AECOM

Site Characterization Work Plan

Off-Site 91 Leighton Avenue (Site No. C828231A)

New York State Department of Environmental Conservation

Project number: 60788778

September 2026

Delivering a better world

Certification

I, Mike Gutmann, PG, certify that I am currently a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this Site Characterization Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10) and Green Remediation (DER-31).



Signature	Date
	9/28/2026

Quality Information

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Revision History

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Acronyms and Abbreviations

AECOM	AECOM USA, Inc.
ATL	Atlantic Testing Laboratories, Limited
bgs	below ground surface
BMP	best management practice
CAMP	Community Air Monitoring Program
CLCPA	Climate Leadership & Community Protection Act
DER	Division of Environmental Remediation
DPT	direct push technology
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
FAP	Field Activity Plan
FS	Feasibility Study
FWIRA	Fish and Wildlife Resource Impact Analysis
ft	feet
GPR	ground penetrating radar
GSR	Green and Sustainable Remediation
HASP	Health and Safety Plan
ID	inner diameter
IDW	investigation derived waste
Matrix	Matrix Environmental Technologies Inc.
Momentum	Momentum Environmental
MS	matrix spike
MSD	matrix spike duplicate
NTU	nephelometric turbidity units
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
PAHs	polycyclic aromatic hydrocarbons
PID	photoionization detector
ppb	parts per billion
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
ROD	Record of Decision
ROW	right of way
SC	Site Characterization
SCG	Standards, Criteria, or Guidance
SCWP	Site Characterization Work Plan
SVI	soil vapor intrusion
TCE	Trichloroethene
TCL	Target Compound List
µg/m^3	micrograms per cubic meter
ULSD	Ultra Low Sulfur Diesel
USCS	Unified Soil Classification System
VOC	volatile organic compound
WA	work authorization

1. Introduction

AECOM USA, Inc. (AECOM) is pleased to submit this Site Characterization Work Plan (SCWP) to the New York State Department of Environmental Conservation (NYSDEC) for the 91 Leighton Avenue Off-Site Area ("the Site", Site No. C828231A). This work is located off-Site of the Brownfield Cleanup Program property at 91 Leighton Avenue (Site No. C828231). NYSDEC requested that a Site Characterization (SC) be conducted on the Off-Site Area. This SCWP incorporates SC field investigation elements requested by the NYSDEC in their Notice to Proceed correspondence dated April 17, 2026, the New York State Department of Health (NYSDOH) soil vapor intrusion (SVI) field elements requested on May 18, 2026, AECOM's 2.11 work scope and budget package approved by NYSDEC on July 20, 2026, and additional communication since that time. This SCWP will be used by AECOM personnel in conjunction with AECOM's Health and Safety Plan (HASP, in **Appendix A**), Field Activity Plan (FAP, in **Appendix B**), Quality Assurance Project Plan (QAPP, in **Appendix C**), and Green and Sustainable Remediation (GSR) Plan (in **Appendix D**).

The Site comprises the downgradient areas adjoining 91 Leighton Avenue in the City of Rochester, Monroe County, New York. **Figure 1** presents the Site Location. The Site boundary is not currently defined but includes the City-owned roadways and right-of-ways (ROWs) for Leighton Avenue to the north and Greenleaf Street to the west, followed by select medium density residential properties. Previous investigations at 91 Leighton Avenue identified solvents (e.g., trichloroethene [TCE], etc.) in the groundwater and soil vapor, which may have migrated off-site to the north and west.

The investigation scope of work described in this SCWP includes the following activities:

- Overburden and bedrock monitoring well installation;
- Groundwater monitoring, sampling and analysis; and,
- Soil vapor intrusion sampling and analysis.

1.1 Site Description and Background

1.1.1 Site History

Leighton Avenue and Greenleaf Street were constructed in prior to the 1900's, and the nearby residential homes were constructed between the 1870's and early 1900's.

The property at 91 Leighton Avenue was developed in 1930 with a commercial/industrial building utilized for various purposes including manufacturing, warehousing, and distribution (NYSDEC, 2026). Between at least 1938 and 1955, it was occupied by Rochester Can Co., Inc., a can manufacturing facility, and maintained a metal lacquer spray booth and die storage area. A railroad spur was also located on the eastern portion of the property between at least 1938 and 1971. Information regarding operations from 1955 to 2022 is limited. The City of Rochester issued a permit to remove one (1) 550-gallon tank in 1982, but no information regarding the tank location or closure documentation has been obtained by NYSDEC. A fire in October 2022 destroyed the 55,925 square foot building, which was primarily used for warehousing, distribution, and vehicle storage at that time. The fire was started by fuel that was ignited while a tenant was working on a vehicle, causing the building to burn to the ground. The property has been unoccupied since the 2022 fire and remains undeveloped.

1.1.2 Contamination

The primary contaminants of concern associated with the property at 91 Leighton Avenue are chlorinated volatile organic compounds (VOCs), primarily TCE, in soil, groundwater, and soil vapor. Investigation of the Site is necessary to determine if the identified contaminants of concern are present in groundwater, soil vapor, and/or indoor air in the adjacent downgradient off-site area.

Previous environmental investigations conducted at 91 Leighton Avenue identified TCE and its associated degradation products in groundwater throughout the property, with the highest concentrations at the north end, exceeding groundwater standards (5 parts per billion [ppb]), with a maximum concentration of 3,500 ppb (NYSDEC, 2026). TCE was also detected in soil vapor at elevated concentrations up to 420 micrograms per cubic meter (µg/m^3), at the central-west portion of the property. The former metal lacquer spray booth was located in the general vicinity of the elevated concentrations of chlorinated VOCs in groundwater and soil vapor and may be a potential source of contamination. Elevated levels of heavy metals and polycyclic aromatic hydrocarbons (PAHs) were identified in soil, likely associated with the placement of fill material and remnant materials from the fire. A remedial investigation is currently underway to assess the nature and extent of contamination at 91 Leighton Avenue to determine the appropriate remedial actions (NYSDEC, 2026).

1.1.3 Geology / Hydrogeology

The City of Rochester and vicinity is situated in the Erie-Ontario Lowlands physiographic province of New York State (Broughton, et al. 1966). The province is characterized by low plains with little relief. In the Ontario lowland south of Lake Ontario, two escarpments occur which correspond to the underlying Onondaga Limestone and Lockport Dolomite bedrock units. These rocks are Silurian in age, strike east-west, and dip gently to the south at approximately 1 degree or 40 to 50 feet per mile (Rickard, L. *et al.,* 1970). The dip of the rocks follow the structural trend of a homocline affecting the Paleozoic basement rocks across western and southern New York State. In general, dip increases from west to east across western and central New York. Bedrock joints are common in the Lockport Formation and are a result of structural stresses during the late Paleozoic Appalachian deformation (Zenger 1965). Bedrock outcrops along the nearby Genesee River are characterized by occasional near vertical joints and horizontal bedding planes. The Genesee River is located approximately 2 miles west of the Site.

The following geologic units are assumed to be present at the Site from ground surface to approximately 14 feet below ground surface (bgs) based on previous investigations completed at 91 Leighton Avenue:

- Fill consisting of gravel, sand, slag, etc. is present from surface to the top of bedrock.
- Consolidated sediments composed of lacustrine silt and clay are present between the fill and the top of bedrock.
- Top of bedrock, which is upper Silurian Lockport Group dolostone, is present from approximately 7 to 14 feet bgs.
- The depth to groundwater is approximately 7 to 12 feet bgs.

2. Site Characterization Work Plan

2.1 Purpose

The purpose of this SCWP is to identify the procedures and criteria to complete the SC in accordance with DER-10. The primary objectives of the proposed SC includes, but is not limited to, the following:

- Evaluate groundwater in overburden and bedrock to characterize hydrogeologic conditions and evaluate potential contaminant migration pathways;
- Collect and analyze groundwater samples from newly installed monitoring wells to assess contaminant concentrations and groundwater quality; and,
- Evaluate SVI potential at adjacent residential homes through the collection of indoor air and sub-slab vapor samples and evaluation of the data compared to current New York State Department of Health requirements (NYSDOH, 2006).

