regulations for transport of hazardous material and hazardous waste as applicable.

14. TRANSPORT INFORMATION

US DOT

UN Identification Number	NA 1993
Proper Shipping Name	Diesel fuel
Hazard Class and Packing Group	3, PGIII
Shipping Label	Flammable liquid
Placard / Bulk Package	Flammable liquid, 1993
Emergency Response Guidebook Guide Number	128

This product may be re-classified as a “Combustible Liquid” meeting the definition in 49 CFR 173.120 unless transported by vessel or aircraft.
Specific placard requirements must be met for shipments of this product as a Combustible Liquid by rail (See 49 CFR 172.332).
Non-bulk packages (<= 119 gal) of Combustible Liquids in package sizes less than the product reportable quantity are not regulated as hazardous materials if the material does not meet any other hazard class.

IATA Information

UN Identification Number	UN 1202
Proper Shipping Name	Diesel fuel
Hazard Class and Packing Group	3, PGIII
ICAO Label	3
Packing Instructions Cargo	310
Max Quantity Per Package Cargo	220L
Packing Instructions Passenger	309Y
Max Quantity per Package Passenger	60L

ICAO

UN Identification Number	UN 1202
Shipping Name / Description	Diesel fuel
Hazard Class and Packing Group	3, PG III
IMDG Label	3

IMDG

UN Identification Number	UN 1202
Shipping Name / Description	Diesel fuel
Hazard Class and Packing Group	3, PGIII
IMDG Label	3
EmS Number	F-E-S-E
Marine Pollutant	Yes

15. REGULATORY INFORMATION

U.S. Federal, State, and Local Regulatory Information
Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

OSHA Hazard Communication Standard
This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning And Community Right-to-Know Act of 1986) Sections 311 and 312

Immediate (Acute) Health Hazard	Yes
Delayed (Chronic) Health Hazard	Yes
Fire Hazard	Yes
Reactive Hazard	No
Sudden Release of Pressure Hazard	No

Clean Water Act (Oil Spills)
Any spill or release of this product to “navigable waters” (Essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA Section 103 and SARA Section 304 (Release to the Environment)
The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts this material. This product does not contain any chemicals subject to the reporting requirements of CERCLA Section 103 or SARA 304.

SARA Section 313- Supplier Notification
This product does not contain any chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372.

EPA Notification (Oil Spills)
If the there is a discharge of more than 1,000-gallons of oil into or upon navigable waters of the United States, or if it is the second spill event of 42 gallons or more of oil into water within a twelve (12) month period, a written report must be submitted to the Regional Administrator of the EPA within sixty days of the event.

Pennsylvania Right to Know Hazardous Substance list:
The following product components are cited in the Pennsylvania Special Hazardous Substance List, and are present at levels which require reporting.

Component	CAS	Amount
Diesel Fuel	68476-34-6	100%

New Jersey Right to Know Hazardous Substance list:
The following product components are cited in the New Jersey Right to Know Hazardous Substance List, and are present at levels which require reporting.

Component	CAS	Amount
Diesel Fuel	68476-34-6	100%

California Proposition 65 WARNING: This product contains chemicals known to the State of California to cause Cancer or Reproductive Toxicity.

Component	CAS	Amount
Naphthalene	91-20-3	<0.1%

U.S. 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 (DSL)
All substances contained in this product are listed on the Canadian Domestic Substances List (DSL) or are not required to be listed.

Canadian Regulatory Information (WHMIS)
Class B3 – Combustible Liquid
Class D2A – Materials causing other toxic effects. (Very Toxic)

16. OTHER INFORMATION

Version	5
Issue Date	June 26, 2019
Prior Issue Date	May 20, 2016

Description of Revisions
Update viscosity information in Section 9. Update transportation information in Section 14 to clarify US DOT re-classification option as a Combustible Liquid.

Abbreviations

˚F	Degrees Fahrenheit (temperature)
<	Less than
=	Equal to
>	Greater than
AP	Approximately
C	Centigrade (temperature)
kg	Kilogram
L	Liter
mg	Milligrams
mL	Milliliter
mm^2	Square millimeters
mmHg	Millimeters of mercury (pressure)
N/A	Not applicable
N/D	Not determined
ppm	Parts per million
sec	Second
ug	Micrograms

Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
AL	Action Level
ANSI	American National Standards Institute
API	American Petroleum Institute
CAS	Chemical Abstract Service
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation
EC50	Ecological concentration 50%
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guideline
GHS	Global Harmonized System

HMIS	Hazardous Materials Information System
IARC	International Agency for Research On Cancer
IATA	International Air Transport Association
IMDG	International Maritime Dangerous Goods
Koc	Soil Organic Carbon
LC50	Lethal concentration 50%
LD50	Lethal dose 50%
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act Reauthorization Act of 1986 Title III
REL	Recommended Exposure Limit (NIOSH)
RVP	Reid Vapor Pressure
SARA	Superfund Amendments and
SCBA	Self Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
UN	United Nations
UNECE	United Nations Economic Commission for Europe
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Canadian Workplace Hazardous Materials Information System

Disclaimer of Expressed and Implied Warranties

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

** End of Safety Data Sheet **

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Effective date: 11/20/2014 **Revision:** 05/12/2015

ALCONOX

1 Identification of the Substance/mixture and of the Company/Undertaking

1.1 Product identifier
Trade name: ALCONOX
Application of the substance / the preparation: Cleaning material/ Detergent

1.2 Relevant identified uses of the substance or mixture and uses advised against:
No additional information available.

1.3 Details of the supplier of the Safety Data Sheet
Manufacturer/Supplier:
Alconox, Inc.
30 Glenn St., Suite 309
White Plains, NY 10603
Phone: 914-948-4040

Further information obtainable from: Product Safety Department

1.4 Emergencytelephone number:
ChemTel Inc.: (800)255-3924, +1 (813)248-0585

2 Hazards Identification

2.1 Classification of the substance or mixture Classification according to Regulation (EC) No 1272/2008:

Eye Irrit. 2B; H320: Causes eye irritation.

Information concerning particular hazards for human and environment:
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.
Classificationsystem:
The classification is according to the latest editions of the EU-lists, and extended by company and literature data

2.2 Label elements
Labelling according to Regulation (EC) No 1272/2008:
The product is classified and labelled according to the CLP regulation.

Hazardpictograms:

Signal word: Warning

Hazard-determining components of labelling:
Sodium Alkylbenzene Sulfonate
Hazardstatements:
H320: Causes eye irritation.

Precautionary statements:
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P264: Wash thoroughly after handling.
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.

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Other Hazard description:
WHMIS-classification and symbols:
D2B - Toxic material causing other toxic effects

NFPA ratings (scale 0 - 4)

Health = 1
Fire = 0
Reactivity = 0

HMIS-ratings (scale 0 - 4)

HEALTH	1	
FIRE	0	
REACTIVITY	0	

Health = 1
Fire = 0
Reactivity = 0

2.3 Other hazards
Results of PBT and vPvB assessment
PBT: Not applicable.
vPvB: Not applicable.

3 Composition/Information on Ingredients

3.2 Chemical characterization: Mixture
Description: Hazardous ingredients of mixture listed below.

Identifying Nos.	Description	Wt. %
CAS: 68081-81-2	Sodium Alkylbenzene Sulfonate	10 - 25%
CAS: 497-19-8	Sodium Carbonate	5-15%
CAS: 7722-88-5	Tetrasodium pyrophosphate	5-15%
CAS: N/A	Proprietary (non-classified)	40-60%

Additional information: For the wording of the listed risk phrases refer to section 16.

4 First Aid Measures

4.1 Description of first aid measures
General information:
Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and SDS to health professional with contaminated individual.
After inhalation:
Supply fresh air; consult doctor in case of complaints.
After skin contact:
Immediately wash with water and soap and rinse thoroughly. If skin irritation continues, consult a doctor.

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

After eye contact:
Remove contact lenses if worn. Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.

After swallowing:
Rinse out mouth and then drink plenty of water. Do not induce vomiting; call for medical help immediately.

4.2 Most important symptoms and effects, both acute and delayed:
No additional information available.

4.3 Indication of any immediate medical attention and special treatment needed:
No additional information available.

5 Firefighting Measures

5.1 Extinguishing media:
Suitable extinguishing agents:
CO2, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

5.2 Special hazards arising from the substance or mixture:
No additional information available.

5.3 Advice for firefighters:
Protective equipment:
Wear self-contained respiratory protective device.
Wear fully protective suit.

6 Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures:
Product forms slippery surface when combined with water.

6.2 Environmental precautions:
Do not allow product to reach sewage system or any water course.

6.3 Methods and material for containment and cleaning up:
Pick up mechanically.
Clean the affected area carefully; suitable cleaners are: Warm water

6.4 Reference to other sections:
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information

7 Handling and Storage

7.1 Precautions for safe handling:
Ensure good ventilation/exhaustion at the workplace.
Keep receptacles tightly sealed.
Prevent formation of dust.
Information about fire - and explosion protection: No special measures required.

7.2 Conditions for safe storage, including any incompatibilities:
Storage:
Requirements to be met by storerooms and receptacles: No special requirements.
Information about storage in one common storage facility: None required.
Further information about storage conditions: Protect from humidity and water.

7.3 Specific end use(s): No additional information available.

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according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

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ALCONOX

8 Exposure Controls/Personal Protection

8.1 Control parameters

Ingredients with limit values that require monitoring at the workplace: Not required.

Additional information: The lists valid during the making were used as basis.

8.2 Exposure controls:

Personal protective equipment:

General protective and hygienic measures:

Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the skin.
Avoid contact with the eyes and skin.

Respiratory protection:

Not required under normal conditions of use.
In case of brief exposure or low pollution use respiratory filter device.
In case of intensive or longer exposure use self-contained respiratory protective device.

Protection of hands:

Protective gloves

The glove material has to be impermeable and resistant to the product. Selection of the glove material should be based on the penetration time, rates of diffusion and the degradation of the glove material.

Material of gloves:

The selection of a suitable gloves does not only depend on the material, but also on the quality, and varies from manufacturer to manufacturer.

Penetration time of glove material:

The exact break through time has to be determined by the manufacturer of the protective gloves. DO NOT exceed the breakthrough time set by the Manufacturer.

For long term contact, gloves made of the following materials are considered suitable:

Butyl rubber, BR
Nitrile rubber, NBR
Natural rubber (NR)
Neoprene gloves

Eye protection:

Safety glasses

Body protection: Protective work clothing

9 Physical and Chemical Properties

9.1 Information on basic physical and chemical properties:

General Information:

Appearance:

Form:	Powder
Color:	White
Odor:	Odorless
Odor threshold:	Not determined.
pH-value (10 g/l) at 20 °C:	9.5 (NA for Powder form)

Change in condition:

Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	Not determined.

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Flash point:	Not applicable.
Flammability (solid, gaseous):	Not determined.
Ignition temperature:	Not determined.
Decomposition temperature:	Not determined.
Self-igniting:	Product is not selfigniting.
Danger of explosion:	Product does not present an explosion hazard.
Explosion limits:	
Lower:	Not determined.
Upper:	Not determined.
Vapor pressure:	Not applicable.
Density at 20°C:	1,1 g/cm³
Relative density:	Not determined.
Vapor density:	Not applicable.
Evaporation rate:	Not applicable.
Solubility in / Miscibility with water:	Soluble.
Segregation coefficient (n-octanol/water):	Not determined.
Viscosity:	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
Solvent content:	
Organic solvents:	0.0 %
Solids content:	100 %
9.2 Other information:	No additional information available.

10 Stability and Reactivity

10.1 Reactivity:

10.2 Chemical stability:

Thermal decomposition / conditions to be avoided:

No decomposition if used according to specifications.

10.3 Possibility of hazardous reactions:

Reacts with acids.
Reacts with strong alkali.
Reacts with strong oxidizing agents.

10.4 Conditions to avoid:

No additional information available.

10.5 Incompatible materials:

No additional information available.

10.6 Hazardous decomposition products:

Carbon monoxide and carbon dioxide
Phosphorus compounds
Sulphur oxides (SOx)

11 Toxicological Information

11.1 Information on toxicological effects:

Toxicity data: No additional information available.

Primary irritant effect:

On the skin: Irritating to skin and mucous membranes.

On the eye: Strong irritant with the danger of severe eye injury.

Sensitization: No sensitizing effects known.

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according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

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ALCONOX

Additional toxicological information:
The product shows the following dangers according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version: Irritant.
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation ofesophagus and stomach.

12 Ecological Information

12.1 Toxicity:
Aquatic toxicity: No additional information available.
12.2 Persistence and degradability: No additional information available.
12.3 Bioaccumulative potential: Not worth-mentioning accumulating in organisms.
12.4 Mobility in soil: No additional information available.
Ecotoxical effects:
Remark: Harmful to fish
Additional ecological information:
General notes:
Water hazard class 2 (German Regulation) (Self-assessment): hazardous for water.
Do not allow product to reach ground water, water course or sewage system.
Danger to drinking water if even small quantities leak into the ground.
12.5 Results of PBT and vPvB assessment:
PBT: Not applicable.
vPvB: Not applicable.
12.6 Other adverse effects: No additional information available.

13 Disposal Considerations

13.1 Waste treatment methods:
Recommendation:
Smaller quantities can be disposed of with household waste.
Small amounts may be diluted with plenty of water and washed away. Dispose of bigger amounts in accordance with Local Authority requirements.
The surfactant used in this product complies with the biodegradability criteria as laid down in Regulation (EC) No. 648/2004 on detergents. Data to support this assertion are held at the disposal of the competent authorities of the Member States and will be made available to them, at their direct request or at the request of a detergent manufacturer.
Uncleaned packaging:
Recommendation: Disposal must be made according to official regulations.
Recommended cleansing agents: Water, together with cleansing agents, if necessary.

14 Transport Information

14.1 UN-Number:
DOT, ADR, ADN, IMDG, IATA: Not Regulated

14.2 UN proper shipping name:
DOT, ADR, IMDG, IATA: Not Regulated

14.3 Transport hazard class(es):
DOT, ADR, IMDG, IATA:
Class: Not Regulated
Label: -

14.4 Packing group:
DOT, ADR, IMDG, IATA: Not Regulated

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14.5 Environmental hazards:
Marine pollutant: No

14.6 Special precautions for user: Not applicable.

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.

UN "Model Regulation": Not Regulated

15 Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:
United States (USA):
SARA:
Section 355 (extremely hazardous substances): None of the ingredient is listed.
Section 313 (Specific toxic chemical listings): None of the ingredient is listed.
TSCA (Toxic Substances Control Act): All ingredients are listed.

Proposition 65 (California):
Chemicals known to cause cancer: None of the ingredient is listed.
Chemicals known to cause reproductive toxicity for females: None of the ingredient is listed.
Chemicals known to cause reproductive toxicity for males: None of the ingredient is listed.
Chemicals known to cause developmental toxicity: None of the ingredient is listed.

Carcinogenic Categories:
EPA (Environmental Protection Agency): None of the ingredient is listed.
TLV (Threshold Limit Value established by ACGIH): None of the ingredient is listed.
NIOSH-Ca (National Institute for Occupational Safety and Health): None of the ingredient is listed.
OSHA-Ca (Occupational Safety & Health Administration): None of the ingredient is listed.

Canadá:
Canadian Domestic Substances List (DSL): All ingredients are listed.
Canadian Ingredient Disclosure list (limit 0.1%): None of the ingredient is listed.
Canadian Ingredient Disclosure list (limit 1%):

497-19-8	Sodium Carbonate
7722-88-5	Tetrasodium pyrophosphate
151-21-3	Sodium dodecylsulphate

15.2 Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

16 Other Information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

Relevant phrases:

H320: Causes eye irritation.