The locations of the proposed monitoring wells, and SVI sampling properties are shown on **Figure 2** (locations may change based on physical access constraints). NYSDEC will be notified prior to any changes to the proposed sampling locations.

2.2 Scope of Work

The scope of work for the field investigation consists of the following tasks:

- Task 1 – Utility Clearance
- Task 2 – Soil Boring Advancement, Well Installation and Well Development
- Task 3 – Groundwater Monitoring, Sampling, and Analysis
- Task 4 – Soil Vapor Intrusion Sampling and Analysis
- Task 5 – Topographic and Site Survey
- Task 6 – Investigation Derived Waste Management

The field investigation tasks are further described below.

2.2.1 Task 1 – Utility Clearance

Prior to mobilization, the drilling subcontractor, Atlantic Testing Laboratories, Limited (ATL), shall have all required public utility clearance mark-outs and right of way (ROW) permits necessary for commencing drilling activities at the site.

Prior to any intrusive work (i.e., well and sub-slab vapor pin advancement), public utility operators will be contacted via 811 UDIG NY, Inc. (https://udigny.org/) and requested to mark underground lines leading to the work areas, before the intrusive work begins. If available, it is requested that NYSDEC and/or each property owner provide AECOM with available pre-existing maps and/or information showing underground utilities that are present at each proposed location. These utility maps shall be considered to inform the potential location of underground utilities. Once public utility information is obtained, geophysical screening will be conducted by a utility locating subcontractor to identify the presence of underground utilities or any anomalies (e.g., underground storage tanks) within the work areas. This will be done using geophysical methods (i.e., ground penetrating radar and electromagnetic conductivity).

Prior to any intrusive work, geophysical screening will be conducted by Matrix Environmental Technologies Inc. (Matrix) to identify the presence of underground utilities or any anomalies (e.g., underground storage tanks) within the work areas. This will be done using geophysical methods (i.e., ground penetrating radar and electromagnetic conductivity). Public utility clearances through 811 UDIG will be required prior to mobilization by the private utility surveyor.

2.2.2 Task 2 – Soil Boring Advancement, Well Installation and Well Development

An AECOM geologist will oversee the advancement of four (4) soil borings throughout the Site for well installation (MW-01, MW-02, BW-01, and BW-02, as shown on **Figure 2**) by a drilling subcontractor, ATL. AECOM may recommend adjustments to proposed monitoring well locations and will inform NYSDEC if adjustments are recommended. Prior to mobilization, the drilling subcontractor will complete the required utility clearance mark-outs and maintain permits necessary for commencing drilling activities. Additionally, at each proposed soil location, ATL will hand clear/soft dig to a depth of 5 feet bgs. If necessary, air knife or Vactron will be utilized to aid in hand clearing.

Two (2) soil borings (MW-01 and MW-02) will be advanced up to the bedrock interface using a track-mounted DPT or other drill rig and converted into overburden monitoring wells. The purpose of this work is to assess the presence or absence of contaminant concentrations in overburden groundwater downgradient of the source property, and to evaluate hydrogeologic conditions. These monitoring wells will be installed to intercept and triangulate groundwater within the overburden and advanced to approximately 12 to 15 ft bgs. Borings will be advanced using 4¼-inch diameter hollow stem auger drilling methods. Each overburden monitoring well will be constructed with a 10-foot-long, 2-inch inner diameter (ID) Schedule 40 PVC, 0.010” slot size screen and riser to grade and finished with a lockable J-plug and flush mount steel curb box.

Two (2) soil borings (BW-01 and BW-02) will be advanced into bedrock up to 30 feet bgs using a rotary/core drill rig and converted into bedrock monitoring wells. The purpose of this work is to assess the presence or absence of contaminant concentrations in bedrock groundwater downgradient of the source property, and to evaluate hydrogeologic conditions. These monitoring wells will be installed to intercept groundwater within the shallow bedrock to a depth of approximately 30 ft bgs. Borings will be advanced using 6¼-inch diameter hollow stem augers through overburden and converted to rotary drilling methods upon encountering bedrock. A nominal 6-inch rock-socket will be advanced approximately three (3) ft into the bedrock, and a four (4) inch carbon steel casing will be grouted into the bedrock rock socket to seal off the overburden. After at least 24-hours, the bedrock will be cored using an Nx-tooling to approximately 30 ft bgs. A nominal 3-7/8 -inch roller bit will then be utilized to ream the well to completion. Each bedrock monitoring well will be constructed as an open bedrock well and finished with a flush mount steel curb box.

The drill rig will be capable of advancing a 2-inch outside diameter by 4- or 5- foot-long acetate lined macrocore sampler through the overburden material, terminating at the bedrock interface. Drilling and soil sampling for characterization purposes will be conducted continuously to classify the subsurface material. Soil samples will be visually described and classified, inspected for signs of contamination, and screened with a PID for the presence of organic vapors by an AECOM geologist. The AECOM geologist will classify soils in accordance with the Unified Soil Classification System (USCS) and record PID measurements for each one (1) foot interval. Subsurface information will be recorded on soil boring logs. No soil samples will be collected from the borings intended to be constructed as monitoring wells.

Rock cores will be drilled at each of the bedrock monitoring wells to a target depth of approximately 30 ft bgs (or approximately 12 ft into bedrock, whichever is shallower). Rock cores will be collected to obtain additional stratigraphic data. After the geologist completes logging and takes photographs, the rock cores will be drummed for off-site disposal.

After the AECOM geologist completes soil logging and soil sampling, drilling spoils will be placed into New York State Department of Transportation (NYSDOT)-approved 55-gallon drums as investigation-derived waste (IDW) in the IDW staging area (discussed further in Section 2.2.6).

A community air monitoring program (CAMP) will be implemented during intrusive site activities to monitor and record potential airborne contaminants during drilling activities. In accordance with DER-10 guidance, CAMP monitoring will include continuous real-time monitoring for VOCs and particulates. Two (2) CAMP stations will be established in the field, with one (1) CAMP at an upwind position and one (1) CAMP station at a downwind position. Daily CAMP data summary reports will be provided to NYSDEC and NYSDOH Project Managers within one (1) business day of completion of each field activity. The Daily CAMP report will consist of a figure showing work zones and monitoring stations and downloaded CAMP

data. The report will also indicate any CAMP exceedances and the corrective actions taken, if needed. Refer to **Appendix E** for the NYSDOH Generic Community Air Monitoring Plan.

New monitoring wells will be developed using hydrolift and peristaltic pumps to: remove residual drilling cuttings; improve pumping performance of the well; and to collect representative groundwater samples from the wells. Water quality parameters including pH, conductivity, dissolved oxygen, turbidity, temperature, and oxidation-reduction potential will be monitored at regular intervals. Well development water will be placed into NYSDOT-approved 55-gallon drums as IDW in the IDW staging area.

AECOM staff will take field notes using digital EQuIS Collect Forms.

2.2.3 Task 3 – Groundwater Monitoring, Sampling, and Analysis

Two (2) rounds of groundwater monitoring, sampling and analysis will be conducted, in two (2) different seasons to account for seasonal variability. Prior to the start of each groundwater sampling event, a complete synoptic round of water levels will be collected by AECOM field staff at the four (4) newly installed monitoring wells (MW-01, MW-02, BW-01, and BW-02) and the existing monitoring well network on-site (MW-01, MW-02, MW-03, MW-04, MW-05, MW-06, MW-07, MW-08, GPMW-01, GPMW-05, GPMW-10, GPMW-13, GPMW-14, and GPMW-15, as shown on **Figure 2**). Groundwater levels will be measured from the highest point of the top of the inner well casing.

Groundwater sampling will be performed in accordance with low-flow groundwater sampling procedures as referenced in the FAP and QAPP. One (1) groundwater sample will be collected from each monitoring well and submitted for laboratory analysis of target compound list (TCL) VOCs (Method 8260C). Appropriate quality assurance / quality control (QA/QC) samples will also be collected, including field duplicates, matrix spike (MS) samples, matrix spike duplicate (MSD) samples, equipment/rinse blanks, field blanks, and trip blanks. The proposed groundwater sampling and QA/QC analytical plan is presented in **Table 1**.

Dedicated sampling equipment will be used at each well. Purge water from monitoring wells will be placed into NYSDOT-approved 55-gallon drums as IDW in the IDW staging area.

AECOM staff will take field notes using digital EQuIS Collect Forms.

2.2.4 Task 4 – Soil Vapor Intrusion Sampling and Analysis

Soil vapor intrusion sampling will be conducted during the upcoming heating season, which runs from November 15, 2026 to March 31, 2027. Prior to mobilization, coordination and access agreements will need to be obtained from NYSDEC for each property proposed for sampling. A site access agreement will need to be executed by residents prior to entry. NYSDEC will provide AECOM with proof of access for each property before entry. AECOM staff will direct any questions from the property owners to NYSDEC. Refer to **Appendix F** for access agreements.

Indoor air, outdoor ambient air, and sub-slab soil vapor samples will be collected at the following four (4) residential properties, subject to access agreements:

- 61 Leighton Avenue
- 74-76 Leighton Avenue
- 82 Leighton Avenue
- 112 Leighton Avenue / 77 Herkimer Street

Indoor air samples will be collected from the basement and from the lowest living space level of each residence, where vapor infiltration is suspected, such as near sump pumps or indoor wells, or in a central location. Indoor air samples will be collected at approximately 3 feet above ground to represent a height at which occupants normally are seated or sleeping. A representative outdoor ambient air sample will be collected from a localized area that is not accessible to the public and is at an upwind location during the day of sampling. Indoor and outdoor air sampling will be conducted prior to the sub-slab vapor sampling.

Sub-slab soil vapor samples will be collected from a central location within the lowest level of each residence, away from foundation footings and from the soil or aggregate directly below the basement slab or slab on-grade if possible, depending on building and floor construction. A permanent sub-slab vapor pin will be installed by AECOM staff prior to sampling. Each vapor pin will be constructed with a stainless-steel sampling device and a flush mount steel protective casing. Dedicated sampling equipment will be used at each vapor pin. Each vapor sampling location will be leak tested prior to sampling.

Air and vapor samples will be collected using a 6-liter (L) Summa® canister over a 24-hour period at each location. Ideally, residences will be sampled on the same day if schedules allow. Air and vapor sampling will be performed in accordance with sampling procedures as referenced in the FAP and QAPP. Newly installed soil vapor pins will be purged and leak tested by AECOM field staff prior to sampling. Dedicated sampling equipment will be used at each vapor probe. Two (2) indoor air and one (1) sub-slab vapor samples will be collected from each residence and submitted for laboratory analysis of VOCs (Method TO-15). Appropriate QA/QC samples will also be collected, including a field duplicate. One (1) outdoor air ambient sample will be collected during the indoor air sampling program. The proposed SVI sampling and QA/QC analytical plan is presented in **Table 1**.

2.2.5 Task 5 – Topographic and Site Survey

An AECOM NYS licensed surveyor will complete a topographic and Site survey referenced to New York State Plane coordinates and vertical datum. The survey will be conducted to establish the location and elevation of the newly installed monitoring wells (MW-01, MW-02, BW-01, and BW-02), buildings, and notable site features. Refer to **Figure 2** for the proposed sampling locations.

2.2.6 Task 6 – Investigation-Derived Waste Handling

IDW generated during the field activities, including soil spoils, bedrock slurry, decontamination fluids, well development water, and purge water, will be containerized in NYSDOT approved 55-gallon drums and handled using the procedures described in the FAP. The drums with bedrock slurry will be allowed to settle and the water will be decanted into separate drums to allow for waste disposal of solids and water. The drums will be labeled as non-hazardous pending laboratory results. The IDW will be subject to waste characterization sampling as indicated in **Table 1**.

The drums will be staged in a secure location at 91 Leighton Avenue until transport and disposal are arranged.

Upon receipt of the waste characterization sample results, waste profiles will be generated for the IDW stored in the staging area, which will then be promptly transported under manifest by the waste subcontractor, Momentum Environmental (Momentum), for proper disposal. Rock cores will be left on-site or disposed as IDW.

2.3 Report Preparation

The SC Report will be prepared in accordance with DER-10 and DER-31 and submitted as a draft report within 60 days after all fieldwork has been completed and data has been received and validated.

A final version of the report will be submitted within 30 business days after the Department's comments on the draft report are received by AECOM.

The report for this task will include the following:

- A description of all field activities conducted on the Site during the SC;
- Summary of Environmental Data Records Search;
- A summary of previous investigations conducted on the source site at 91 Leighton Avenue (Site No. C828231);
- A discussion of analytical results;

- Data summary tables of analyzed compounds with available NYS standards, criteria, guidance (SCG), and non-compliance values highlighted, collected during this SC site work;
- A Site map depicting relevant Site features;
- Figures depicting monitoring wells, soil vapor probes, and key Site features;
- Figures depicting sample locations and NYS SCG non-compliance values from the groundwater and soil vapor analytical data collected during this SC;
- Figures depicting groundwater elevation contours;
- Field notes and/or daily activity logs;
- Photographs taken at the Site during field activities;
- Soil boring logs;
- Monitoring well construction logs;
- Monitoring well development logs;
- Monitoring well purge logs with water quality measurements;
- Soil vapor probe construction logs;
- Soil vapor probe purge, leak testing and sample logs;
- Survey field notes and Site sketches;
- A drawing depicting surveyed sampling and monitoring well locations, and notable site features;
- CAMP data;
- Data usability summary reports (DUSRs) (including Form 1s) containing only data from the current SC fieldwork; and,
- Summary of GSR elements in accordance with the Climate Leadership & Community Protection Act (CLCPA) and will be certified as prepared in substantial conformance with DER-31.

This task includes EQuIS submittals to NYSDEC for analytical data collected by AECOM during the SC.

2.4 Green & Sustainable Remediation Initiative Efforts

Development of this SCWP was completed with the goal of implementing sustainable practices where possible in accordance with the goals of the DER-31 Green Remediation Policy (January 2011 and November 2023 Memorandum). Pursuant to the NYSDEC DER-31 GSR initiative, GSR principles and techniques shall be implemented to the extent feasible during site investigation, interim remedial measures and site management stages of projects under NYSDEC programs. The major GSR components are as follows:

- Considering the environmental impacts of investigative technologies over the long term;
- Reducing direct and indirect greenhouse gas and other emissions;
- Increasing energy efficiency and minimizing use of non-renewable energy;
- Conserving and efficiently managing resources and materials;
- Reducing waste, increasing recycling, and increasing reuse of materials which would otherwise be considered a waste; and
- Incorporating GSR principles and techniques to the extent feasible in the future development at this site.

During implementation of this work plan, the following GSR efforts will be incorporated into field activities:

- Use of battery powered pumps.

- Reduce vehicle idling. All vehicles, both on and off road (including construction equipment) will be shut off when not in use for more than 5 minutes, consistent with 6 NYCRR Part 217 Motor Vehicle Emissions, Subpart 217-3 Idling Prohibition For Heavy Duty Vehicles.
- Use of Ultra Low Sulfur Diesel (ULSD) for drilling rigs.
- Use of low-flow sampling techniques to limit waste generation.
- Segregating recyclables from disposable waste material.
- Use phosphate-free detergents in place of organic solvents or acids.
- Use local staff (including subcontractors) when possible, to limit travel and petroleum fuel consumption.
- Use of newer equipment models meeting higher energy conservation standards.
- Source newer and lower-emission Tier 4 diesel equipment for pumps and drilling/ direct push equipment where possible.
- Use appropriately sized construction equipment, and pumps for each task.
- Use lower emission vehicles such as electric vehicles or small trucks or SUVs rather than full-size, where appropriate.
- GPR will be used as a non-invasive method, in lieu of excavating, to clear for utilities as well as identify any potential previously unidentified underground structures.
- IDW drums will be grouped and stored in a secure location throughout field activities and removed from the Site in a single event at the end of each field mobilization as applicable, rather than daily pickups.
- When applicable, visits to stores to purchase field supplies, etc., and trips to the laboratory to drop off sample coolers will be limited or combined to save energy, reduce emissions, reduce localized noise, vibration, and wear and tear on roads.