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Effective date: 11/20/2014 **Revision:** 05/12/2015

ALCONOX

Abbreviations and Acronyms:

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road.
IMDG: International Maritime Code for Dangerous Goods.
DOT: US Department of Transportation.
IATA: International Air Transport Association.
GHS: Globally Harmonized System of Classification and Labelling of Chemicals.
ACGIH: American Conference of Governmental Industrial Hygienists.
NFPA: National Fire Protection Association (USA).
HMIS: Hazardous Materials Identification System (USA).
WHMIS: Workplace Hazardous Materials Information System (Canada).
VOC: Volatile Organic Compounds (USA, EU).
LC50: Lethal concentration, 50 percent.
LD50: Lethal dose, 50 percent.

SDS Created by:

Global Safety Management, Inc.
10006 Cross Creek Blvd
Tampa, FL, 33647
Tel: 1-844-GSM-INFO (1-844-476-4636)
Website: www.GSMSDS.com

Safety Data Sheet

Nitric Acid, 15.6 M, Concentrated

CAROLINA®
www.carolina.com

Section 1 Product Description

Product Name:	Nitric Acid, 15.6 M, Concentrated
Recommended Use:	Science education applications
Synonyms:	Inorganic Acid
Distributor:	Carolina Biological Supply Company 2700 York Road, Burlington, NC 27215 1-800-227-1150
Chemical Information:	800-227-1150 (8am-5pm (ET) M-F)
Chemtrec:	800-424-9300 (Transportation Spill Response 24 hours)

Section 2 Hazard Identification

Classification of the chemical in accordance with paragraph (d) of §1910.1200;

DANGER

May intensify fire; oxidizer. Causes severe skin burns and eye damage. Causes serious eye damage. Fatal if inhaled. Harmful to aquatic life.

GHS Classification:
Acute Toxicity - Inhalation Vapor Category 1, Skin Corrosion/Irritation Category 1A, Serious Eye Damage/Eye Irritation Category 1, Acute Toxicity - Inhalation Dust / Mist Category 2, Oxidizing Liquid Category 3, Hazardous to the aquatic environment - Acute Category 3

Section 3 Composition / Information on Ingredients

Chemical Name	CAS #	%
Nitric Acid	7697-37-2	70
Water	7732-18-5	30

Section 4 First Aid Measures

Emergency and First Aid Procedures

Inhalation:	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
Eyes:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Skin Contact:	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse.
Ingestion:	If swallowed, rinse mouth with water (only if the person is conscious). Do NOT induce vomiting. IF NECESSARY SEEK MEDICAL ATTENTION

Section 5 Firefighting Procedures

Extinguishing Media:	Use media suitable to extinguish surrounding fire.
Fire Fighting Methods and Protection:	Firefighters should wear full protective equipment and NIOSH approved self-contained breathing apparatus.
Fire and/or Explosion Hazards:	Can react explosively with certain reducing agents and combustibles such as metal powders, carbides, H2S, turpentine.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide, Nitrogen containing gases, Not Flammable, but reacts with most metals to form flammable hydrogen gas.

Section 6 Spill or Leak Procedures

Steps to Take in Case Material Is Released or Spilled: Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section 8 of this SDS. Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill. Ventilate the contaminated area.
Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation. Do not allow the spilled product to enter public drainage system or open waterways. Large spills may be neutralized with dilute alkaline solutions of soda ash, or lime

Section 7 Handling and Storage

Handling: Keep away from heat/sparks/open flames/hot surfaces. – No smoking. Keep/Store away from clothing/…/combustible materials. Take any precaution to avoid mixing with combustibles. Do not breathe dust/fume/gas/mist/vapors/spray. Wash thoroughly after handling. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Wear protective gloves/protective clothing/eye protection/face protection. Wear respiratory protection. Do not breathe dust. Avoid contact with skin and eyes.

Storage: Store in a well-ventilated place. Keep container tightly closed. Store locked up. Keep container tightly closed in a cool place.

Storage Code: White - Corrosive. Separate acids from bases; separate oxidizer acids from organic acids.

Section 8 Protection Information

	ACGIH		OSHA PEL	
Chemical Name	**(TWA)**	**(STEL)**	**(TWA)**	**(STEL)**
Nitric Acid	2 ppm TWA	4 ppm STEL	2 ppm TWA; 5 mg/m3 TWA	4 ppm TWA; 10 mg/m3 TWA

Control Parameters

Engineering Measures: No exposure limits exist for the constituents of this product. General room ventilation might be required to maintain operator comfort under normal conditions of use.

Personal Protective Equipment (PPE): Lab coat, apron, eye wash, safety shower.

Respiratory Protection: Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms.

Respirator Type(s): NIOSH approved air purifying respirator with acid gas cartridge.

Eye Protection: Wear chemical splash goggles when handling this product. Have an eye wash station available.

Skin Protection: Avoid skin contact by wearing chemically resistant gloves, an apron and other protective equipment depending upon conditions of use. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work.

Gloves: Neoprene, Natural rubber

Section 9 Physical Data

Formula: Concentrated HNO3
Molecular Weight: 63.01 g/mol
Appearance: Colorless to pale yellow Liquid
Odor: Strong Acrid
Odor Threshold: 0.29 - 0.98 ppm; 0.75 - 2.5 mg/m³
pH: 1
Melting Point: -42 - -38 C
Boiling Point: 83 C
Flash Point: No data available
Flammable Limits in Air: N/A

Vapor Pressure: 7.1 mmHg at 20 °C
Evaporation Rate (BuAc=1): N/A
Vapor Density (Air=1): 2.17
Specific Gravity: 1.51
Solubility in Water: Soluble
Log Pow (calculated): -2.3 at 25 °C
Autoignition Temperature: No data available
Decomposition Temperature: No data available
Viscosity: No data available
Percent Volatile by Volume: N/A

Safety Data Sheet

Section 10 Reactivity Data

Reactivity: No data available
Chemical Stability: Stable under normal conditions.
Conditions to Avoid: None known.
Incompatible Materials: Water-reactive materials, Organics,, Metals, Strong reducing agents, Alcohols, Aldehydes, Ammonia
Hazardous Decomposition Products: Not Flammable, but reacts with most metals to form flammable hydrogen gas., Nitrogen containing gases, Carbon dioxide, Carbon monoxide
Hazardous Polymerization: Will not occur

Section 11 Toxicity Data

Routes of Entry Inhalation, Ingestion, and Skin contact.
Symptoms (Acute): Respiratory disorders
Delayed Effects: No data available

Acute Toxicity:

Chemical Name	CAS Number	Oral LD50	Dermal LD50	Inhalation LC50
Nitric Acid	7697-37-2			INHALATION LC50 Rat 67 PPM(NO2)
Water	7732-18-5	Oral LD50 Rat 90000 mg/kg		

Carcinogenicity:

Chemical Name	CAS Number	IARC	NTP	OSHA
Nitric Acid	7697-37-2	Listed	Not listed	Not listed

Chronic Effects:
Mutagenicity: No evidence of a mutagenic effect.
Teratogenicity: No evidence of a teratogenic effect (birth defect).
Sensitization: No evidence of a sensitization effect.
Reproductive: No evidence of negative reproductive effects.
Target Organ Effects:
Acute: See Section 2
Chronic: Not listed as a carcinogen by IARC, NTP or OSHA.

Section 12 Ecological Data

Overview: Slight ecological hazard. In high concentrations, this product may be dangerous to plants and/or wildlife. Because of the low pH of this product, it would be expected to produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems.
Mobility: No data
Persistence: No data
Bioaccumulation: No data
Degradability: No data
Other Adverse Effects: No data

Chemical Name	CAS Number	Eco Toxicity
Nitric Acid	7697-37-2	96 HR LC50 GAMBUSIA AFFINIS 72 MG/L
Water	7732-18-5	No data available

Section 13 Disposal Information

Disposal Methods: Dispose in accordance with all applicable Federal, State and Local regulations. Always contact a permitted waste disposer (TSD) to assure compliance.
Waste Disposal Code(s): D002

Section 14 Transport Information

Ground - DOT Proper Shipping Name:
UN2031
Nitric Acid
Class 8(5.1)
Packing Group II

Air - IATA Proper Shipping Name:
UN2031, Nitric Acid, 8, pg II

Section 15 Regulatory Information

TSCA Status: All components in this product are on the TSCA Inventory.

Chemical Name	CAS Number	§ 313 Name	§ 304 RQ	CERCLA RQ	§ 302 TPQ	CAA 112(2) TQ
Nitric Acid	7697-37-2	Nitric acid	1000 lb RQ	1000 lb final RQ; 454 kg final RQ	1000 lb TPQ	No

Section 16 Additional Information

Revised: 09/03/2014 **Replaces: 09/03/2014** **Printed: 09-11-2014**

The information provided in this (Material) Safety Data Sheet represents a compilation of data drawn directly from various sources available to us. Carolina Biological Supply makes no representation or guarantee as to the suitability of this information to a particular application of the substance covered in the (Material) Safety Data Sheet.

Glossary

ACGIH	American Conference of Governmental Industrial Hygienists
CAS	Chemical Abstract Service Number
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation
IARC	International Agency for Research on Cancer
N/A	Not Available
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
ppm	Parts per million
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
TLV	Threshold Limit Value
TSCA	Toxic Substances Control Act
IDLH	Immediately dangerous to life and health

Safety Data Sheet

RUST-OLEUM CORPORATION
* Trusted Quality Since 1921 *
www.rustoleum.com

1. Identification

Product Name: PRO LSPR 6PK MARK WHITE

Product Identifier: 2592838

Product Use/Class: Marking Paint/Aerosols

Supplier: Rust-Oleum Corporation
11 Hawthorn Parkway
Vernon Hills, IL 60061
USA

Manufacturer: Rust-Oleum Corporation
11 Hawthorn Parkway
Vernon Hills, IL 60061
USA

Preparer: Regulatory Department

Emergency Telephone: 24 Hour Hotline: 847-367-7700

Revision Date: 8/17/2015

Supercedes Date: 5/27/2015

2. Hazard Identification

Classification

Symbol(s) of Product

Signal Word
Danger

Possible Hazards
69% of the mixture consists of ingredient(s) of unknown acute toxicity.

GHS HAZARD STATEMENTS

Flammable Aerosol, category 1	H222	Extremely flammable aerosol.
Skin Irritation, category 2	H315	Causes skin irritation.
Acute Toxicity, Inhalation, category 4	H332	Harmful if inhaled.
Germ Cell Mutagenicity, category 1B	H340	May cause genetic defects. Classified as mutagenic Category 1 if one ingredient is present at or above 0.1%. Applies to liquids, solids (w/w units) and gases (v/v). The substance may also have its own exposure limit. Routes of exposure are dependent on ingredient form.
Carcinogenicity, category 1B	H350	May cause cancer. Classified as carcinogenic Category 1 on the basis of epidemiological and/or animal data. Mixtures are classified as carcinogenic when at least 1 ingredient has been classified as carcinogenic and is present at 0.1% or above Routes of exposure are dependent on ingredient form.

GHS LABEL PRECAUTIONARY STATEMENTS

P201	Obtain special instructions before use.
P211	Do not spray on an open flame or other ignition source.
P251	Do not pierce or burn, even after use.
P261	Avoid breathing dust, fumes, gases, mists, vapors, or spray.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P281	Use personal protective equipment as required.
P302+P352	IF ON SKIN: Wash with plenty of soap and water.

P308+P313	IF exposed or concerned: Get medical advice/attention.
P312	Call a POISON CENTER or doctor/physician if you feel unwell.
P362	Take off contaminated clothing.
P410+P412	Protect from sunlight. Do not expose to temperatures exceeding 50°C / 122°F.

3. Composition/Information On Ingredients

HAZARDOUS SUBSTANCES

Chemical Name	CAS-No.	Wt.% Range	GHS Symbols	GHS Statements
Propane	74-98-6	10-25	No Information	No Information
Limestone	1317-65-3	10-25	No Information	No Information
Titanium Dioxide	13463-67-7	2.5-10	No Information	No Information
Toluene	108-88-3	2.5-10	GHS02-GHS07-GHS08	H225-302-304-315-332-336-373
n-Butane	106-97-8	2.5-10	No Information	No Information
Xylene (mixed isomers)	1330-20-7	2.5-10	GHS02-GHS07	H226-312-315-332
Naphtha, Hydrotreated Heavy	64742-48-9	2.5-10	GHS08	H304
Aliphatic Hydrocarbon	64742-89-8	2.5-10	GHS08	H304-340-350
Ethylbenzene	100-41-4	1.0-2.5	GHS02-GHS07	H225-332
Amorphous Silica	7631-86-9	0.1-1.0	GHS06	H331

4. First-aid Measures

FIRST AID - EYE CONTACT: Immediately flush eyes with plenty of water for at least 15 minutes holding eyelids open. Get medical attention. Do NOT allow rubbing of eyes or keeping eyes closed.

FIRST AID - SKIN CONTACT: Wash skin with soap and water. Remove contaminated clothing. Get medical attention if irritation develops or persists.

FIRST AID - INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention. Do NOT use mouth-to-mouth resuscitation. If you experience difficulty in breathing, leave the area to obtain fresh air. If continued difficulty is experienced, get medical assistance immediately.

FIRST AID - INGESTION: Aspiration hazard: Do not induce vomiting or give anything by mouth because this material can enter the lungs and cause severe lung damage. Get immediate medical attention. If swallowed, get medical attention.

5. Fire-fighting Measures

EXTINGUISHING MEDIA: Alcohol Film Forming Foam, Carbon Dioxide, Dry Chemical, Dry Sand, Water Fog

UNUSUAL FIRE AND EXPLOSION HAZARDS: FLASH POINT IS LESS THAN 20°F. EXTREMELY FLAMMABLE LIQUID AND VAPOR!Water spray may be ineffective. Closed containers may explode when exposed to extreme heat due to buildup of steam. Closed containers may explode when exposed to extreme heat. Vapors may form explosive mixtures with air. Vapors can travel to a source of ignition and flash back. Keep containers tightly closed. Isolate from heat, electrical equipment, sparks and open flame. Perforation of the pressurized container may cause bursting of the can. No unusual fire or explosion hazards noted.

SPECIAL FIREFIGHTING PROCEDURES: Water may be used to cool closed containers to prevent pressure buildup and possible autoignition or explosion. Full protective equipment including self-contained breathing apparatus should be used. Evacuate area and fight fire from a safe distance. Use water spray to keep fire-exposed containers cool. Containers may explode when heated.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: Contain spilled liquid with sand or earth. DO NOT use combustible materials such as sawdust. Isolate the hazard area and deny entry to unnecessary and unprotected personnel. Remove all sources of ignition, ventilate area and remove with inert absorbent and non-sparking tools. Dispose of according to local, state (provincial) and federal regulations. Do not incinerate closed containers. Ventilate area, isolate spilled material, and remove with inert absorbent. Dispose of contaminated absorbent, container, and unused contents in accordance with local, state, and federal regulations.

7. Handling and Storage

HANDLING: Wash thoroughly after handling. Wash hands before eating. Remove contaminated clothing and launder before reuse. Use only with adequate ventilation. Follow all MSDS/label precautions even after container is emptied because it may retain product residues. Avoid breathing fumes, vapors, or mist. Avoid contact with eyes, skin and clothing.