Throughout the SC, material and equipment use will be tracked to assess the effectiveness of BMPs. The New York State Department of Environmental Conservation Form A (Summary of Green Remediation Metrics) will be used for reporting. A copy of Form A is included in **Appendix D**.

2.5 General Notes

The field work conducted as part of this SC will be completed and/or overseen by qualified AECOM staff, who will follow the health and safety procedures outlined in the Health and Safety Plan (HASP, in **Appendix A**), the field sampling protocols outlined in the Field Activities Plan (FAP, in **Appendix B**), and the QA/QC protocols outlines in the Quality Assurance Project Plan (QAPP, in **Appendix C**).

Samples collected as part of this SC will be analyzed by the NYSDEC call-out laboratory, Pace Analytical Services, LLC, which is an Environmental Laboratory Approval program (ELAP) certified lab. Proper QA/QC will be collected in accordance with the Site-specific QAPP (**Appendix C**) and the Sample Analytical Program (**Table 1**). Category B deliverables are required for all groundwater, air and vapor analytical data. Level 3 data validation and DUSRs will be completed by AECOM.

3. Anticipated Field Schedule

This WA will be performed according to the following anticipated time frames:

Activity	Proposed Schedule
Preliminary Site Visit with NYSDEC	5/8/26
NYSDEC Approval of 2.11 Package	7/20/26
Utility Clearances	9/29/26
Drilling and Well Installation	mid-October
First Round Groundwater Monitoring & Sampling	Late October / early November
SVI Sampling	During the Heating Season (11/15/26 to 3/31/27)
Second Round Groundwater Monitoring & Sampling	Late Winter

4. References

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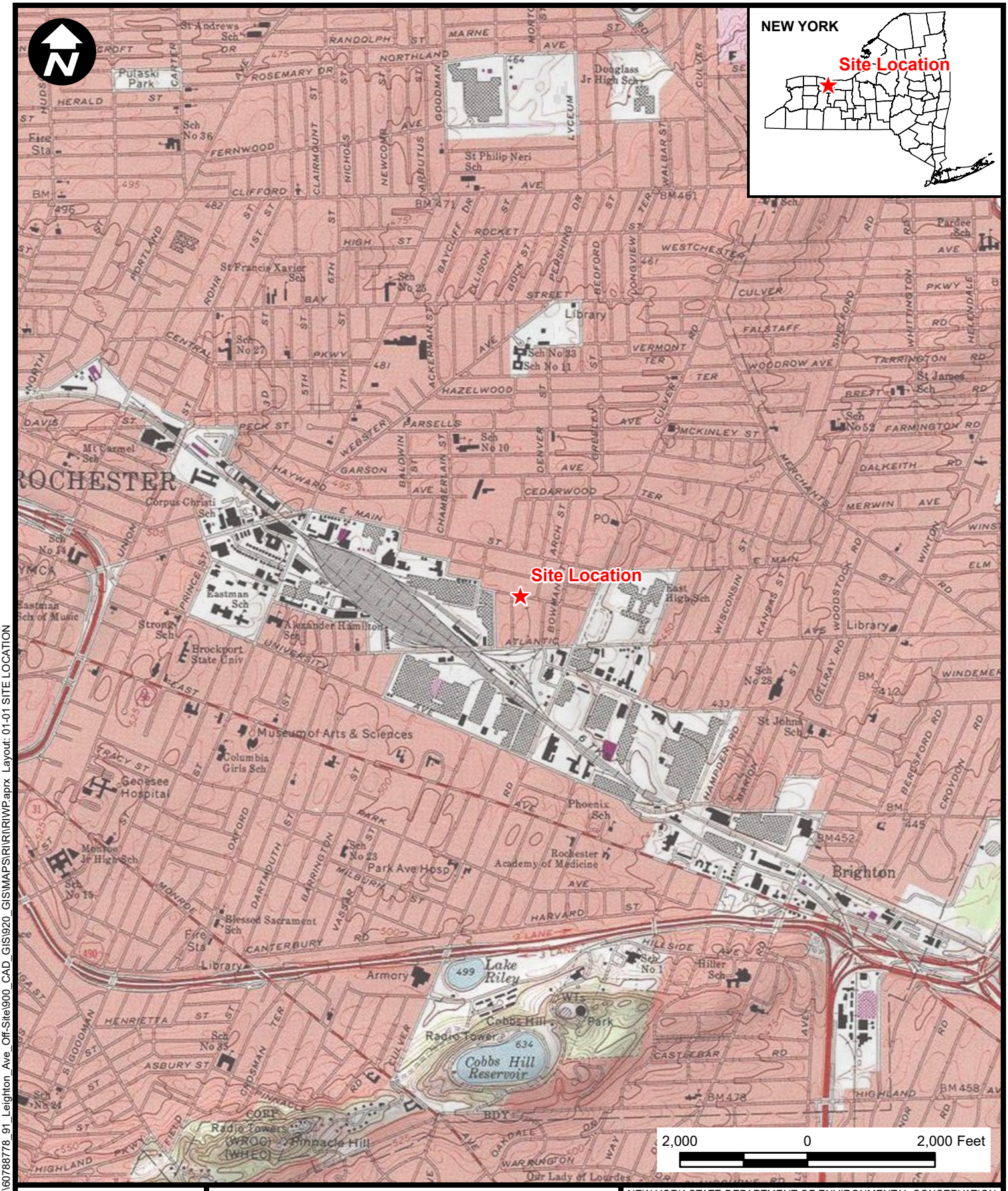
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Figures



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Source: USGS 1:24,000-scale topographic map, 7.5 x 7.5 Minute
Quadrangle: Mallory, 1978

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
OFF-SITE 91 LEIGHTON AVENUE
C828231A

SITE LOCATION

SITE CHARACTERIZATION WORK PLAN
OFF-SITE 91 LEIGHTON AVENUE
ROCHESTER, NEW YORK

FILE NAME:	DRAWN:	PROJECT NO.:	DATE:	FIGURE NO.:
RI.aprx	ET	60788778	8/14/2026	1

File Path: L:\DCS\Projects_ENV\60788778_91_Leighton_Ave_Off-Site\900_CAD_GIS\920_GIS\MAPS\RI\RI\RIWP.aprx Layout: 01-01 SITE LOCATION



Legend

- Proposed Bedrock Well
- Proposed Overburden Well
- Proposed Soil Vapor Intrusion Sampling (Sub-Slab Vapor and Indoor Air Sampling)
- Pre-existing SVI Sample Points
- Pre-Existing Wells (Approximate Location)

SOURCE(S):
NYS ITS GIS Program Office, 2020
Monroe County GIS Portal

25 0 25 50
Feet

AECOM

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
OFF-SITE 91 LEIGHTON AVE
C828231A

PROPOSED SAMPLING LOCATIONS

SITE CHARACTERIZATION WORK PLAN
OFF-SITE 91 LEIGHTON AVENUE
ROCHESTER, NEW YORK

FILE NAME:	DRAWN:	PROJECT NO.:	DATE:	FIGURE NO.:
RI.aprx	ET	60788778	8/14/2026	2

File Path: L:\DCS\Projects_ENV\60788778_91_Leighton_Ave_Off-Site\900_CAD_GIS\920_GIS\MAPS\RI\RI\RIWP.aprx Layout: 02 - PROPOSED SAMPLING PLAN

Tables

Table 1
Proposed Sampling Analyses
Site Characterization Work Plan
91 Leighton Avenue Off-Site, Rochester, NY (Site No. C828231A)

AECOM

Type of Sampling Locations	Proposed Sampling Location	Proposed Sampling ID	Approximate Depth (ft bgs)	Parameters								
				Groundwater		Vapor / Air	Waste					
				Summer	Fall	Winter						
				TCL VOCs (8260C)		VOCs (TO-15 SIM)	TCLP (1311/ 8260C/ 8270D/ 8081B/ 8151A/ 6010C/ 7470A)	Corrosivity, as pH (9040C/9045D)	Ignitability (1010B/1030)	Total Sulfide (9030B)	Total Cyanide (9014)	PCBs (8082A)
New Monitoring Wells (MWs)	Leighton Ave ROW	MW-01	15	1	1		2	2	2	2	2	2
	Greenleaf St ROW	MW-02	15	1	1							
	Leighton Ave ROW	BW-01	30	1	1							
	Leighton Ave ROW	BW-02	30	1	1							
Sub-Total	4	4	90	4	4		2	2	2	2	2	2
Soil Vapor Intrusion Samples (SVI) in Residential Homes	61 Leighton Ave	SVP-RES1-01	Sub-Slab			1						
		IA-RES1-01	Indoor Air Basement			1						
		IA-RES1-02	Indoor Air First Floor			1						
	74-76 Leighton Ave	SVP-RES2-01	Sub-Slab			1						
		IA-RES2-01	Indoor Air Basement			1						
		IA-RES2-02	Indoor Air First Floor			1						
	82 Leighton Ave	SVP-RES3-01	Sub-Slab			1						
		IA-RES3-01	Indoor Air Basement			1						
		IA-RES3-02	Indoor Air First Floor			1						
	112 Leighton Ave / 77 Herkimer St	SVP-RES4-01	Sub-Slab			1						
		IA-RES4-01	Indoor Air Basement			1						
		IA-RES4-02	Indoor Air First Floor			1						
	Background	OA-01	Outdoor Air			1						
Sub-Total	5	13	-			13						
Total Regular Aqueous Samples				4	4		1	1	1	1	1	1
Total Regular Vapor/Air Samples						13						
Total Regular Solid Waste Samples							1	1	1	1	1	1
QA/QC	Duplicates [1]			1	1	2	0	0	0	0	0	0
	Matrix Spike (MS) [2]			1	1	0	0	0	0	0	0	0
	Matrix Spike Duplicate (MSD) [2]			1	1	0	0	0	0	0	0	0
	Trip Blank [3]			1	1	0	0	0	0	0	0	0
	Equipment / Rinsate Blank [4]			1	1	0	0	0	0	0	0	0
	Total QA/QC Samples			5	5	2	0	0	0	0	0	0
Total Samples for Laboratory Analysis				9	9	15	2	2	2	2	2	2

Notes:

(1) Duplicate samples for groundwater will be collected at a rate of 1 per 20 samples. Duplicate samples for vapor will be collected at a rate of 1 per 10 samples.
(2) Matrix Spike and Matrix Spike Duplicate samples will be collected for groundwater samples only, at a rate of 1 per 20 samples.
(3) VOC trip blanks will be collected for groundwater samples only, at a rate of 1 per cooler containing VOC aqueous samples.
(4) Rinsate Blanks will be collected for groundwater samples only, at a rate of 1 per week per media or 1 per 20 samples.

bgs - below ground surface
ft - feet
QA/QC - quality assurance/quality control
TCL - Target Compound List
TCLP - Toxicity charecteristic leaching procedure (includes VOCs, SVOCs, pesticides, herbicides, and metals)
VOCs - Volatile organic compounds

Table 2
Contact List
Site Characterization Work Plan
Genesee Valley Metal Finishing, Rochester, NY (Site No. 828228)

Entity	Location	Name	Title	Phone Number	Email
AECOM (Environmental Consultant)	50 Lakefront Blvd, Ste 111 Buffalo, NY 14202	Mike Gutmann	Project Manager	716-345-4649	mike.gutmann@aecom.com
		Edyta Chorostkowska	Task Manager	845-248-4099	edyta.chorostkowska@aecom.com
		Ernie Thalhamer	Site Supervisor	716-289-3188	ernie.thalhamer@aecom.com
		Caroline Lee	Health and Safety Manager	445-345-3568	caroline.lee@aecom.com
NYSDEC	625 Broadway, 12th Floor Albany, NY 12233-7017	Makaila Adair	Project Manager	518-402-9702	makaila.adair@dec.ny.gov
		Jeffrey Dyber, PE	Senior Project Manager, Section Chief	518-402-9698	jeffrey.dyber@dec.ny.gov
NYSDOH	Empire State Plaza Corning Tower, Albany, NY 12237	Megan Rivera	Health Specialist	518-402-7877	megan.rivera@health.ny.gov

Appendix A – Health and Safety Plan (HASP)

Project-Specific SH&E Plan

91 Leighton Avenue Off-Site
60788778
91 Leighton Avenue
Rochester, NY 14609
U.S.A.
Latitude: 43.158166667
Longitude: -77.57125

August 2026

Delivering a better world

Quality Information

Prepared by	Checked by (Area/Regional/Business Line SH&E Manager or Delegate)	Approved by (Project Manager, Project Director, or Business Line Lead)
		
Signature	Signature	Signature
Kevin J. McGovern, PG, CHMM, STS	Caroline Lee, CSP	Mike Gutmann, PG
Print Name	Print Name	Print Name

Expiration:	August 14, 2027	Valid for 1 year maximum or until the scope of work, subcontractor(s), methods, and/or equipment change.

Revision History

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1. Safety, Health, and Environment (SH&E) Program

1.1 AECOM SH&E Policy

The SH&E Policy – AECOM Global (available on AECOM's Ecosystem intranet) establishes the framework to safeguard AECOM employees and stakeholders through effective management of risk and commitment to a Culture of Caring.

1.2 Safety for Life

Safety for Life is our comprehensive global SH&E program. Its key components, our Culture of Caring, our foundational Life-Preserving Principles, and a wealth of supporting resources and tools, combine to enable AECOM personnel to contribute to and apply our Safety for Life program both on and off the job.

1.3 Life-Preserving Principles

AECOM has adopted the Life-Preserving Principles – AECOM Global (available on AECOM's Ecosystem intranet) which guide our global SH&E program, Safety for Life. These nine principles advance our commitment to achieve our ultimate objective of incident prevention, and protection of the environment while executing our work.

1.4 Safety Tenets

The safety tenets listed below must be followed. If a violation of a safety tenet is observed, the associated work activity must be stopped immediately, and corrective action must be taken.

	Use Stop Work Authority immediately upon observation of Imminent Danger. Refer to Safety Tenets and Stopping Work – Americas.
	Keep the worksite free of hazards that could cause slips, trips, and falls. For work at height, refer to Work at Height – Americas.
	Obtain authorization before entering a confined space. Refer to Confined Spaces – Americas.
	Confirm that safety precautions are in place for ground intrusive work. Refer to Ground Disturbance – Americas.
	Take precautions to prevent falling into a body of water when working on, in, and near water. Refer to Work On, In, or Near Water – Americas.
	Do not work alone when performing tasks with High Potential (HiPo) Risks or when working remotely. Refer to SH&E Risk Assessment and Planning – Americas.
	Only work on or near a roadway with proper traffic safety controls in place. Refer to Highway and Road Work – Americas.
	Only foul a railroad track with appropriate approvals, proper training, and train protection. Refer to Railroads – Americas.
	Wear a seatbelt and never use mobile communication devices or other devices while driving. Refer to Driving – Americas.
	Assess risk for all work and changes to scope of work. Refer to SH&E Risk Assessment and Planning – Americas.
	Complete SH&E training required to perform identified tasks. Refer to SH&E Training – Americas.
	Conduct site-specific safety orientation for all first-time visits. Refer to SH&E Training – Americas.
	Use the required personal protective equipment (PPE). Refer to Safety Gear – Americas.
	Only use equipment that is maintained in a safe condition and appropriate to the work performed. Refer to Heavy Equipment and Machines – Americas and Hand and Power Tools – Americas.
	Report for work fit for duty. Refer to Fitness for Duty – Americas.