STORAGE: Store in a dry, well ventilated place. Keep container tightly closed when not in use. Keep containers tightly closed. Isolate from heat, electrical equipment, sparks and open flame. Contents under pressure. Do not store above 120 ° F. Store large quantities in buildings designed and protected for storage of NFPA Class I flammable liquids. Keep away from heat, sparks, flame and sources of ignition. Avoid excess heat. Product should be stored in tightly sealed containers and protected from heat, moisture, and foreign materials.

8. Exposure Controls/Personal Protection

Chemical Name	CAS-No.	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA PEL-CEILING
Propane	74-98-6	20.0	1000 ppm	N.E.	1000 ppm	N.E.
Limestone	1317-65-3	15.0	N.E.	N.E.	15 mg/m3	N.E.
Titanium Dioxide	13463-67-7	10.0	10 mg/m3	N.E.	15 mg/m3	N.E.
Toluene	108-88-3	10.0	20 ppm	N.E.	200 ppm	300 ppm
n-Butane	106-97-8	10.0	N.E.	1000 ppm	N.E.	N.E.
Xylene (mixed isomers)	1330-20-7	10.0	100 ppm	150 ppm	100 ppm	N.E.
Naphtha, Hydrotreated Heavy	64742-48-9	10.0	N.E.	N.E.	N.E.	N.E.
Aliphatic Hydrocarbon	64742-89-8	5.0	N.E.	N.E.	N.E.	N.E.
Ethylbenzene	100-41-4	5.0	20 ppm	N.E.	100 ppm	N.E.
Amorphous Silica	7631-86-9	1.0	N.E.	N.E.	N.E.	N.E.

PERSONAL PROTECTION

ENGINEERING CONTROLS: Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Use explosion-proof ventilation equipment. Provide general dilution of local exhaust ventilation in volume and pattern to keep TLV of hazardous ingredients below acceptable limits. Prevent build-up of vapors by opening all doors and windows to achieve cross-ventilation.

RESPIRATORY PROTECTION: A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use. A NIOSH/MSHA approved air purifying respirator with organic vapor cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits.

SKIN PROTECTION: Use gloves to prevent prolonged skin contact. Nitrile or Neoprene gloves may afford adequate skin protection.

EYE PROTECTION: Use safety eyewear designed to protect against splash of liquids.

OTHER PROTECTIVE EQUIPMENT: Refer to safety supervisor or industrial hygienist for further guidance regarding types of personal protective equipment and their applications.

HYGIENIC PRACTICES: Wash thoroughly with soap and water before eating, drinking or smoking. Remove contaminated clothing immediately and launder before reuse.

9. Physical and Chemical Properties

Appearance:	Aerosolized Mist	**Physical State:**	Liquid
Odor:	Solvent Like	**Odor Threshold:**	N.E.
Relative Density:	0.899	**pH:**	N.A.
Freeze Point, °C:	N.D.	**Viscosity:**	N.D.
Solubility in Water:	Slight	**Partition Coefficient, n-octanol/ water:**	N.D.
Decompostion Temp., °C:	N.D.		
Boiling Range, °C:	-24 - 177	**Explosive Limits, vol%:**	0.9 - 9.5
Flammability:	Supports Combustion	**Flash Point, °C:**	-96
Evaporation Rate:	Faster than Ether	**Auto-ignition Temp., °C:**	N.D.
Vapor Density:	Heavier than Air	**Vapor Pressure:**	N.D.

(See "Other information" Section for abbreviation legend)

10. Stability and Reactivity

CONDITIONS TO AVOID: Avoid temperatures above 120°F (49°C). Avoid contact with strong acid and strong bases. Avoid all possible sources of ignition.

INCOMPATIBILITY: Incompatible with strong oxidizing agents, strong acids and strong alkalies.

HAZARDOUS DECOMPOSITION: By open flame, carbon monoxide and carbon dioxide. When heated to decomposition, it emits acrid smoke and irritating fumes. Contains solvents which may form carbon monoxide, carbon dioxide, and formaldehyde.

HAZARDOUS POLYMERIZATION: Will not occur under normal conditions.

STABILITY: This product is stable under normal storage conditions.

11. Toxicological information

EFFECTS OF OVEREXPOSURE - EYE CONTACT: Causes Serious Eye Irritation

EFFECTS OF OVEREXPOSURE - SKIN CONTACT: May be absorbed through the skin in harmful amounts. May cause skin irritation. Allergic reactions are possible.

EFFECTS OF OVEREXPOSURE - INHALATION: Harmful if inhaled. High gas, vapor, mist or dust concentrations may be harmful if inhaled. Avoid breathing fumes, spray, vapors, or mist. High vapor concentrations are irritating to the eyes, nose, throat and lungs. Prolonged or excessive inhalation may cause respiratory tract irritation.

EFFECTS OF OVEREXPOSURE - INGESTION: Harmful if swallowed.

EFFECTS OF OVEREXPOSURE - CHRONIC HAZARDS: May cause central nervous system disorder (e.g., narcosis involving a loss of coordination, weakness, fatigue, mental confusion, and blurred vision) and/or damage. High concentrations may lead to central nervous system effects (drowsiness, dizziness, nausea, headaches, paralysis, and blurred vision) and/or damage. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Overexposure to xylene in laboratory animals has been associated with liver abnormalities, kidney, lung, spleen, eye and blood damage as well as reproductive disorders. Effects in humans, due to chronic overexposure, have included liver, cardiac abnormalities and nervous system damage. IARC lists Ethylbenzene as a possible human carcinogen (group 2B). Contains Titanium Dioxide. Titanium Dioxide is listed as a Group 2B-"Possibly carcinogenic to humans" by IARC. No significant exposure to Titanium Dioxide is thought to occur during the use of products in which Titanium Dioxide is bound to other materials, such as in paints during brush application or drying. Risk of overexposure depends on duration and level of exposure to dust from repeated sanding of surfaces or spray mist and the actual concentration of Titanium Dioxide in the formula. (Ref: IARC Monograph, Vol. 93, 2010)

PRIMARY ROUTE(S) OF ENTRY: Eye Contact, Ingestion, Inhalation, Skin Absorption, Skin Contact

ACUTE TOXICITY VALUES

The acute effects of this product have not been tested. Data on individual components are tabulated below:

CAS-No.	Chemical Name	Oral LD50	Dermal LD50	Vapor LC50
74-98-6	Propane	N.I.	N.I.	658 mg/L Rat
13463-67-7	Titanium Dioxide	>10000 mg/kg Rat	N.I.	N.I.
108-88-3	Toluene	636 mg/kg Rat	8390 mg/kg Rabbit	12.5 mg/L Rat
106-97-8	n-Butane	N.I.	N.I.	658 mg/L Rat
1330-20-7	Xylene (mixed isomers)	4300 mg/kg Rat	N.I.	47635 mg/L Rat
64742-48-9	Naphtha, Hydrotreated Heavy	>5000 mg/kg Rat	>3160 mg/kg Rabbit	N.I.
64742-89-8	Aliphatic Hydrocarbon	N.I.	3000 mg/kg Rabbit	N.I.
100-41-4	Ethylbenzene	3500 mg/kg Rat	15354 mg/kg Rabbit	17.2 mg/L Rat
7631-86-9	Amorphous Silica	>5000 mg/kg Rat	>2000 mg/kg Rabbit	>2.2 mg/L Rat

N.I. - No Information

12. Ecological Information

ECOLOGICAL INFORMATION: Product is a mixture of listed components.

13. Disposal Information

DISPOSAL INFORMATION: Dispose of material in accordance to local, state, and federal regulations and ordinances. Do not allow to enter waterways, wastewater, soil, storm drains or sewer systems.

14. Transport Information

	Domestic (USDOT)	International (IMDG)	Air (IATA)	TDG (Canada)
UN Number:	N.A.	1950	1950	N.A.
Proper Shipping Name:	Paint Products in Limited Quantities	Aerosols	Aerosols	Paint Products in Limited Quantities
Hazard Class:	N.A.	2.1	2.1	N.A.
Packing Group:	N.A.	N.A.	N.A.	N.A.
Limited Quantity:	Yes	Yes	Yes	Yes

15. Regulatory Information

U.S. Federal Regulations:

CERCLA - SARA Hazard Category

This product has been reviewed according to the EPA 'Hazard Categories' promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

Fire Hazard, Pressure Hazard, Acute Health Hazard, Chronic Health Hazard

Sara Section 313:

This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

Chemical Name	CAS-No.
Toluene	108-88-3
Xylene (mixed isomers)	1330-20-7
Ethylbenzene	100-41-4

Toxic Substances Control Act:

This product contains the following chemical substances subject to the reporting requirements of TSCA 12(b) if exported from the United States:

No TSCA 12(b) components exist in this product.

16. Other Information

HMIS RATINGS
Health: 2* **Flammability:** 4 **Physical Hazard:** 0 **Personal Protection:** X

NFPA RATINGS
Health: 2 **Flammability:** 4 **Instability** 0

VOLATILE ORGANIC COMPOUNDS, g/L: 537

SDS REVISION DATE: 8/17/2015

REASON FOR REVISION: Product Composition Changed
Substance and/or Product Properties Changed in Section(s):
01 - Identification
02 - Hazard Identification
05 - Fire-fighting Measures
09 - Physical & Chemical Properties
15 - Regulatory Information
16 - Other Information
Statement(s) Changed

Legend: N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

Rust-Oleum Corporation believes, to the best of its knowledge, information and belief, the information contained herein to be accurate and reliable as of the date of this safety data sheet. However, because the conditions of handling, use, and storage of these materials are beyond our control, we assume no responsibility or liability for personal injury or property damage incurred by the use of these materials. Rust-Oleum Corporation makes no warranty, expressed or implied, regarding the accuracy or reliability of the data or results obtained from their use. All materials may present unknown hazards and should be used with caution. The information and recommendations in this material safety data sheet are offered for the users' consideration and examination. It is the responsibility of the user to determine the final suitability of this information and to comply with all applicable international, federal, state, and local laws and regulations.

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Identification of the substance	**Perfluorooctanic acid sodium salt** ROTI®Star PFAS Standard
Article number	20P2
CAS number	335-95-5
Alternative name(s)	PFAS

1.2 Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses:	Laboratory and analytical use Laboratory chemical
Uses advised against:	Do not use for products which come into contact with foodstuffs. Do not use for private purposes (household).

1.3 Details of the supplier of the safety data sheet

Carl Roth GmbH + Co KG
Schoemperlenstr. 3-5
D-76185 Karlsruhe
Germany

Telephone:+49 (0) 721 - 56 06 0
Telefax: +49 (0) 721 - 56 06 149
e-mail: sicherheit@carlroth.de
Website: www.carlroth.de

Competent person responsible for the safety data sheet:	:Department Health, Safety and Environment
e-mail (competent person):	**sicherheit@carlroth.de**

1.4 Emergency telephone number

Name	Street	Postal code/city	Telephone	Website
NSW Poisons Information Centre Childrens Hospital	Hawkesbury Road	2145 Westmead, NSW	131126	

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification acc. to GHS

Section	Hazard class	Category	Hazard class and category	Hazard statement
3.2	Skin corrosion/irritation	2	Skin Irrit. 2	H315
3.3	Serious eye damage/eye irritation	2A	Eye Irrit. 2A	H319
3.8R	Specific target organ toxicity - single exposure (respiratory tract irritation)	3	STOT SE 3	H335

For full text of abbreviations: see SECTION 16

2.2 Label elements

Labelling

Signal word **Warning**

Pictograms

GHS07

Hazard statements

H315	Causes skin irritation
H319	Causes serious eye irritation
H335	May cause respiratory irritation

Precautionary statements

Precautionary statements - prevention

P261	Avoid breathing dust/fume/gas/mist/vapours/spray
P280	Wear protective gloves

Precautionary statements - response

P302+P352	IF ON SKIN: Wash with plenty of soap and water
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P312	Call a POISON CENTER or doctor/physician if you feel unwell

Precautionary statements - storage

P403+P233	Store in a well-ventilated place. Keep container tightly closed

Precautionary statements - disposal

P501	Dispose of contents/container to industrial combustion plant

2.3 Other hazards

Results of PBT and vPvB assessment

According to the results of its assessment, this substance is not a PBT or a vPvB.

Endocrine disrupting properties

Does not contain an endocrine disruptor (EDC) in a concentration of ≥ 0,1%.

SECTION 3: Composition/information on ingredients

3.1 Substances

Name of substance	Perfluorooctanic acid sodium salt
Molecular formula	$C_8HF_{15}O_2Na$
Molar mass	437.1 $^{g}/_{mol}$
CAS No	335-95-5

SECTION 4: First aid measures

4.1 Description of first aid measures

General notes

Take off contaminated clothing.

Following inhalation

Provide fresh air. In all cases of doubt, or when symptoms persist, seek medical advice.

Following skin contact

Rinse skin with water/shower. In case of skin irritation, consult a physician.

Following eye contact

Irrigate copiously with clean, fresh water for at least 10 minutes, holding the eyelids apart. In case of eye irritation consult an ophthalmologist.

Following ingestion

Rinse mouth. Call a doctor if you feel unwell.

4.2 Most important symptoms and effects, both acute and delayed

Irritation, Cough, Dyspnoea

4.3 Indication of any immediate medical attention and special treatment needed

none

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

co-ordinate firefighting measures to the fire surroundings
water, foam, dry extinguishing powder, ABC-powder

Unsuitable extinguishing media

water jet

5.2 Special hazards arising from the substance or mixture

Combustible.

Hazardous combustion products

In case of fire may be liberated: Carbon monoxide (CO), Carbon dioxide (CO_2)

5.3 Advice for firefighters

In case of fire and/or explosion do not breathe fumes. Fight fire with normal precautions from a reasonable distance. Wear self-contained breathing apparatus.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

Avoid contact with skin, eyes and clothes. Do not breathe dust.

6.2 Environmental precautions

Keep away from drains, surface and ground water.

6.3 Methods and material for containment and cleaning up

Advice on how to contain a spill

Covering of drains. Take up mechanically.

Advice on how to clean up a spill

Take up mechanically. Control of dust.

Other information relating to spills and releases

Place in appropriate containers for disposal. Ventilate affected area.

6.4 Reference to other sections

Hazardous combustion products: see section 5. Personal protective equipment: see section 8. Incompatible materials: see section 10. Disposal considerations: see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Provision of sufficient ventilation. Avoid dust formation.

Advice on general occupational hygiene

Wash hands before breaks and after work. Keep away from food, drink and animal feedingstuffs.

7.2 Conditions for safe storage, including any incompatibilities

Store in a dry place. Keep in a cool place.

Incompatible substances or mixtures

Observe hints for combined storage.

Consideration of other advice:

Specific designs for storage rooms or vessels

Recommended storage temperature: 2 – 8 °C

7.3 Specific end use(s)

No information available.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

National limit values

Occupational exposure limit values (Workplace Exposure Limits)

This information is not available.

8.2 Exposure controls

Individual protection measures (personal protective equipment)

Eye/face protection

Use safety goggle with side protection.

Skin protection

• hand protection

Wear suitable gloves. Chemical protection gloves are suitable, which are tested according to EN 374. For special purposes, it is recommended to check the resistance to chemicals of the protective gloves mentioned above together with the supplier of these gloves. The times are approximate values from measurements at 22 ° C and permanent contact. Increased temperatures due to heated substances, body heat etc. and a reduction of the effective layer thickness by stretching can lead to a considerable reduction of the breakthrough time. If in doubt, contact manufacturer. At an approx. 1.5 times larger / smaller layer thickness, the respective breakthrough time is doubled / halved. The data apply only to the pure substance. When transferred to substance mixtures, they may only be considered as a guide.

• type of material

NBR (Nitrile rubber)

• material thickness

>0,11 mm

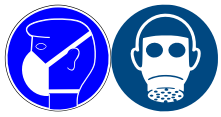
• breakthrough times of the glove material

>480 minutes (permeation: level 6)

• other protection measures

Take recovery periods for skin regeneration. Preventive skin protection (barrier creams/ointments) is recommended.

Respiratory protection



Respiratory protection necessary at: Dust formation. Particulate filter device (EN 143). P2 (filters at least 94 % of airborne particles, colour code: White).

Environmental exposure controls

Keep away from drains, surface and ground water.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	solid
Form	crystalline
Colour	not determined
Odour	characteristic
Melting point/freezing point	not determined
Boiling point or initial boiling point and boiling range	275 °C
Flammability	this material is combustible, but will not ignite readily
Lower and upper explosion limit	not determined
Flash point	not applicable
Auto-ignition temperature	not determined
Decomposition temperature	not relevant
pH (value)	not applicable
Kinematic viscosity	not relevant
Solubility(ies)	
Water solubility	(soluble)
Partition coefficient	
Partition coefficient n-octanol/water (log value):	this information is not available
Vapour pressure	not determined
Density and/or relative density	
Density	not determined
Relative vapour density	information on this property is not available
Particle characteristics	No data available.
Other safety parameters	
Oxidising properties	none

9.2 Other information

Information with regard to physical hazard classes:	hazard classes acc. to GHS (physical hazards): not relevant

Other safety characteristics:	There is no additional information.

SECTION 10: Stability and reactivity

10.1 Reactivity

The product in the delivered form is not dust explosion capable; the enrichment of fine dust however leads to the danger of dust explosion.

10.2 Chemical stability

The material is stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.

10.3 Possibility of hazardous reactions

Violent reaction with: strong oxidiser

10.4 Conditions to avoid

There are no specific conditions known which have to be avoided.

10.5 Incompatible materials

There is no additional information.

10.6 Hazardous decomposition products

Hazardous combustion products: see section 5.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Classification acc. to GHS

Acute toxicity

Shall not be classified as acutely toxic.

Skin corrosion/irritation

Causes skin irritation.

Serious eye damage/eye irritation

Causes serious eye irritation.

Respiratory or skin sensitisation

Shall not be classified as a respiratory or skin sensitiser.

Germ cell mutagenicity

Shall not be classified as germ cell mutagenic.

Carcinogenicity

Shall not be classified as carcinogenic.

Reproductive toxicity

Shall not be classified as a reproductive toxicant.

Specific target organ toxicity - single exposure

May cause respiratory irritation.

Specific target organ toxicity - repeated exposure

Shall not be classified as a specific target organ toxicant (repeated exposure).

Aspiration hazard

Shall not be classified as presenting an aspiration hazard.

Symptoms related to the physical, chemical and toxicological characteristics

• If swallowed

Data are not available.

• If in eyes

Causes serious eye irritation

• If inhaled

Irritation to respiratory tract, cough, Dyspnoea

• If on skin

causes skin irritation

• Other information

This information is based upon the present state of our knowledge. Substance not yet fully tested.

11.2 Endocrine disrupting properties

Does not contain an endocrine disruptor (EDC) in a concentration of ≥ 0,1%.

SECTION 12: Ecological information

12.1 Toxicity

Shall not be classified as hazardous to the aquatic environment.

12.2 Persistence and degradability

Data are not available.

12.3 Bioaccumulative potential

Data are not available.

12.4 Mobility in soil

Data are not available.

12.5 Results of PBT and vPvB assessment

According to the results of its assessment, this substance is not a PBT or a vPvB.

12.6 Endocrine disrupting properties

Does not contain an endocrine disruptor (EDC) in a concentration of ≥ 0,1%.

12.7 Other adverse effects

Data are not available.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

This material and its container must be disposed of as hazardous waste. Dispose of contents/container in accordance with local/regional/national/international regulations.

Sewage disposal-relevant information

Do not empty into drains.

Relevant provisions relating to waste(Basel Convention)

Properties of waste which render it hazardous

H11 Toxic (Delayed or chronic)

13.3 Remarks

Waste shall be separated into the categories that can be handled separately by the local or national waste management facilities. Please consider the relevant national or regional provisions.

SECTION 14: Transport information

14.1	**UN number**	not subject to transport regulations
14.2	**UN proper shipping name**	not assigned
14.3	**Transport hazard class(es)**	not assigned
14.4	**Packing group**	not assigned
14.5	**Environmental hazards**	non-environmentally hazardous acc. to the dangerous goods regulations

14.6 Special precautions for user

There is no additional information.

14.7 Transport in bulk according to IMO instruments

The cargo is not intended to be carried in bulk.

14.8 Information for each of the UN Model Regulations

Transport informationNational regulationsAdditional information(UN RTDG)

Not subject to transport regulations. UN RTDG

International Maritime Dangerous Goods Code (IMDG) - Additional information

Not subject to IMDG.

International Civil Aviation Organization (ICAO-IATA/DGR) - Additional information

Not subject to ICAO-IATA.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

There is no additional information.

Other information

Directive 94/33/EC on the protection of young people at work. Observe employment restrictions under the Maternity Protection Directive (92/85/EEC) for expectant or nursing mothers.

National inventories

Country	Inventory	Status
CN	IECSC	substance is listed
EU	ECSI	substance is listed
JP	CSCL-ENCS	substance is listed
TW	TCSI	substance is listed
US	TSCA	substance is listed as "ACTIVE"

Legend

CSCL-ENCS	List of Existing and New Chemical Substances (CSCL-ENCS)
ECSI	EC Substance Inventory (EINECS, ELINCS, NLP)
IECSC	Inventory of Existing Chemical Substances Produced or Imported in China
TCSI	Taiwan Chemical Substance Inventory
TSCA	Toxic Substance Control Act

15.2 Chemical Safety Assessment

No Chemical Safety Assessment has been carried out for this substance.

SECTION 16: Other information

Abbreviations and acronyms

Abbr.	Descriptions of used abbreviations
CAS	Chemical Abstracts Service (service that maintains the most comprehensive list of chemical substances)
DGR	Dangerous Goods Regulations (see IATA/DGR)
EINECS	European Inventory of Existing Commercial Chemical Substances
ELINCS	European List of Notified Chemical Substances
GHS	"Globally Harmonized System of Classification and Labelling of Chemicals" developed by the United Nations
IATA	International Air Transport Association
IATA/DGR	Dangerous Goods Regulations (DGR) for the air transport (IATA)
ICAO	International Civil Aviation Organization
IMDG	International Maritime Dangerous Goods Code
NLP	No-Longer Polymer
PBT	Persistent, Bioaccumulative and Toxic
UN RTDG	UN Recommendations on the Transport of Dangerous Good
vPvB	Very Persistent and very Bioaccumulative

Key literature references and sources for data

Safe Work Australia’s Code of Practice for Labelling of Workplace Hazardous Chemicals (under WHS Regulations).

UN Recommendations on the Transport of Dangerous Good. International Maritime Dangerous Goods Code (IMDG). Dangerous Goods Regulations (DGR) for the air transport (IATA).

List of relevant phrases (code and full text as stated in section 2 and 3)

Code	Text
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.

Disclaimer

This information is based upon the present state of our knowledge. This SDS has been compiled and is solely intended for this product.

SAFETY DATA SHEET

Creation Date 03-Feb-2010 **Revision Date** 24-Dec-2021 **Revision Number** 3

1. Identification

Product Name **Trichloroethylene**

Cat No. : **T340-4; T341-4; T341-20; T341-500; T403-4**

CAS No 79-01-6
Synonyms Trichloroethene (Stabilized/Technical/Electronic/Certified ACS)

Recommended Use Laboratory chemicals.
Uses advised against .

Details of the supplier of the safety data sheet

Company
Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/Irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 2
Carcinogenicity	Category 1A
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Heart, spleen, Blood.	

Label Elements

Signal Word

Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause drowsiness or dizziness
Suspected of causing genetic defects
May cause cancer
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Harmful to aquatic life with long lasting effects
WARNING. Cancer and Reproductive Harm - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Trichloroethylene	79-01-6	>95

4. First-aid measures

General Advice Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Eye Contact	In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.
Inhalation	Remove to fresh air. If not breathing, give artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.
Ingestion	Do NOT induce vomiting. Call a physician or poison control center immediately.
Most important symptoms and effects	May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray, carbon dioxide (CO2), dry chemical, alcohol-resistant foam.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	410 °C / 770 °F
Explosion Limits	
Upper	44.8 vol %
Lower	8 vol %
Oxidizing Properties	Not oxidising
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. Containers may explode when heated. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
Chlorine. Phosgene. Carbon monoxide (CO). Carbon dioxide (CO_2). Hydrogen chloride gas.
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
2	1	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment as required. Keep people away from and upwind of spill/leak. Evacuate personnel to safe areas.
Environmental Precautions	Should not be released into the environment. Do not flush into surface water or sanitary sewer system.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling Wear personal protective equipment/face protection. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not breathe mist/vapors/spray. Do not ingest. If swallowed then seek immediate medical assistance.

Storage. Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from light. Do not store in aluminum containers. Incompatible Materials. Strong oxidizing agents. Strong bases. Amines. Alkali metals. Metals. .

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Trichloroethylene	TWA: 10 ppm STEL: 25 ppm	(Vacated) TWA: 50 ppm (Vacated) TWA: 270 mg/m³ Ceiling: 200 ppm (Vacated) STEL: 200 ppm (Vacated) STEL: 1080 mg/m³ TWA: 100 ppm	IDLH: 1000 ppm	TWA: 10 ppm STEL: 25 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: NIOSH - National Institute for Occupational Safety and Health

Engineering Measures Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-85 °C / -121 °F
Boiling Point/Range	87 °C / 188.6 °F
Flash Point	No information available
Evaporation Rate	0.69 (Carbon Tetrachloride = 1.0)

Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	44.8 vol %
Lower	8 vol %
Vapor Pressure	77.3 mbar @ 20 °C
Vapor Density	4.5 (Air = 1.0)
Specific Gravity	1.460
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	410 °C / 770 °F
Decomposition Temperature	> 120°C
Viscosity	0.55 mPa.s (25°C)
Molecular Formula	C2 H Cl3
Molecular Weight	131.39

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Light sensitive.

Conditions to Avoid Incompatible products. Excess heat. Exposure to light. Exposure to moist air or water.

Incompatible Materials Strong oxidizing agents, Strong bases, Amines, Alkali metals, Metals,

Hazardous Decomposition Products Chlorine, Phosgene, Carbon monoxide (CO), Carbon dioxide (CO_2), Hydrogen chloride gas

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Trichloroethylene	LD50 = 4920 mg/kg (Rat)	LD50 = 29000 mg/kg (Rabbit)	LC50 = 26 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes and skin

Sensitization May cause sensitization by skin contact

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
Trichloroethylene	79-01-6	Group 1	Known	A2	X	A2

IARC (International Agency for Research on Cancer)

IARC (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

NTP: (National Toxicity Program)

NTP: (National Toxicity Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen

A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)

Mutagenic Effects Mutagenic effects have occurred in humans.

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Central nervous system (CNS)
STOT - repeated exposure Kidney Liver Heart spleen Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Do not empty into drains. The product contains following substances which are hazardous for the environment. Contains a substance which is:. Harmful to aquatic organisms. Toxic to aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Trichloroethylene	EC50: = 175 mg/L, 96h (Pseudokirchneriella subcapitata) EC50: = 450 mg/L, 96h (Desmodesmus subspicatus)	LC50: 31.4 - 71.8 mg/L, 96h flow-through (Pimephales promelas) LC50: 39 - 54 mg/L, 96h static (Lepomis macrochirus)	EC50 = 0.81 mg/L 24 h EC50 = 115 mg/L 10 min EC50 = 190 mg/L 15 min EC50 = 235 mg/L 24 h EC50 = 410 mg/L 24 h EC50 = 975 mg/L 5 min	EC50: = 2.2 mg/L, 48h (Daphnia magna)

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

Component	log Pow
Trichloroethylene	2.4

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Trichloroethylene - 79-01-6	U228	-

14. Transport information

DOT

UN-No UN1710
Proper Shipping Name TRICHLOROETHYLENE
Hazard Class 6.1

Packing Group III

TDG

UN-No UN1710
Proper Shipping Name TRICHLOROETHYLENE
Hazard Class 6.1
Packing Group III

IATA

UN-No UN1710
Proper Shipping Name TRICHLOROETHYLENE
Hazard Class 6.1
Packing Group III

IMDG/IMO

UN-No UN1710
Proper Shipping Name TRICHLOROETHYLENE
Hazard Class 6.1
Packing Group III

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
Trichloroethylene	79-01-6	X	ACTIVE	R;S

Legend:
TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

TSCA 12(b) - Notices of Export

Component	CAS No	**TSCA 12(b)** - Notices of Export
Trichloroethylene	79-01-6	Section 5 Section 6

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
Trichloroethylene	79-01-6	X	-	201-167-4	X	X	X	X	X	X

KECL - NIER number or KE number (http://ncis.nier.go.kr/en/main.do)

U.S. Federal Regulations

SARA 313

Component	CAS No	Weight %	SARA 313 - Threshold Values %
Trichloroethylene	79-01-6	>95	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Trichloroethylene	X	100 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors

Trichloroethylene	X		-

OSHA - Occupational Safety and Health Administration: Not applicable

CERCLA: This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Trichloroethylene	100 lb 1 lb	-

California Proposition 65: This product contains the following Proposition 65 chemicals.

Component	CAS No	California Prop. 65	Prop 65 NSRL	Category
Trichloroethylene	79-01-6	Carcinogen Developmental Male Reproductive	14 µg/day 50 µg/day	Developmental Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Trichloroethylene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security: This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade: No information available

Authorisation/Restrictions according to EU REACH

Component	REACH (1907/2006) - Annex XIV - Substances Subject to Authorization	REACH (1907/2006) - Annex XVII - Restrictions on Certain Dangerous Substances	REACH Regulation (EC 1907/2006) article 59 - Candidate List of Substances of Very High Concern (SVHC)
Trichloroethylene	Carcinogenic Category 1B Article 57 Application date: October 21, 2014 Sunset date: April 21, 2016 Exemption - None	Use restricted. See item 28. (see link for restriction details) Use restricted. See item 75. (see link for restriction details)	SVHC Candidate list - 201-167-4 - Carcinogenic, Article 57a

After the sunset date the use of this substance requires either an authorization or can only be used for exempted uses, e.g. use in scientific research and development which includes routine analytics or use as intermediate.

https://echa.europa.eu/authorisation-list
https://echa.europa.eu/substances-restricted-under-reach
https://echa.europa.eu/candidate-list-table

Safety, health and environmental regulations/legislation specific for the substance or mixture

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Trichloroethylene	79-01-6	Listed	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive	Seveso III Directive	Rotterdam	Basel Convention

		(2012/18/EC) - Qualifying Quantities for Major Accident Notification	(2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Convention (PIC)	(Hazardous Waste)
Trichloroethylene	79-01-6	Not applicable	Not applicable	Not applicable	Annex I - Y45

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 03-Feb-2010
Revision Date 24-Dec-2021
Print Date 24-Dec-2021
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

Creation Date 16-September-2014 **Revision Date** 26-December-2021 **Revision Number** 4

1. Identification

Product Name **trans-1,2-Dichloroethylene, stabilized**

Cat No. : **AC406840000; AC406840250; AC406842500**

CAS-No 156-60-5
Synonyms trans-Acetylene dichloride

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company
Importer/Distributor
Fisher Scientific
112 Colonnade Road,
Ottawa, ON K2E 7L6,
Canada
Tel: 1-800-234-7437

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Manufacturer
Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

WHMIS 2015 Classification Classified as hazardous under the Hazardous Products Regulations (SOR/2015-17)

Flammable liquids	Category 2
Acute oral toxicity	Category 4
Acute Inhalation Toxicity	Category 4

Label Elements

Signal Word
Danger

Hazard Statements
Highly flammable liquid and vapor
Harmful if swallowed or if inhaled
Harmful if inhaled

Precautionary Statements
Prevention
Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharges
Avoid breathing dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Response
IF INHALED: Remove person to fresh air and keep comfortable for breathing
Call a POISON CENTER/ doctor if you feel unwell
Rinse mouth
In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish
Explosion risk in case of fire
Fight fire with normal precautions from a reasonable distance
Evacuate area
Storage
Store in a well-ventilated place. Keep cool
Disposal
Dispose of contents/container to an approved waste disposal plant

Other Hazards
Harmful to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Ethene, 1,2-dichloro-, (1E)-	156-60-5	>95

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Get medical attention.