2. Project Contacts and Resources

2.1 Key Personnel

Level	Title	Name	Phone #
Project Level	**Project Manager (PM)**	Mike Gutmann, PG	(716) 345-4649
	Deputy Project Manager (DPM)	Edyta Chorostkowska	(845) 248-4099
	Task Lead	Ernie Thalhamer	(716) 289-3188
	Site Supervisor (SS)	Collin Horrocks	(585) 317-6137
	Site Safety Lead (SSL): if applicable (Section 2.2)	Collin Horrocks	(585) 317-6137
	Client Contact	Makaila Adair	(518) 402-9702
***Region Level**	**SH&E Manager**	Caroline Lee, CSP	(445) 345-3568
	Regional SH&E Director	Peter Gregory, CSP	(201) 602.3511

*Note: For guidance on who to list, refer to the appropriate SH&E Organization Chart:

East Org Chart	West Org Chart	Canada Org Chart

2.2 Site Safety Lead (SSL) Determination

AECOM SSL requirements apply if the answer is "yes" to both questions below.

1.	**Will an AECOM employee be tasked with directly supervising safety implementation on a program or project?**	☒ Yes ☐ No
2.	**Do the program or project activities include one or more high hazards (see Question 3 below)?**	☒ Yes ☐ No

Note: If you have questions about "high hazard" activities, please reach out to your SH&E Manager – the Ask SH&E link may be used.

3. Select one of the two options below:

☒ **Site Safety Lead is approved (through the SSL Platform), and the PM acknowledges the SSL is qualified and authorizes the SSL to monitor/supervise the following high hazards (check the boxes below that apply):**

☐ Confined Spaces	☐ Hazardous Energy/Control	☐ Underground Work
☐ Hazardous Substances/Respiratory Protection	☒ Heavy Equipment/Machines	☐ Working at Heights
☒ Ground Disturbance	☐ Highway and Road Work	☐ Work On, In, or Near Water
☒ Power Tools	☐ Railroad	☐ Radiological Hazards
☐ Non-Standard Driving (e.g., utility task vehicles, all-terrain vehicles, off-road vehicles, and pulling a trailer or other equipment)	☐ Other - **Specify**:	Click here to enter

☐ **An approved SSL is NOT required for the project scope of work.**

2.3 Short Service Employee (SSE) Log

1. An Employee is designated as an SSE if they are undertaking work in the field and have less than 6 months experience working in the industry of the work to be performed. An employee is not considered an SSE, when they have more than 6 months field work experience in a similar industry and can demonstrate competency in AECOM's safety management system and processes.

2. ☒ Project scope of work does **NOT** involve short service employees.

2.4 Subcontractors and Third Parties

1. Refer to Subcontractor Selection and Stewardship – Americas.

2. ☐ Project scope of work does NOT involve AECOM subcontractors or third parties.

☒ Project scope of work DOES involve one or more AECOM subcontractors and/or third parties. Their information is provided below.

Company/ Affiliation	Relationship to AECOM	Primary Emergency Contact Name and Phone Number	Alternate Emergency Contact Name and Phone Number
Matrix Environmental Technologies Inc.	☒ AECOM Subcontractor (Managed) ☐ Sub of AECOM Sub (Managed) ☐ Client Direct-Hire Contractor (Unmanaged) ☐ Third Party (Unmanaged)	Nickolas Ander, (716) 662-0745	TBD
Atlantic Testing Laboratories, Limited	☒ AECOM Subcontractor (Managed) ☐ Sub of AECOM Sub (Managed) ☐ Client Direct-Hire Contractor (Unmanaged) ☐ Third Party (Unmanaged)	Greg Geno, (315) 386-4578	TBD
Momentum Environmental, LLC	☒ AECOM Subcontractor (Managed) ☐ Sub of AECOM Sub (Managed) ☐ Client Direct-Hire Contractor (Unmanaged) ☐ Third Party (Unmanaged)	Linda J. Grimmer, (716) 803-9823	TBD

Notes:

a. An emergency contact is someone who is capable of initiating medical case management/incident response for their company.

b. An alternate emergency contact is recommended, but not required for client direct-hire contractors and third parties.

c. For a subcontractor of an AECOM subcontractor, one of the emergency contacts can be a representative from the AECOM subcontractor that hired them.

2.5 Lone Worker Management Plan

1. AECOM discourages employees from working alone (i.e., where AECOM personnel are out of visual and audio range of others) when performing field tasks. If lone work is to be performed, a communications/check-in plan must be developed and implemented.

2. ☒ The project scope of work does NOT involve the lone worker operations.

3. Site Description and Scope of Work

1. Site Location and Description	The Leighton Avenue Site (the "site") is a 1.720 acre site located at 91 Leighton Avenue in the City of Rochester, Monroe County, NY. All former site features were destroyed by a fire in October 2022. The former building slabs and paved surfaces remain in place and comprise the vast majority of surface cover.
Site Background/ History	Prior to 1930 the site was undeveloped and consisted of vacant land. By 1930 the site was developed with a commercial/industrial building utilized for various purposes including manufacturing, warehousing, and distribution. Between at least 1938 and 1955, the site was occupied by Rochester Can Co., Inc and was utilized as a can manufacturing facility. The facility maintained a metal lacquer spray booth and die storage area while occupied by Rochester Can Co. The former metal lacquer spray booth was located in the general vicinity of the elevated concentrations of chlorinated VOCs identified during groundwater sampling. A railroad spur was also located on the eastern portion of the site between at least 1938 and 1971. Information regarding operations from 1955 to 2022 is limited. The City of Rochester issued a permit to remove one (1) 550-gallon tank from the site in 1982. No information regarding the tank location or closure documentation has been obtained. A fire in October 2022 destroyed the 55,925 square foot building. At the time of the fire, the building was primarily used for warehousing, distribution, and vehicle storage. The fire was started by fuel that was ignited while a tenant was working on a vehicle, causing the building to burn to the ground. The site has been unoccupied since the 2022 fire and remains undeveloped.
Client and/or Third-Party Operations at Site	☒ There are NO client and/or third-party operations anticipated at the Site during AECOM's field activities.
	☐ Client and/or third-party operations are anticipated at the Site during AECOM's field activities.
	Click here to enter
Scope of Work	AECOM was retained by the NYSDEC to conduct a Site Characterization immediately outside of the 91 Leighton Avenue site (NYSDEC Site No.: C828231A). The following primary and auxiliary / supporting activities will be required to complete the scope of work and accomplish project objectives and must be included in a Task Hazard Assessment (THA): • Utility clearance at proposed monitoring well locations along Leighton Avenue and Greenleaf Street. • Bedrock and overburden well installation, development, and sampling • Soil vapor intrusion sampling • Topographic and site survey • Investigation derived waste management (i.e., drum handling). The project scope of work will be implemented as outlined below.

Project Start Date	4/17/2026	**Field Work Start Date or Next Mobilization to Site**	9/11/2026	**Project Completion Date**	TBD

4. Risk Assessment

☐	AECOM or AECOM-managed subcontractors are NOT self-performing or exposed to any of the activities below.
☒	AECOM or AECOM-managed subcontractors are self-performing or exposed to any of the activities/hazards below.

Drug & Alcohol Testing	Medical Surveillance	Heat and Cold Stress
Excessive Noise	Biological Hazards	Ground Disturbance
Heavy Equipment and Machines	Railroads	Underground Work
Highway and Road Work	Hazardous Substances and Communication	Hand and Power Tools

Confined Spaces	Working at Height	Work On, In, or Near Water
Respiratory Protection	Hot Work	Hazardous Energy Control
Radiological Hazards		
Non-standard driving activities, including undertaking trips more than 250 miles each way, driving in remote or hazardous areas, or operation of utility task vehicles (UTVs), all-terrain vehicles (ATVs), off-road vehicles, towing trailers, or other equipment		

4.1 Anticipated Activities, Situations, and Hazards

Select all applicable boxes that describe the activities, situations, or hazards expected to occur during the project's scope of work.
Note: Project Team = AECOM employees, AECOM managed contractors, and their managed subcontractors (all tiers)