Inhalation Remove from exposure, lie down. Remove to fresh air. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention. If not breathing, give artificial respiration.

Ingestion Do NOT induce vomiting. Get medical attention.

Most important symptoms/effects Difficulty in breathing. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Water spray. Carbon dioxide (CO_2). Dry chemical. Chemical foam. Water mist may be used to cool closed containers. Water mist may be used to cool closed containers.

Unsuitable Extinguishing Media No information available

Flash Point 6 °C / 42.8 °F

Method - No information available

Autoignition Temperature 440 °C / 824 °F

Explosion Limits

Upper	12.80%
Lower	9.70%
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Flammable. Vapors may travel to source of ignition and flash back. Containers may explode when heated. Vapors may form explosive mixtures with air. Thermal decomposition can lead to release of irritating gases and vapors. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
Carbon monoxide (CO). Carbon dioxide (CO_2). Phosgene. Hydrogen chloride gas.
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	3	0	N/A

6. Accidental release measures

Personal Precautions Remove all sources of ignition. Take precautionary measures against static discharges. Use personal protective equipment as required. Ensure adequate ventilation.

Environmental Precautions Do not flush into surface water or sanitary sewer system. See Section 12 for additional Ecological Information. Avoid release to the environment. Collect spillage.

Methods for Containment and Clean Up Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling Wear personal protective equipment/face protection. Ensure adequate ventilation. Avoid contact with skin and eyes. Handle product only in closed system or provide appropriate exhaust ventilation. Use spark-proof tools and explosion-proof equipment. Use only non-sparking tools. Keep away from open flames, hot surfaces and sources of ignition. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Take precautionary measures against static discharges.

Storage. Keep in a dry, cool and well-ventilated place. Keep container tightly closed. Keep away from heat, sparks and flame. Flammables area. Keep container tightly closed in a dry and well-ventilated place. Incompatible Materials. Bases. Strong acids. Strong oxidizing agents.

8. Exposure controls / personal protection

Exposure Guidelines

Component	Alberta	British Columbia	Ontario TWAEV	Quebec	ACGIH TLV	OSHA PEL	NIOSH IDLH
Ethene, 1,2-dichloro-, (1E)-	TWA: 200 ppm TWA: 793 mg/m^3	TWA: 200 ppm	TWA: 200 ppm		TWA: 200 ppm		

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

Engineering Measures

Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment. Wherever possible, engineering control measures such as the isolation or enclosure of the process, the introduction of process or equipment changes to minimise release or contact, and the use of properly designed ventilation systems, should be adopted to control hazardous materials at source

Personal protective equipment

Eye Protection Goggles
Hand Protection Protective gloves

Glove material	Breakthrough time	Glove thickness	Glove comments
Natural rubber Nitrile rubber Neoprene PVC	See manufacturers recommendations	-	Splash protection only

Inspect gloves before use. observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. (Refer to manufacturer/supplier for information) gloves are suitable for the task: Chemical compatability, Dexterity, Operational conditions, User susceptibility, e.g. sensitisation effects, also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion. gloves with care avoiding skin contamination.

Respiratory Protection

When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
To protect the wearer, respiratory protective equipment must be the correct fit and be used and maintained properly
Recommended Filter type: Organic gases and vapours filter Type A Brown conforming to EN14387

When RPE is used a face piece Fit Test should be conducted

Environmental exposure controls

Prevent product from entering drains.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice. Keep away from food, drink and animal feeding stuffs. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Wash hands before breaks and after work.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	No information available
pH	6.5-7.2
Melting Point/Range	-50 °C / -58 °F

Boiling Point/Range	48 °C / 118.4 °F @ 760 mmHg
Flash Point	6 °C / 42.8 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	12.80%
Lower	9.70%
Vapor Pressure	331 mmHg @ 25 °C
Vapor Density	3.34 (Air = 1.0)
Specific Gravity	1.260
Solubility	Immiscible with water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	440 °C / 824 °F
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C2 H2 Cl2
Molecular Weight	96.94

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Keep away from open flames, hot surfaces and sources of ignition. Exposure to air. Exposure to light. Incompatible products. Exposure to moist air or water.

Incompatible Materials Bases, Strong acids, Strong oxidizing agents

Hazardous Decomposition Products Carbon monoxide (CO), Carbon dioxide (CO_2), Phosgene, Hydrogen chloride gas

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethene, 1,2-dichloro-, (1E)-	LD50 = 1235 mg/kg (Rat)	>5 g/kg (Rabbit)	LC50 = 24100 ppm (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Ethene, 1,2-dichloro-, (1E)-	156-60-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Ethene, 1,2-dichloro-, (1E)-	Not listed	LC50: = 135 mg/L, 96h static (Lepomis macrochirus)	Not listed	Not listed

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

Component	log Pow
Ethene, 1,2-dichloro-, (1E)-	1.48

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Ethene, 1,2-dichloro-, (1E)- - 156-60-5	U079	-

14. Transport information

DOT

UN-No UN1150
Proper Shipping Name 1,2-DICHLOROETHYLENE
Hazard Class 3
Packing Group II

TDG

UN-No UN1150
Proper Shipping Name 1,2-DICHLOROETHYLENE
Hazard Class 3
Packing Group II

IATA

UN-No UN1150
Proper Shipping Name 1,2-DICHLOROETHYLENE
Hazard Class 3
Packing Group II

IMDG/IMO

UN-No	UN1150
Proper Shipping Name	1,2-DICHLOROETHYLENE
Hazard Class	3
Packing Group	II

15. Regulatory information

International Inventories

Component	CAS-No	DSL	NDSL	TSCA	TSCA Inventory notification - Active-Inactive	EINECS	ELINCS	NLP
Ethene, 1,2-dichloro-, (1E)-	156-60-5	X	-	X	ACTIVE	205-860-2	-	-

Component	CAS-No	IECSC	KECL	ENCS	ISHL	TCSI	AICS	NZIoC	PICCS
Ethene, 1,2-dichloro-, (1E)-	156-60-5	X	KE-10123	X	X	X	X	X	X

Legend:
X - Listed '-' - Not Listed
KECL - NIER number or KE number (http://ncis.nier.go.kr/en/main.do)
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
IECSC - Chinese Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
ENCS - Japanese Existing and New Chemical Substances
AICS - Australian Inventory of Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances

Canada

SDS in compliance with provisions of information as set out in Canadian Standard - Part 4, Schedule 1 and 2 of the Hazardous Products Regulations (HPR) and meets the requirements of the HPR (Paragraph 13(1)(a) of the Hazardous Products Act (HPA)).

Component	Canada - National Pollutant Release Inventory (NPRI)	Canadian Environmental Protection Agency (CEPA) - List of Toxic Substances	Canada's Chemicals Management Plan (CEPA)
Ethene, 1,2-dichloro-, (1E)-	Part 4 Substance		

Other International Regulations

Authorisation/Restrictions according to EU REACH

Safety, health and environmental regulations/legislation specific for the substance or mixture

Component	CAS-No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Ethene, 1,2-dichloro-, (1E)-	156-60-5	Listed	Not applicable	Not applicable	Not applicable

Component	CAS-No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)
Ethene, 1,2-dichloro-, (1E)-	156-60-5	Not applicable	Not applicable	Not applicable	Annex I - Y45

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific

Email: EMSDS.RA@thermofisher.com

Creation Date	16-September-2014
Revision Date	26-December-2021
Print Date	26-December-2021
Revision Summary	This document has been updated to comply with the requirements of WHMIS 2015 to align with the Globally Harmonised System (GHS) for the Classification and Labelling of Chemicals.

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

p-Dichlorobenzene,

SECTION 1 : Identification of the substance/mixture and of the supplier

Product name : **p-Dichlorobenzene,**

Manufacturer/Supplier Trade name:

Manufacturer/Supplier Article number: **S25299A**

Recommended uses of the product and uses restrictions on use:

Manufacturer Details:

AquaPhoenix Scientific
9 Barnhart Drive, Hanover, PA 17331

Supplier Details:

Fisher Science Education
15 Jet View Drive, Rochester, NY 14624

Emergency telephone number:

Fisher Science Education Emergency Telephone No.: 800-535-5053

SECTION 2 : Hazards identification

Classification of the substance or mixture:

Irritant

Health hazard

Environmentally Damaging

Eye irrit. cat 2
Carc. 2
Aquatic AcTox. 1
Aquatic Chr. 1

Signal word :Warning

Hazard statements:
Causes serious eye irritation
Suspected of causing cancer
Very toxic to aquatic life
Very toxic to aquatic life with long lasting effects

Precautionary statements:
If medical advice is needed, have product container or label at hand
Keep out of reach of children
Read label before use
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood

Avoid release to the environment
Do not eat, drink or smoke when using this product
Wash skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
IF exposed or concerned: Get medical advice/attention
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing
If eye irritation persists get medical advice/attention
Collect spillage
Store locked up
Dispose of contents and container as instructed in Section 13

Combustible Dust Hazard: :
May form combustible dust concentrations in air (during processing).

Other Non-GHS Classification:

WHMIS

B3

D2A

NFPA/HMIS

NFPA SCALE (0-4)

HMIS RATINGS (0-4)

SECTION 3 : Composition/information on ingredients

Ingredients:		
CAS 106-46-7	p-Dichlorobenzene	100 %
		Percentages are by weight

SECTION 4 : First aid measures

Description of first aid measures

After inhalation: Move exposed individual to fresh air. Loosen clothing as necessary and position individual in a comfortable position.Seek medical advice if discomfort or irritation persists.If breathing difficult, give oxygen.

After skin contact: Wash affected area with soap and water. Rinse/flush exposed skin gently using water for 15-20 minutes. Seek medical advice if discomfort or irritation persists.

After eye contact: Protect unexposed eye. Rinse/flush exposed eye(s) gently using water for 15-20 minutes. Remove contact lens(es) if able to do so during rinsing. Seek medical attention if irritation persists or if

concerned.

After swallowing: Rinse mouth thoroughly. Do not induce vomiting. Have exposed individual drink sips of water. Seek medical attention if irritation, discomfort or vomiting persists.

Most important symptoms and effects, both acute and delayed:

Irritation, Nausea,Headache, Shortness of breath.;

Indication of any immediate medical attention and special treatment needed:

If seeking medical attention, provide SDS document to physician.

SECTION 5 : Firefighting measures

Extinguishing media

Suitable extinguishing agents: If in laboratory setting, follow laboratory fire suppression procedures. Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition

For safety reasons unsuitable extinguishing agents:

Special hazards arising from the substance or mixture:

Combustion products may include carbon oxides or other toxic vapors.Thermal decomposition can lead to release of irritating gases and vapors.Avoid generating dust; fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

Advice for firefighters:

Protective equipment: Use NIOSH-approved respiratory protection/breathing apparatus.

Additional information (precautions): Move product containers away from fire or keep cool with water spray as a protective measure, where feasible.Use spark-proof tools and explosion-proof equipment.

SECTION 6 : Accidental release measures

Personal precautions, protective equipment and emergency procedures:

Wear protective equipment. Transfer to a disposal or recovery container.Use spark-proof tools and explosion-proof equipment.Use respiratory protective device against the effects of fumes/dust/aerosol. Keep unprotected persons away. Ensure adequate ventilation.Keep away from ignition sources. Protect from heat.Stop the spill, if possible. Contain spilled material by diking or using inert absorbent.

Environmental precautions:

Prevent from reaching drains, sewer or waterway. Collect contaminated soil for characterization per Section 13

Methods and material for containment and cleaning up:

If in a laboratory setting, follow Chemical Hygiene Plan procedures.Collect liquids using vacuum or by use of absorbents. Place into properly labeled containers for recovery or disposal. If necessary, use trained response staff/contractor.Dust deposits should not be allowed to accumulate on surfaces, as these may form an explosive mixture if they are released into the atmosphere in sufficient concentration. Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air). Remove all sources of ignition. Provide ventilation.

Reference to other sections:

SECTION 7 : Handling and storage

Precautions for safe handling:

Minimize dust generation and accumulation. Wash hands after handling. Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air). Routine housekeeping should be instituted to ensure that dusts do not accumulate on surfaces. Dry powders can build static electricity charges when subjected to the friction of transfer and mixing operations. Follow good hygiene procedures when handling chemical materials. Do not eat, drink, smoke, or use personal products when handling chemical substances. If in a laboratory setting, follow Chemical Hygiene Plan.Use only in well ventilated areas.Avoid contact with eyes, skin, and clothing.

Conditions for safe storage, including any incompatibilities:

Store in a cool location. Provide ventilation for containers. Avoid storage near extreme heat, ignition sources or open flame. Store away from foodstuffs. Store away from oxidizing agents.Keep container tightly sealed.Store with like hazards

SECTION 8 : Exposure controls/personal protection

Control Parameters:	106-46-7, p-Dichlorobenzene, ACGIH 10 ppm TWA
Appropriate Engineering controls:	Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use/handling.Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapor or dusts (total/respirable) below the applicable workplace exposure limits (Occupational Exposure Limits-OELs) indicated above.Use under a fume hood. It is recommended that all dust control equipment such as local exhaust ventilation and material transport systems involved in handling of this product contain explosion relief vents or an explosion suppression system or an oxygen deficient environment.Ensure that dust-handling systems (such as exhaust ducts, dust collectors, vessels, and processing equipment) are designed in a manner to prevent the escape of dust into the work area (i.e., there is no leakage from the equipment).
Respiratory protection:	Not required under normal conditions of use. Use suitable respiratory protective device when high concentrations are present. Use suitable respiratory protective device when aerosol or mist is formed. For spills, respiratory protection may be advisable. Use adequate general or local exhaust ventilation keep airborne concentrations low. A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.
Protection of skin:	The glove material has to be impermeable and resistant to the product/ the substance/ the preparation being used/handled.Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation.
Eye protection:	Safety glasses with side shields or goggles.
General hygienic measures:	The usual precautionary measures are to be adhered to when handling chemicals. Keep away from food, beverages and feed sources. Immediately remove all soiled and contaminated clothing. Wash hands before breaks and at the end of work. Do not inhale gases/fumes/dust/mist/vapor/aerosols. Avoid contact with the eyes and skin.

SECTION 9 : Physical and chemical properties

Appearance (physical state,color):	White solid	**Explosion limit lower**: **Explosion limit upper**:	Not Determined Not Determined
Odor:	mothball - like - penetra ting odor	**Vapor pressure**:	1 mm Hg @ 25 deg C
Odor threshold:	Not Determined	**Vapor density**:	5.1

p-Dichlorobenzene,

pH-value:	Not Determined	**Relative density**:	1.458 @ 20°C
Melting/Freezing point:	53 C	**Solubilities**:	Insoluble in water
Boiling point/Boiling range:	174 C	**Partition coefficient (n-octanol/water)**:	octanol/water: log Pow: 3.40
Flash point (closed cup):	65 C	**Auto/Self-ignition temperature**:	Not Determined
Evaporation rate:	Not Determined	**Decomposition temperature**:	Not Determined
Flammability (solid,gaseous):	Not Determined	**Viscosity**:	a. Kinematic:Not Determined b. Dynamic: Not Determined
Density: Not Determined			

SECTION 10 : Stability and reactivity

Reactivity:
Chemical stability: No decomposition if used and stored according to specifications.
Possible hazardous reactions:
Conditions to avoid: Store away from oxidizing agents, strong acids or bases.High temperatures, ignition sources, dust generation.
Incompatible materials: Strong acids.Strong bases.Strong oxidizing agents.
Hazardous decomposition products: Hydrogen chloride, chlorine, carbon monoxide, carbon dioxide.

SECTION 11 : Toxicological information

Acute Toxicity:		
Oral:	2950 mg/kg	Oral LD50 Mouse
Inhalation:	5.07 mg/kg	LC50 inhalation - rat
Chronic Toxicity: No additional information.		
Corrosion Irritation: No additional information.		
Sensitization:		No additional information.
Single Target Organ (STOT):		No additional information.
Numerical Measures:		No additional information.
Carcinogenicity:		p-Dichlorobenzene: IARC: 2B - Group 2B: Possibly carcinogenic to humans. p-Dichlorobenzene: NTP: Reasonably anticipated to be a human carcinogen. p-Dichlorobenzene: 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.
Mutagenicity:		No additional information.
Reproductive Toxicity:		No additional information.

SECTION 12 : Ecological information

Ecotoxicity

Pimephales promelas : 96 Hr LC50: 18 - 50 mg/L [static]

Pimephales promelas : 96 Hr LC50: 4 mg/L [flow-through]

Oncorhynchus mykiss : 96 Hr LC50: 1.05 - 1.2 mg/L [flow-through]

Oncorhynchus mykiss : 96 Hr LC50: 0.88 mg/L [static]

Lepomis macrochirus : 96 Hr LC50: 3.9 - 4.8 mg/L [static]

Persistence and degradability: Readily degradable in the environment.
Bioaccumulative potential:
Mobility in soil:
Other adverse effects:

SECTION 13 : Disposal considerations

Waste disposal recommendations:

Product/containers must not be disposed together with household garbage. Do not allow product to reach sewage system or open water.It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities (US 40CFR262.11). Consult federal state/ provincial and local regulations regarding the proper disposal of waste material that may incorporate some amount of this product.

SECTION 14 : Transport information

UN-Number

3077

UN proper shipping name

Environmentally hazardous substance, solid, n.o.s. (1,4 - Dichlorobenzene)

Transport hazard class(es)

Class:
9 Miscellaneous dangerous substances and articles

Packing group:III
Environmental hazard:
Transport in bulk:
Special precautions for user:

SECTION 15 : Regulatory information

United States (USA)

SARA Section 311/312 (Specific toxic chemical listings):

Acute, Chronic

SARA Section 313 (Specific toxic chemical listings):

106-46-7 p-dichlorobenzene

RCRA (hazardous waste code):

None of the ingredients is listed

TSCA (Toxic Substances Control Act):

All ingredients are listed.

CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act):

106-46-7 p-dichlorobenzene 100

Proposition 65 (California):

Chemicals known to cause cancer:

106-46-7 p-dichlorobenzene

Chemicals known to cause reproductive toxicity for females:

None of the ingredients is listed

Chemicals known to cause reproductive toxicity for males:

None of the ingredients is listed

Chemicals known to cause developmental toxicity:

None of the ingredients is listed

Canada

Canadian Domestic Substances List (DSL):

All ingredients are listed.

Canadian NPRI Ingredient Disclosure list (limit 0.1%):

None of the ingredients is listed

Canadian NPRI Ingredient Disclosure list (limit 1%):

None of the ingredients is listed

SECTION 16 : Other information

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.Note:. The responsibility to provide a safe workplace remains with the user.The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment.The information contained herein is, to the best of our knowledge and belief, accurate.However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material.It is the responsibility of the user to comply with all applicable laws and regulations applicable to this material.

GHS Full Text Phrases:

Abbreviations and acronyms:

IMDG: International Maritime Code for Dangerous Goods
PNEC: Predicted No-Effect Concentration (REACH)
CFR: Code of Federal Regulations (USA)
SARA: Superfund Amendments and Reauthorization Act (USA)
RCRA: Resource Conservation and Recovery Act (USA)
TSCA: Toxic Substances Control Act (USA)
NPRI: National Pollutant Release Inventory (Canada)
DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)

HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)
DNEL: Derived No-Effect Level (REACH)

Effective date : 12.19.2014
Last updated : 03.19.2015

SAFETY DATA SHEET

Vinyl Chloride

Section 1. Identification

GHS product identifier : Vinyl Chloride

Chemical name : vinyl chloride

Other means of identification : chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro- (vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro- (vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC

SDS # : 001067

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas
CARCINOGENICITY - Category 1
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May cause frostbite
May displace oxygen and cause rapid suffocation.
May cause cancer.
May cause damage to organs through prolonged or repeated exposure. (liver)

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. Wear eye or face protection. Wear protective clothing. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Do not breathe gas.

Section 2. Hazards identification

Response : Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Store locked up. Protect from sunlight. Store in a well-ventilated place.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : vinyl chloride

Other means of identification : chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro-(vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC

Product code : 001067

CAS number/other identifiers

CAS number : 75-01-4

Ingredient name	%	CAS number
vinyl chloride	100	75-01-4

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Section 4. First aid measures

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
halogenated compounds

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Section 6. Accidental release measures

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Do not breathe gas. Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Store locked up. Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
vinyl chloride	**ACGIH TLV (United States, 3/2017).** TWA: 1 ppm 8 hours. **OSHA PEL (United States, 6/2016).** STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours. **OSHA PEL 1989 (United States, 3/1989).** STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Section 8. Exposure controls/personal protection

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [COLORLESS GAS OR LIQUID (BELOW 7 F) WITH A PLEASANT ODOR AT HIGH CONCENTRATIONS. [NOTE: SHIPPED AS A LIQUEFIED COMPRESSED GAS.]

Color : Colorless.

Odor : Characteristic.

Odor threshold : Not available.

pH : Not available.

Melting point : -153.8°C (-244.8°F)

Boiling point : -13.4°C (7.9°F)

Critical temperature : 158.45°C (317.2°F)

Flash point : Closed cup: -78°C (-108.4°F)
Open cup: -78°C (-108.4°F)

Evaporation rate : Not available.

Flammability (solid, gas) : Not available.

Lower and upper explosive (flammable) limits : Lower: 3.8%
Upper: 29.3%

Section 9. Physical and chemical properties

Vapor pressure : Not available.

Vapor density : 2.2 (Air = 1)

Specific Volume (ft ^{3}/lb) : 6.25

Gas Density (lb/ft ^{3}) : 0.16129 (21.1°C / 70 to °F)

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 1.1 g/l

Partition coefficient: n-octanol/water : 1.38

Auto-ignition temperature : 472°C (881.6°F)

Decomposition temperature : Not available.

Viscosity : Not applicable.

Flow time (ISO 2431) : Not available.

Molecular weight : 62.5 g/mole

Aerosol product

Heat of combustion : -18924336 J/kg

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Section 11. Toxicological information

Classification

Product/ingredient name	OSHA	IARC	NTP
vinyl chloride	+	1	Known to be a human carcinogen.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
vinyl chloride	Category 2	Not determined	liver

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : May cause damage to organs through prolonged or repeated exposure.

Carcinogenicity : May cause cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Section 11. Toxicological information

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
vinyl chloride	1.38	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Vinyl chloride; Ethene, chloro-	75-01-4	Listed	U043

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1086	UN1086	UN1086	UN1086	UN1086
UN proper shipping name	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED

Section 14. Transport information

Transport hazard class(es)	2.1	2.1	2.1	2.1	2.1
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : **Reportable quantity** 1 lbs / 0.454 kg. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.
Limited quantity Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: 150 kg.
Special provisions 21, B44, T50

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).
Explosive Limit and Limited Quantity Index 0.125
ERAP Index 3000
Passenger Carrying Road or Rail Index Forbidden

IATA : **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: 150 kg.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined
Clean Water Act (CWA) 307: vinyl chloride
Clean Air Act (CAA) 112 regulated flammable substances: vinyl chloride

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

Section 15. Regulatory information

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	vinyl chloride	75-01-4	100
Supplier notification	vinyl chloride	75-01-4	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

California Prop. 65

⚠ **WARNING**: This product can expose you to Vinyl chloride, which is known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov.

Ingredient name	No significant risk level	Maximum acceptable dosage level
Vinyl chloride	Yes.	-

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : **Japan inventory (ENCS)**: This material is listed or exempted.
Japan inventory (ISHL): This material is listed or exempted.

Malaysia : This material is listed or exempted.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

Thailand : Not determined.

Turkey : This material is listed or exempted.

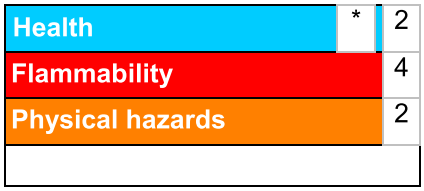
Section 15. Regulatory information

United States : This material is listed or exempted.

Viet Nam : Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1	Expert judgment
GASES UNDER PRESSURE - Liquefied gas	Expert judgment
CARCINOGENICITY - Category 1	Expert judgment
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2	Expert judgment

History

Date of printing : 7/9/2018

Date of issue/Date of revision : 7/9/2018

Date of previous issue : 10/11/2016

Version : 0.02

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

Section 16. Other information

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

APPENDIX G

from Post Road Service and Tire Center, 107 W P...
to White Plains Hospital

2 min (0.4 mile)

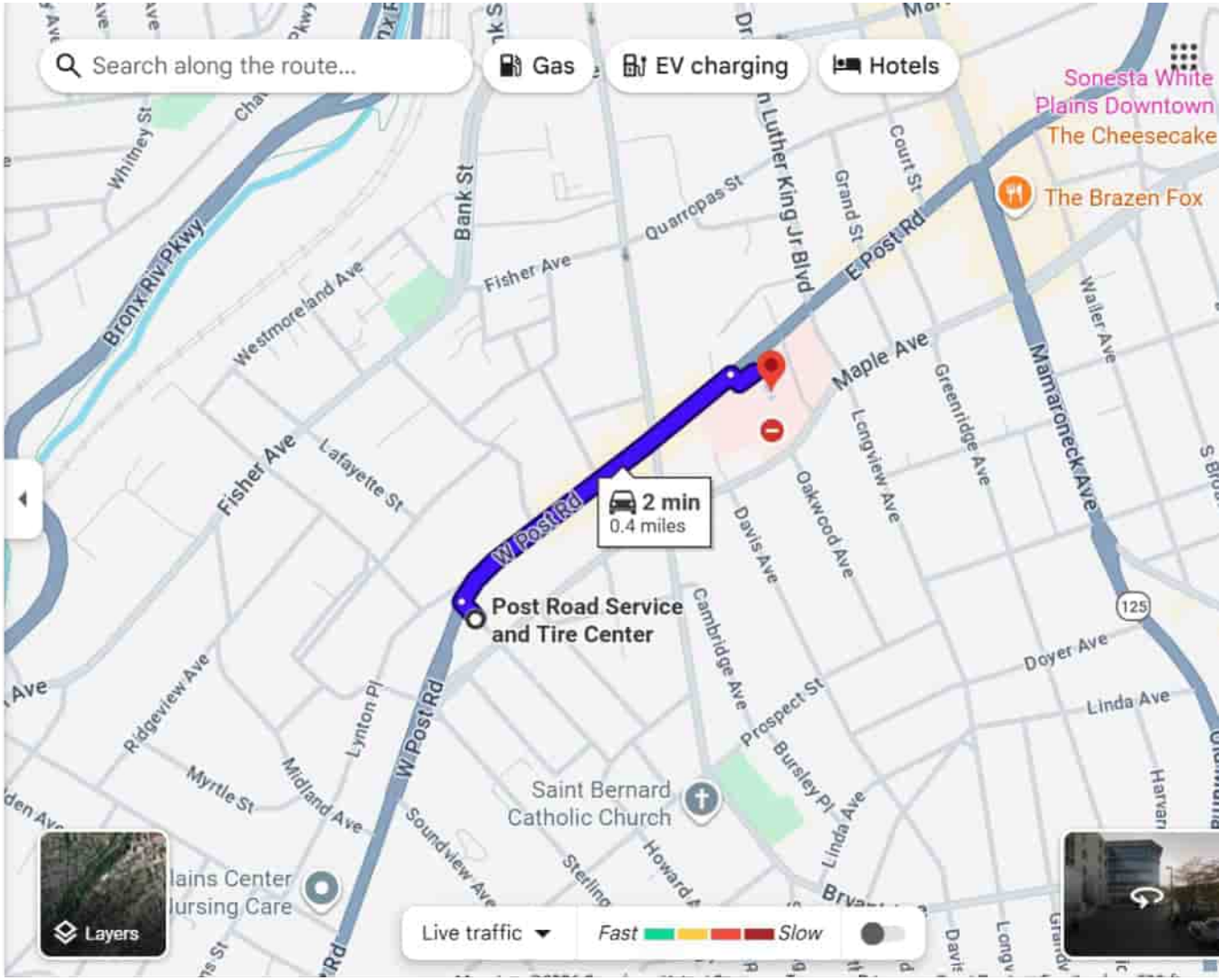
via W Post Rd

Fastest route now, avoids road closure

Post Road Service and Tire Center
107 W Post Rd, White Plains, NY 10606

- Head toward W Post Rd
  115 ft
- Turn right onto W Post Rd
  0.3 mi
- Turn right
  Destination will be on the right
  154 ft

White Plains Hospital
41 E Post Rd, White Plains, NY 10601



APPENDIX H

CORE DOWN DRILLING, LLC
SITE SPECIFIC HEALTH & SAFETY PLAN

Site Name: Post Road Corridor White Plains - Off-Site

Task: Soil Borings and Monitoring Well Installations

February 2026

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APPENDIX B GEOPROBE INSPECTION FORM
APPENDIX C OSHA 300 AND 301 LOG FORMS (BLANK)

1 Site Background

Ecology and Environment Engineering and Geology, P.C. (E & E) has been contracted by the New York State Department of Conservation (NYSDEC) to provide site investigation services for the off-site portion of NYSDEC Brownfield Cleanup Program (BCP) Site No. C360129 (the Site), located at 77 West Post Rd in White Plains, New York, 10606. The off-site portion is DEC Site No. C360129A.