Fitness for Duty – Americas		
☒	**Does the project scope of work or the work location require workers to be enrolled in a medical surveillance program?**	**If not already enrolled and current, contact the Occupational Health Team at nurse@aecom.com and indicate any project-specific protocols.** Click here to enter
Hazardous Substance and Communication – Americas		
☒	**Does the project scope of work require chemical materials (i.e., hazardous materials/substance and/or Materials of Trade) to be brought onto the site to perform work?**	**Use Project Hazardous Materials Communication Plan – Americas**
☒	**Is potential exposure to chemical hazards reasonably anticipated to have the potential to result in inhalation, dermal contact, ingestion, or injection routes of exposure during the performance of one or more tasks?** **Chemical hazards can be from materials brought on the Site to perform work, constituents of concern found or suspected to be in environmental media under investigation, and/or simultaneous operations being performed at the Site by the property owner/third party.**	**For the U.S., use Project Hazardous Substance Exposure Control Plan – Americas**
☐	**Will activities being performed at hazardous waste sites (i.e., HAZWOPER) involve or potentially involve employee or equipment exposure to and/or physical contact with hazardous materials, hazardous substances, hazardous wastes, and/or health hazards?**	**For the U.S., use Project Hazardous Substance Exposure Control Plan – Americas**
Respiratory Protection – Americas		
☐	**Are respirators required for use on site?**	**If yes, please complete the following:**
		Type of respirator to be used
		Click here to enter
		Type of cartridge to be used
		Click here to enter
		Hazardous material(s) being controlled by the respirator
		Click here to enter
		Cartridge change out schedule
		Click here to enter

		Respirator storage procedure
		Click here to enter
		Respirator maintenance procedure
		Click here to enter
		Locations on the site and for which task(s) respirators are required
		Click here to enter
		Add Respiratory Equipment Inspection – Americas, as required
☒	**Are respirators being used voluntarily?**	**Add Voluntary Use of Respirators– Americas**
☐	**Will activities include hot work?**	**If yes, add contractor/client hot work procedures and permit form**
Heat and Cold Stress – Americas		
☒	**Is there potential for heat stress to occur?**	**Source(s) of heat stress**
		Weather
		Engineering controls
		Wait for cooler weather
		Administrative controls
		Cooling breaks, with drinks (e.g.., Gatorade, etc.).
		Personal protective equipment
		Ice Vest
		If applicable, add Heat Stress Monitoring Log – Americas
		Add a heat stress monitoring plan if required by the state where the work will take place (e.g., Oregon, California, Washington, Nevada, or Maryland)
☒	**Is there potential for cold stress to occur?**	**Engineering controls**
		Wait for warmer weather
		Administrative controls
		Warming breaks, with hot liquid
		Personal protective equipment
		Warm Cloths
Biological Hazards – Americas		
☒	**Are there any known wildlife, domestic animals (including pets or livestock), biting or stinging insects, or hazardous plants present at the project site?**	**Complete the biological hazard control plan below.**
		Animals of concern (select all that apply)
		☐ Bears ☐ Carnivores ☐ Ungulates (hoofed mammal) ☒ Snakes ☐ Alligators
		☐ Other (specify): Click here to enter
		Insects of concern (select all that apply)
		☒ Ticks ☐ Spiders ☐ Stinging Insects (Bees/Mosquitos)
		☐ Other (specify): Click here to enter
		Plants of concern (select all that apply)

		☒ Poison ivy ☐ Poison oak ☐ Poison sumac ☐ Giant hogweed (giant cow parsnip) ☐ Wild parsnip ☐ Devils club ☐ Stinging nettle	
		☐ Other (specify):	Click here to enter
		Equipment to be used specific to animals, plants, and insects of concern (e.g., snake chaps, bear spray, etc.)	
		Click here to enter	
		Identify the response procedure in case one is encountered	
		Avoidance, tick checks and have a tick removal tool on their person.	
☐	**Is there potential for work in areas that may expose project team member(s) to human bodily fluids (e.g., sanitary sewers, sharps, etc.)?**	**Bloodborne Pathogen – Exposure Control Plan**	
		Exposure Determination (source of exposure)	
		Click here to enter	
		Training	
		Click here to enter	
		Hepatitis B Vaccination offered	
		Click here to enter	
		Engineering Work Practice Controls	
		Click here to enter	
		PPE	
		Click here to enter	

Noise – Americas

☒	**Is there potential for work activities to expose project team member(s) to an average of 85 decibels (dBA) over an 8-hour period, or 94 decibels over a 1-hour period?** **Note: A sign and symptom of exceeding 85 dBA may be having to shout to be heard by someone 3 feet away, and/or experiencing ringing of your ears, respectively.**	**Hearing protection device (HPD) selected**	Ear Muffs/ Plugs
		Areas of required HPD use	Well Installation Drill Rig
		Monitoring Procedures and Action Levels Noise Dosimeter Instrument Type	Follow drillers competent person
		Action Level	**Response Activity**
		<85 dBA	• **Continue work activities.**
		>85 dBA	• **Don hearing protection (plugs or muffs) with Minimum Noise Reduction Rating (NRR) of 27.**
			• **Contact the Site Safety Lead or Supervisor.**
		>95 dBA	• **Don dual hearing protection (muffs over plugs).**
			• **Contact the Site Safety Lead or Supervisor.**
		>100 dBA	• **Cease activities and contact the Site Safety Lead or Site Supervisor.**
			• **Implement additional control measures and obtain Project Manager approval before resuming work.**

Ground Disturbance – Americas

☒	**Will performing/managing excavation, drilling, surface mining, and/or other ground disturbance operations be required?**	Private Utility Locator, Site Plans, Previous Efforts **Add Utilities and Subsurface Clearance Checklist – Americas**

☒	**Will working around or performing oversight of drilling operations be required?**	**Add Drill Site Safety Inspection Checklist – Americas**
☐	**Will a designated Competent Person for excavation and/or trenching operations be required?**	**Add Daily Excavation Checklist – Americas**
☐	**Is there a potential to encounter munitions and explosives of concern (MEC), which includes unexploded ordnance (UXO), discarded military munitions (DMM), and explosive compounds, on a project site?**	**Contact the Munitions Response Program (MRP) Technical Group**
☐	**Will rope access be required?**	**Add a rope access safe work plan**
Highway and Road Work – Americas		
☒	**Will project team member(s) be required to work on or adjacent to a roadway with live traffic being managed by others?**	**Attach the site-specific traffic control plan (TCP) being implemented by others (contractors, client, etc.)**
☐	**Will project team member(s) be responsible for and/or directly managing traffic control procedures, implementation, and set-up while working on/adjacent to live traffic, no matter the duration?**	**Attach a site-specific traffic control plan (TCP) prepared by a Competent Person.**
Heavy Equipment and Machines – Americas		
☒	**Will there be work on sites with exposure to heavy mobile equipment (skid steers, back hoes, excavators, etc.)?**	**Describe onsite heavy equipment:** Drill Rigs
☐	**Does any of the work involve directly managing employees and/or subcontractors operating heavy equipment and/or machines?**	**As applicable, add:** • **Lift Classification Checklist – Americas** • **Critical Lift Plan – Americas** • **Personnel Platform Lifting – Americas** • **Pre-Operations Powered Industrial Truck Checklist** • **MEWP Pre-Operation Checklist – Americas** • **Under Bridge Inspection Unit Pre-Operation Checklist – Americas**
Hand and Power Tools – Americas		
☒	**Will project team member(s) work with hand and/or power tools?**	**Add Tool-Specific THA and manufacturer's operating manual**

4.2 Task Hazard Assessment (THA)

1. THA forms must be prepared using Task Hazard Assessment – Americas or equivalent for each task to be performed as part of the scope of work as well as the hazards, associated risk, and appropriate controls for all other on-site activities and exposures. For DCS U.S. East and LATAM and DCS U.S. West, the THA Library Ecosystem page may also be used to find previously approved THAs, though these should be modified to be project and site-specific.