The Site is in a mixed residential and commercial area and consists of empty lots from previously demolished structures. The Site has historically contained dry cleaners, gas stations with underground storage tanks (USTs), automobile service facilities with USTs, above ground storage tanks (ASTs), hydraulic lifts, parking lots, and various commercial businesses and offices.

Environmental investigations at the Site show on- and off-site impacts of CVOCs. Tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride have been reported as chemicals of concern based on the results of those investigations.

The subsurface geology in the vicinity of the Site consists primarily of fill material from grade to approximately 5 to 8 feet below ground surface (ft bgs). The subsurface material below the fill consists primarily of medium sand with varying amounts of gravel and silt, with silt lenses of variable thicknesses. Native till and weathered bedrock have been encountered. The depth to bedrock ranges from approximately 17 to 52 feet below grade. Groundwater at the site most likely ranges from 3 to 11 feet below ground surface and flows toward the northeast.

The purpose of this health and safety plan is to describe onsite procedures to be followed by CDD personnel while conducting onsite drilling work. This plan can be incorporated into the Environmental Health & Safety Plan prepared by Ecology and Environment Engineering and Geology, P.C. (EEEGPC herein). **Section 2.0** presents site specific procedures to be followed to ensure the health and safety of onsite workers. **Sections 3.0** through **6.0** are general in nature and reflect CDD's overall commitment to health and safety.

1.1 PROPOSED WORK SCOPE

Core Down Drilling, LLC (CDD) has been retained by EEEGPC to pre-clear/ air knife soil borings, collect soil samples and install permanent monitoring wells along West Post Avenue, Rathburn Avenue and within a municipally owned parking lot in the City of White Plains, New York. Based on a preliminary site walk, three borings/ wells (MW-1B, MW-2B and MW-3B) will be located in paring spaced along the west side of W Post Road. Two soil borings/ wells (MW-4B and MW-5B) will be located in the grass between the adjacent parking lot and Rathbun Avenue, along the southwest side of the street. The final boring/ well (MW-6B) will be advanced in the municipal parking lot located northeast of the intersection of Maple Avenue and W Post Road.

All appropriate permits are currently being obtained through the City of White Plains Department of Public Works and Westchester County. Work zone traffic control (WZTC) is anticipated to be limited to signage and road cones. Additional WZTC (i.e. flagging crew, lane closure, police detail) may be required based on the outcome of the local and county permitting process and or utility clearance which my require borings to be relocated into travels lanes necessitating a lane closure. This plan will be updated as necessary based on any additional WZTC requirements.

Prior to utilization of drilling equipment, each drilling location will be pre-marked and Dig Safely NY will be notified. If utilities are identified by the public locate, the borings will be relocated outside of the tolerance zone. Generally,

the tolerance zone is defined as 2-feet plus the diameter of the pipe, or at a distance as specified by the owner of said utility. Once the boring location has been selected, an air lance and Utiliscope vacuum will be used to air knife the boring locations to a depth of 5-feet bgs prior to advancing drill tooling.

A total of 6 borings will be installed using a track mounted Geoprobe 7822DT drill rig advancing 4.25" ID Hollow Stem Augers (HSA) and collecting 2-inch split spoon (Standard Penetration Test) soil samples continuously to approximately 25-feet below ground surface. The soil boring locations will be converted to permanent 2-inch I.D. PVC monitoring wells, following the procedures below:

- Monitoring well to be constructed of 2-inch ID schedule-40 PVC, 10 foot section of well screen and riser from the bottom of the bore hole up to the ground surface;
- Annular space around well to be filled with #2 sand to 2 feet above the top of the well screen;
- Bentonite chip seal above the #2 sand;
- Grout annulus to grade with CP-43 approved mix;
- Completed at the surface with an 6-inch steel road box set in concrete pad;

2 SITE SPECIFC WORK SCOPE AND DRILLING PROCEDURES

2.1 FIELD PERSONNEL TRAINING AND PPE

All onsite field workers will have OSHA 40-hour training. All workers will maintain Level C Personal Protective Equipment, including but not limited to, steel toe boots, approved hard hats, safety vests, cut resistant gloves and safety glasses. CAMP and VOC air monitoring will be conducted by the EEEGPC Field Engineer. CDD field personnel will adhere to any additional site-specific health & safety procedures outlined by EEEGPC.

2.2 SOIL CUTTINGS HANDLING

All soil cuttings, purge water, and decontamination rinsate shall be placed in 55-gallon drums (provided by the CDD) and transported to a central storage location. Waste disposal to be coordinated by EEEGPC.

2.3 TOOLING DECONTAMINATION

All down hole tooling will be decontaminated between drilling locations using potable water and alconox detergent. Decontamination required between sample barrel intervals at the boring location (e.g., cutting shoe) will consist of a detergent (e.g., alconox) and water wash with scrub brush potable water rinse. The water generated will be contained and transferred into a 55-gallon DOT approved drum. Pre-packaged acetate liners and PVC well pipe (screen and riser) will not require decontamination and are considered disposable single-use materials.

2.4 SITE DEMOBILIZATION

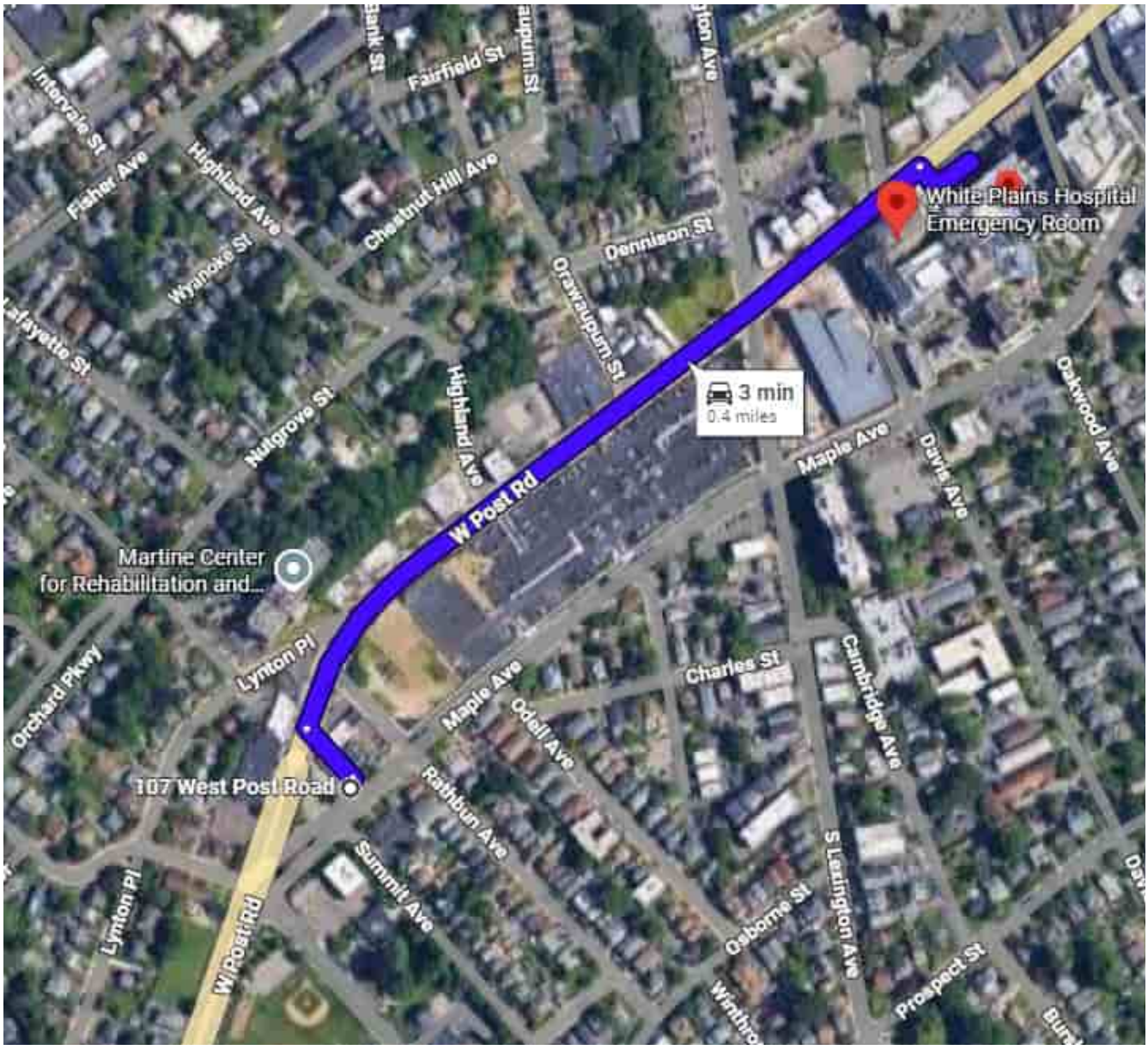
The drill rig tracks and support truck tires will be cleaned onsite if loose soil is observed. No site restoration is proposed. All disposable PPE (i.e. nitrile gloves) will be disposed in a 55-gallon DOT approved drum.

3 EMERGENCY RESPONSE & FIRST-AID PROCEDURES

Emergency Phone Numbers

Safety Coordinator: EEEGPC FIELD REP
First Aid Response: 911
Ambulance: 911
White Plains Hospital Emergency Room
41 E Post Rd, White Plains, NY 10601
(914) 681-0600

Poison Control: (800) 222-1222
Fire Department: 911
Police: 911



3.1 MINOR FIRST-AID TREATMENT

First-aid kits are kept in each truck. If you sustain an injury or are involved in an accident requiring minor first-aid treatment:

- Administer first-aid treatment to the injury or wound.
- If a first-aid kit is used, indicate usage on the accident investigation report.
- Access to a first-aid kit is not intended to be a substitute for medical attention.
- Provide details for the completion of the accident investigation report.
- Inform your supervisor

3.2 NONEMERGENCY MEDICAL TREATMENT

For nonemergency work-related injuries requiring professional medical assistance, management must first authorize treatment. If you sustain an injury requiring treatment other than first aid:

- Inform your supervisor.
- Proceed to the posted medical facility. Your supervisor will assist with transportation, if necessary.
- Provide details for the completion of the accident investigation report.

3.3 EMERGENCY MEDICAL TREATMENT

If you sustain a severe injury requiring emergency treatment:

- Call for help and seek assistance from a co-worker.
- Use the emergency telephone numbers and instructions posted on the first-aid kit to request assistance and transportation to the local hospital emergency room.
- Provide details for the completion of the accident investigation report.

3.4 FIRST-AID INSTRUCTIONS

In all cases requiring emergency medical treatment, immediately call or have a co-worker call to request emergency medical assistance. Use required bloodborne pathogen procedures while administering first aid.

Wounds:

Minor: *Cuts, lacerations, abrasions or punctures*

- Wash the wound using soap and water; rinse it well.
- Cover the wound using a clean dressing.

Major: *Large, deep and bleeding wounds*

- Stop the bleeding by pressing directly on the wound, using a bandage or cloth.
- Keep pressure on the wound until medical help arrives.

Broken Bones:

- Do not move the victim unless it is absolutely necessary.
- If the victim must be moved, “splint” the injured area. Use a board, cardboard or rolled newspaper as

a splint.

Burns:

Thermal (Heat)

- Rinse the burned area without scrubbing it, and immerse it in cold water. *Do not use ice water.*
- Blot dry the area and cover it using sterile gauze or a clean cloth.

Chemical

- Immediately flush the exposed area with cool water for 15 to 20 minutes.

Eye Injury:

Small particles

- Do not rub your eyes.
- Use the corner of a soft clean cloth to draw particles out, or hold the eyelids open and flush the eyes continuously with water.

Large or stuck particles

- If a particle is stuck in the eye, do not attempt to remove it.
- Cover both eyes with a bandage.

Chemical

- Immediately irrigate the eyes and under the eyelids with water for 30 minutes.

Neck or Spine Injury:

- If the victim appears to have injured his or her neck or spine, or is unable to move his or her arm or leg, do not attempt to move the victim unless it is absolutely necessary.

Heat Exhaustion:

- Loosen the victim's tight clothing.
- Give the victim *sips* of cool water.
- Make the victim lie down in a cooler place with the feet raised.

4 ACCIDENT INVESTIGATION

4.1 ACCIDENT INVESTIGATION PROCEDURES

An accident investigation will be performed by the supervisor at the location where the accident occurred. The safety coordinator is responsible for seeing that the accident investigation reports are being filled out completely and that the recommendations are being addressed. Supervisors will investigate all accidents, injuries and occupational diseases using the following investigation procedures:

- Implement temporary control measures to prevent any further injuries to employees.
- Review the equipment, operations and processes to gain an understanding of the accident situation.
- Identify and interview each witness and any other person who might provide clues to the accident's causes.
- Investigate causal conditions and unsafe acts; make conclusions based on existing facts.
- Complete the accident investigation report.
- Provide recommendations for corrective actions.
- Indicate the need for additional or remedial safety training.

Accident investigation reports must be submitted to the safety coordinator within 24 hours of the accident.

OSHA requires employers to report any/all of the following within 8 hours of the incident:

- Fatalities
- A single incident which requires hospitalization of 3 or more employees

OSHA CENTRAL TELEPHONE NUMBER: 1-800-321-6742

4.2 ACCIDENT INVESTIGATION REPORT

Report No.:

Company:

Address:

1. Name of injured:
2. Sex: M F Age: _____ Date of accident:
3. Time of accident: _____a.m. _____p.m. Day of accident:
4. Employee's job title:
5. Length of experience on job: _____years: _____months

6. Address of location where the accident occurred:
7. Nature of injury, injury type, and part of the body affected:
8. Describe the accident and how it occurred:
9. Cause of the accident:
10. Was personal protective equipment required? yes no
    Was it provided? yes no
    Was it being used? yes no
    If "no," explain:
    Was it being used as trained by supervisor or designated trainer? yes no
    If "no," explain:
11. Witness(es):
12. Was safety training provided to the injured? yes no
    If "no," explain:
13. Interim corrective actions taken to prevent recurrence:
14. Permanent corrective action recommended to prevent recurrence:
15. Date of report: _____ , _____ 20
    Prepared by:

    Supervisor **(Signature)**: _____ Date: _____
16. Status and follow-up action taken by safety coordinator:

    Safety Coordinator **(Signature)** _____ Date _____

4.3 INSTRUCTIONS FOR COMPLETING THE ACCIDENT INVESTIGATION REPORT

An accident investigation is not designed to find fault or place blame, but it is an analysis of the accident to determine causes that can be controlled or eliminated.

(Items 1-6) Identification:

(Item 7) **Nature of Injury:** Describe the injury, e.g., strain, sprain, cut, burn, fracture.
Injury Type: First aid—injury resulted in minor injury/treated on premises; Medical—injury treated off premises by physician; Lost time—injured missed more than one day of work; No Injury—no injury, near-miss type of incident.
Part of the Body: Part of the body directly affected, e.g., foot, arm, hand, head.

(Item 8) **Describe the accident**: Describe the accident, including exactly what happened, and where and how it happened. Describe the equipment or materials involved.

(Item 9) **Cause of the accident:** Describe all conditions or acts which contributed to the accident, e.g.—

a. unsafe conditions (spills, grease on the floor, poor housekeeping or other physical conditions).
b. unsafe acts (unsafe work practices such as failure to warn, failure to use required personal protective equipment).

(Item 10) **Personal protective equipment:** This section is self-explanatory.

(Item 11) **Witness(es):** List name(s), address(es), and phone number(s).

(Item 12) **Safety training provided:** Was any safety training provided to the injured relating to the work activity being performed?

(Item 13) **Interim corrective action:** Measures taken by supervisor to prevent recurrence of incident, e.g., barricading accident area, posting warning signs, shutting down operations.

(Item 14): This section is self-explanatory.

(Item 15): This section is self-explanatory.

(Item 16) **Follow-up:** Once the investigation is complete, the safety coordinator shall review and follow up the investigation to ensure that corrective actions recommended by the safety committee and approved by the employer are taken and that control measures have been implemented.

5 RECORDKEEPING PROCEDURES

The safety coordinator will control and maintain all employee accident and injury records. Records are maintained for a minimum of five (5) years and include:

- Accident Investigation Reports, see Section 7, page 17
- Workers' Compensation First Report of Injury or Illness
- Log and Summary of Occupational Injuries and Illnesses as required by OSHA's Recordkeeping Regulation, 29 CRF 1904.2:
  - OSHA Form 300 (Rev. 1-2004): Log of Work Related Injuries and Illnesses. A blank copy of this form is included in **Appendix C**.
  - OSHA Form 300A (Rev. 1-2004): Summary of Work Related Injuries and Illnesses
  - OSHA Form 301: Injury and Illness Incident Report. A blank copy of this form is included in **Appendix C**.

6 SAFETY RULES, POLICIES AND PROCEDURES

The safety rules contained on these pages have been prepared to protect you in your daily work. Employees are to follow these rules, review them often and use good common sense in carrying out assigned duties.

These safety rules shall include both general workplace safety rules and job-specific safety rules.

General Rules:

All employees are to report to work each day well rested and prepared for the daily duties. Operation of heavy equipment including trucks, excavators and drill rigs should be conducted in a safe manner at all times. If for any reason and employee cannot complete their duties in a safe manner, the safety supervisor should be notified and the employee should not show up to work. All traffic and highway rules should be abided to at all times while operating company vehicles.

Job-Specific Rules:

- Inspect drill rig and tooling before use
- Evaluate weather conditions and dress appropriately
- Evaluate potential slip, trip and fall hazards
- Utilize road cones and/or appropriate signage to secure work location
- Minimum PPE includes safety toe or steel toe boots, safety glasses, reflective vests or clothing and hard hat.
- Engage truck emergency breaks and use wheel chocks during rig onloading and offloading
- Inspect site for subsurface utilities prior to commencing drilling activities
- Maintain a minimum of 2-feet of distance between the edge of the drilling string and the outer marking of any subsurface utility
- Discuss boring locations with onsite consultant and geophysical contractor prior to advancement of each soil boring
- Evaluate overhead wires prior to extending the rig mast
- Consider location of the closest hospital shall be made for each project
-

6.1 ALL EMPLOYEES

6.1.1 HOUSEKEEPING

1. Use caution signs/cones to barricade slippery areas.
2. Do not store or leave items on stairways.
3. Return tools to their storage places after using them.
4. Do not block or obstruct stairwells, exits or accesses to safety and emergency equipment such as fire extinguishers or fire alarms.
5. Do not place materials such as boxes or trash in walkways and passageways.
6. Do not use gasoline for cleaning purposes.
7. Mop up water around water fountains, drink machines and ice machines.

6.1.2 LIFTING PROCEDURES

General

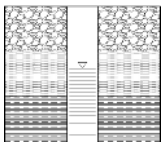
Appendix A

CDD Daily Field Safety Checklist

CDD Daily Field Safety Checklist

Project Address:

Project Date:



Client:

Client Site Contact:

Dig Safe Ticket #(s):

Basic PPE: Hard hat, reflective safety vest, steel or safety toe boots, safety glases and gloves.

Site Information

Time Onsite: Drill Rig:

Time Offsite: CDD Personnel:

Pre-Drilling Site Walk

	Inspection Performed Y/N	Hazard Identified Y/N
1. Walk property boundary and observe utililty markouts and potential conflicts.		
2. Walk boring locations and observe overhead hazards (cables, roof structures, arc hazards).		
3. Identify uneven ground / rollover hazards.		
4. If indoors, is there adequate ventilation for exhaust vapors?		
5. Discuss potential hazards (chemical, radiological, etc.) with consultant and appropriate PPE selection.		
6. Identify potential vehicle/ traffic concerns. Place road cones and position machine to protect driller and field staff.		

7. Discuss additional safety concerns below:

CDD Driller Signature:_____ **Date:** _____

CDD Driller Signature:_____

Client Name (Print):_____ **Date:** _____

Client Signature:_____

TOOL BOX TALKS
Cut-off Saw Safety

Cutoff saws can also be referred to as "quickie saws." Cutoff saws are used for a variety of reasons in the construction trade, namely cutting steel rebar or concrete. Cutoff saws use a round cutting wheel/blade that can be metal for concrete and that travel at extremely high speeds. The blade of the saw is an extremely dangerous object due to its rotating speed and unguarded cutting surface. Cutoff saws can be powered electrically, with gas engines or hydraulically or with compressed air. Below are safety tips for cutoff saw users:

WORKSAFE TIPS

TRAINING REQUIRED
- Always train cutoff saw operators
- Review the owner's manual during training
- They present different hazards than chain saws
- A tool with the capability to cut steel or concrete can most definitely injure an operator

HAZARDS
Cutoff saws expose users to the following hazards:
- Noise from engine and cutting action
- Vibration transmitted through handles
- Dust that contains silica from cutting concrete
- Flying objects as saw makes the cut
- Cutting disc explosion due to high RPM
- Pinch points from unguarded drive belt

PERSONAL PROTECTIVE EQUIPMENT
- Eye protection - flying wastes/disc fragments
- Hearing protection due to extreme noise
- Dust filtering mask when exposed to dusts
- Protective footwear in case tool is dropped
- Gloves for flying objects and vibration

PRE-USE INSPECTION
- Blade not cracked, chipped or warped
- Blade is not excessively worn
- Saw is fueled when cold
- Belt and blade guards are present and adjusted
- Wear Personal Protective Equipment

BEST PRACTICES
- Limit persons or bystanders in the area a cut-off saw is being used.
- Use the saw only for its intended application.
- Match saw discs to the material being sawed.
- Leave guards on saws always.
- Maintain guards in good condition.
- Adjust guards with the saw OFF.
- Adjust the guard before cutting.
- Use wet methods when cutting concrete.
- Concrete dust cutting exposes the operator to silica, a potentially cancer causing dust.
- Wear correct respiratory protection when wet cutting methods aren't possible – silica hazard!
- Match saw RPM with blade RPM – Never use blades with RPM limits LOWER than saw maximum RPM .
- Follow direction of travel when mounting a cutting wheel.
- Remove cutting wheels when transporting a saw – transportation movement can damage a blade.
- Mount cutting discs with the correct tools
- Inspect blades for cracks, warping, overheating or excessive wear BEFORE USE.
- Fuel gasoline-powered saws only when the saw has cooled.
- Use a funnel and safety gasoline can when fueling cutoff saws.
- Start saw properly, on the ground – never "jerk start" cutoff saws.
- Don't set saw down until the blade has stopped!
- Never "hand off" a saw with the blade rotating!

WorkSAFE
Smart, Accident-Free Environments
www.worksafecenter.com
888.499.SAFE (7233)

Tool Box Talk

Date of Discussion_____

Instructor_____

Attendees:

1._____

2._____

3._____

4._____

5._____

6._____

7._____

8._____

9._____

10._____

11._____

12._____

Follow-up Items

These advisory materials have been developed from national standards and sources believed to be reliable, however, no guarantee is made as to the sufficiency of the information contained in the material and Missouri Employers Mutual Insurance Company assumes no liability for its use. Advice about specific situations should be obtained from a safety professional.

Appendix B

Geoprobe Inspection Form

Geoprobe Direct Push Machine Inspection Form: (sonic rig n/a)

Company Name: Location: Date of Inspection:

Equipment Information				Crew Information	Job Information
Unit Number	Current Hours	Next Service Hour	Unit Serial #	Supervisor:	Job Name:

Inspector: Geoprobe Model #

ENGINE COMPARTMENT	Y	N	NA	Comments
Engine oil level add |----------| full				
Engine coolant level add |----------| full				
Hyd. oil level (site glass) btm |----------| top				
Hyd. drain plug cap in place				
Hyd. fill cap installed				
Radiator cleanliness				
Master disconnect secure, clean, functioning				
Battery clean and secure				
Fuse and relay box clean, secure, closed				
Belt in good condition and proper tension				
Air filter cover secure, orientated correctly				
Fuel cap installed				
Hydraulic oil cooler clean				
Hyd lines overall condition and free of leaks				
Wiring secure, condition, frays, corrosion, etc				
MACHINE CHASSIS				
Tracks' condition and correct tension				
Grease chassis as reqd				
Inspect Hyd cylinders for leaks				
Hyd lines overall condition and free of leaks				
Hyd manifolds for security, leaks, damage				
Emergency Stops condition & operation				
Fire Extinguisher				
Strobe light operation				
Wiring secure, condition, corrosion, etc				
Check for loose or missing fasteners				
Frame for damage, cracks, etc				
REMOTE SYSTEMS				
Wireless TX condition, batteries, operation				
Wireless RX security, condition, operation				
Tether Remote – cable, box, condition				
Remote E-stop functionality				

CONTROL PANEL	Y	N	NA	Comments
Cleanliness				
MD3 display condition & messages				
Alarm / Warning light operation				
Manual levers in neutral and secure				
Rocker switches, condition, operation				
Aux flow controls				
Gauges working				
Enable switch operation and condition				
Overlay condition and readability				
Hydraulics free of leaks and secure				
Electrical harness security & condition				
FOOT				
Slides adjusted, secure, lubricated				
Hydraulics free of leaks and secure				
Check for loose or missing fasteners				
GH Hammer charged, secure, condition				
Pull latch security and condition				
Electrical harness security & condition				
E- stop pull cable adjustment, operation				
MACHINE ACCESSORIES				
Moyno Pump or other				
Drop Hammer secure, hyd hoses, lubricated				
Wire Rope condition, secure, lay on drum				
Winch mast shives secured rotating freely				
Mast cylinder upper roll pin installed				
Winch drum backing plate / tensioner				
Winch safety hook condition, & operation				
Extruder installation correct and secure				
Pressure washer instl correct and secure				
Racks, Trays, & etc instl correct & secure				
Safety cage, condition, operation				

MACHINE DISCREPANCIES	SAFETY CRITICAL *(Y/N)*	CORRECTIVE ACTION

FIELD / UNIT NOTES

1 - 800 – GEOPROBE
WWW.GEOPROBE.COM

Appendix C

OSHA 300 and 301 Log Forms

OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 20_

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name Core Down Drilling, LLC

City Brewster State NY

Identify the person			Describe the case			Classify the case — CHECK ONLY ONE box for each case based on the most serious outcome for that case:				Enter the number of days the injured or ill worker was:		Check the "Injury" column or choose one type of illness: (M)					
(A) Case no.	(B) Employee's name	(C) Job title (e.g., Welder)	(D) Date of injury or onset of illness	(E) Where the event occurred (e.g., Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g., Second degree burns on right forearm from acetylene torch)	(G) Death	(H) Days away from work	Remained at Work: (I) Job transfer or restriction	Remained at Work: (J) Other record-able cases	(K) Away from work	(L) On job transfer or restriction	(1) Injury	(2) Skin disorder	(3) Respiratory condition	(4) Poisoning	(5) Hearing loss	(6) All other illnesses
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	days	days	☐	☐	☐	☐	☐	☐
					Page totals➤							(1) Injury	(2) Skin disorder	(3) Respiratory condition	(4) Poisoning	(5) Hearing loss	(6) All other illnesses

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no work-related injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the Log. If you had no cases, write "0."

Employees, former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR Part 1904.35, in OSHA's recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
_____	_____	_____	_____
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
_____	_____
(K)	(L)

Injury and Illness Types

Total number of . . .	(M)		
(1) Injuries	_____	(4) Poisonings	_____
		(5) Hearing loss	_____
(2) Skin disorders	_____	(6) All other illnesses	_____
(3) Respiratory conditions	_____		

Post this Summary page from February 1 to April 30 of the year following the year covered by the form.

Public reporting burden for this collection of information is estimated to average 58 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

Establishment information

Your establishment name Core Down Drilling, LLC

Street **PO Box 763**

City **Brewster** State **NY** ZIP **10509**

Industry description (*e.g., Manufacture of motor truck trailers*)
Environmental & Geotechnical Drilling

Standard Industrial Classification (SIC), if known (*e.g., 3715*)
5 0 8 2

OR

North American Industrial Classification (NAICS), if known (e.g., 336212)
___ ___ ___ ___ ___ ___

Employment information *(If you don't have these figures, see the Worksheet on the back of this page to estimate.)*

Annual average number of employees _____

Total hours worked by all employees last year _____

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Daniel Bellucci — Company executive
Owner — Title
( ) - 845-803-4347 — Phone
/ / — Date

OSHA's Form 301
Injury and Illness Incident Report

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

This *Injury and Illness Incident Report* is one of the first forms you must fill out when a recordable work-related injury or illness has occurred. Together with the *Log of Work-Related Injuries and Illnesses* and the accompanying *Summary,* these forms help the employer and OSHA develop a picture of the extent and severity of work-related incidents.

Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must fill out this form or an equivalent. Some state workers' compensation, insurance, or other reports may be acceptable substitutes. To be considered an equivalent form, any substitute must contain all the information asked for on this form.

According to Public Law 91-596 and 29 CFR 1904, OSHA's recordkeeping rule, you must keep this form on file for 5 years following the year to which it pertains.

If you need additional copies of this form, you may photocopy and use as many as you need.

Completed by _____

Title _____

Phone (_____)_____--_____ **Date** ____/ ____/ ____

Information about the employee

1) **Full name** _____

2) **Street** _____

City _____ **State** _____ **ZIP** _____

3) **Date of birth** _____ / _____ / _____

4) **Date hired** _____ / _____ / _____

5) ❒ **Male**
❒ **Female**

Information about the physician or other health care professional

6) **Name of physician or other health care professional** _____

_____

7) **If treatment was given away from the worksite, where was it given?**

Facility _____

Street _____

City _____ **State** _____ **ZIP** _____

8) **Was employee treated in an emergency room?**
❒ **Yes**
❒ **No**

9) **Was employee hospitalized overnight as an in-patient?**
❒ **Yes**
❒ **No**

Information about the case

10) **Case number from the *Log*** _____ *(Transfer the case number from the Log after you record the case.)*

11) **Date of injury or illness** _____ / _____ / _____

12) **Time employee began work** _____ **AM / PM**

13) **Time of event** _____ **AM / PM** ☐ **Check if time cannot be determined**

14) ***What was the employee doing just before the incident occurred?*** **Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific.** ***Examples:*** **"climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."**

15) ***What happened?*** **Tell us how the injury occurred.** ***Examples:*** **"When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."**

16) ***What was the injury or illness?*** **Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or sore."** ***Examples:*** **"strained back"; "chemical burn, hand"; "carpal tunnel syndrome."**

17) ***What object or substance directly harmed the employee?*** ***Examples:*** **"concrete floor"; "chlorine"; "radial arm saw."** ***If this question does not apply to the incident, leave it blank.***

18) ***If the employee died, when did death occur?*** **Date of death** _____ / _____ / _____

Public reporting burden for this collection of information is estimated to average 22 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Persons are not required to respond to the collection of information unless it displays a current valid OMB control number. If you have any comments about this estimate or any other aspects of this data collection, including suggestions for reducing this burden, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.