2. Each operation being performed by AECOM and each operation performed by an AECOM subcontractor working under the AECOM SH&E Plan is summarized below, and the relevant field forms, including THAs, are included in Appendix C Field Forms

Task Name	Permit(s) Required		Primary Task Performed By	
			AECOM	Subcontractor
General Hazards	☐ Yes	☒ No	☒	☒
Utility Clearance	☐ Yes	☒ No	☐	☒
Monitoring Well Installation	☒ Yes	☐ No	☐	☒
Monitoring Well Development and Sampling	☐ Yes	☒ No	☒	☐
Soil Vapor Intrusion Sampling	☐ Yes	☒ No	☒	☐
Topographic and site survey	☐ Yes	☒ No	☒	☐
IDW Handling	☐ Yes	☒ No	☐	☒

***Note:** **All AECOM subcontractors must have a THA for each assigned task. THA(s) for AECOM subcontractors working under the AECOM SH&E Plan must be included in Appendix C** Field Forms**.**

3. A review of THAs must take place during the Daily Safety Meeting (Section 4.3). When employees arrive on site, conditions may be different from what was originally planned or additional job steps may be required. The THA requires workers to update or 'dirty up' the THA in the 'On-Site Edits' rows to assess the risks presented by the changed condition(s) and requires the worker to describe steps to reduce the risk. If the hazard(s) cannot be successfully mitigated, the work must NOT proceed.

4.3 Daily Safety Meeting

1. A Daily Safety Meeting must be held at the start of each shift to instruct employees, managed subcontractors, and others, as necessary, on the anticipated scope, reasonably anticipated hazards, and controls. Participants in simultaneous operations are encouraged to attend each other's safety meetings, or at the very least, the supervisors should discuss the coordination of activities and associated hazards of each other's tasks.
2. Daily Safety Meeting – Americas, or equivalent form, to document names of all attendees and meeting topics must be completed and retained in the project folder. Alternatively, use the appropriate QR code to download the app and/or go to the eDaily Safety Meeting App Ecosystem page for details, guides, training sessions, and other information:

	iOS	Android
		

How will you conduct and document the daily safety meetings?			
☒ Daily Safety Meeting – Americas	☐ eDaily Safety Meeting App	☐ Other:	Click here to enter

4.4 4-Sight

When preparing hazard assessments and throughout the day workers should use 4-Sight. This is a mental process through which workers ask themselves (and each other) four questions designed to effectively assess hazards. Answering these questions during each task, especially those without established THAs, will help workers identify hazards and condition changes so that they can control them or stop work to seek assistance.

- What am I about to do?
- What could go wrong?
- What could be done to make it safer?



- What have I done to communicate the hazard?

4.5 Stop Work Authority

AECOM empowers and expects all employees to exercise their Stop Work Authority (refer to Safety Tenets and Stopping Work – Americas). All employees have the authority and responsibility to issue a Stop Work Order for work activities deemed to present an Imminent Danger or when the control of an SH&E risk is not clearly established or understood. Employees issuing a Stop Work Order must do so without any fear of retaliation or form of intimidation.

5. Project-Specific SH&E Training

All personnel at project sites must be qualified and experienced in the tasks they are assigned. SH&E Training - Americas establishes the general training requirements for AECOM employees.

Select all boxes that describe the training that is applicable to the site and/or scope of work.			
☒	Project Emergency Response Plan Review	☒	AECOM Field Safety (annual requirement)
☒	Project SH&E Plan Review	☒	Defensive Driving
☒	Site Safety Orientation	☐	AED/First Aid/CPR
☐	Client- or Host Facility-Specific Training	☐	Client- or Host Facility-Specific Training
	Specify: Click here to enter		**Specify:** Click here to enter

5.1 Risk-Based Training

☐	AECOM or AECOM-managed subcontractors are NOT self-performing or exposed to any of the activities below.
☒	AECOM or AECOM-managed subcontractors are self-performing or exposed to any of the activities below. Pre-Task Forms

Drug & Alcohol Testing	Medical Surveillance	Heat and Cold Stress
Excessive Noise	Biological Hazards	Ground Disturbance
Heavy Equipment and Machines	Railroads	Underground Work
Highway and Road Work	Hazardous Substances and Communication	Hand and Power Tools
Confined Spaces	Working at Height	Work On, In, or Near Water
Respiratory Protection	Hot Work	Hazardous Energy Control
Radiological Hazards		
Non-standard driving activities, including undertaking trips more than 250 miles each way, driving in remote or hazardous areas, or operation of utility task vehicles (UTVs), all-terrain vehicles (ATVs), off-road vehicles, towing trailers, or other equipment		

5.2 Competent Persons

A competent person is an employee who, through education, training, and experience, has knowledge of applicable regulatory requirements, is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Competent Person Designation – Americas must be completed, as applicable, and included in Appendix B Pre-Task Forms.

6. Personal Protective Equipment (PPE)

PPE Must	
1.	Properly fit the Employee's body including gender-specific gear and sizing.
2.	Be selected, used, cared for, and stored in accordance with recognized standards (e.g., American National Standards Institute [ANSI]) and manufacturer's specifications/instructions.
3.	Provide effective protection.
4.	Not in itself create a hazard to the wearer.
5.	Be compatible so one item of PPE does not interfere with another.
6.	Be maintained in good working order and in a sanitary condition.
7.	Not be altered in any way.
8.	Be inspected prior to use.
9.	Be removed from service and replaced if worn out, expired, damaged, and/or defective.

Site Minimum PPE	
• Hard hat or helmet • Safety glasses with side shields • High visibility safety vest • Gloves (on person) – required to be worn if handling materials, equipment, etc.	• Shirt with sleeves that cover the shoulders • Long pants • Work boots with defined heel and over-ankle support • Hearing protection (on person)

Project-Specific PPE (Above Site Minimum)		
Applicable?	**Type of PPE Protection**	**Description of PPE**
☐	Head Protection (ANSI Z89.1 / CSA Z94.1)	Click here to enter
☐	Eye Protection (ANSI Z87.1/ CSA Z94.3)	Click here to enter
☐	Face Protection (ANSI Z87.1/ CSA Z94.3)	Click here to enter
☐	Hand Protection (ANSI/ISEA 105 / ISEA 138)	Click here to enter
☐	Body and Limb Protection	Click here to enter
☐	Foot Protection (ASTM F2413/CSA Z195)	Click here to enter
☐	Fall Protection (ANSI A10.14 / ANSI Z359 / CSA Z259)	Click here to enter
☐	Water/Drowning Protection	Click here to enter
☐	Thermal (Cold/Hot) Protection	Click here to enter

7. Contractor Management

☐	**Performance of the project scope of work DOES NOT involve the use of AECOM subcontractors.** Subcontractor Details
☒	**Performance of the project scope of work DOES involve the use of one or more subcontractors. The requirements for subcontractor selection and subcontractor safety responsibilities are outlined in Subcontractor Selection and Stewardship – Americas.**

7.1 Subcontractor Details

Subcontractor 1		
Name of Subcontractor	Matrix Environmental Technologies Inc.	
Assigned Task	**High Risk Task (Yes or No)**	**Contractor Site Supervisor Name and Number**
Utility Clearance	No	Nickolas Ander, (716) 662-0745
Click here to enter	Click here to enter	Click here to enter

Required Subcontractor Documents	
The Project Manager must verify that the following documents are in place for each subcontractor:	
Select one	☐ Subcontractor's Project/Site-specific SH&E Plan **OR** ☒ Subcontractor will work under AECOM's SH&E Plan and field personnel will sign the AECOM SH&E Plan Acknowledge Form

Select all that apply and have been verified	
☒	Copy of signed contract
☒	Project-specific purchase order for subcontractor
☐	Copy of the subcontractor's business license and training certificates (task specific)
☐	Copy of task specific THAs/Job Hazard Analyses (JHAs) and inspection/tailgate forms
☐	Competent Person documentation

Prequalification Status		
Supplier Status		**Action(s)**
☐ Approved		None – skip to the next subcontractor.
☒ Conditionally Approved		PM to work with Procurement to determine AECOM and Prime Contract minimum insurance limits based on a specific scope of work and risk level.
☐ Pending Approval		Subcontractor must not be used until approved or conditionally approved.

Subcontractor 2		
Name of Subcontractor	Atlantic Testing Laboratories, Limited	
Assigned Task	**High-Risk Task (Yes or No)**	**Contractor Site Supervisor Name and Number**
Drilling and Monitoring Well Installation	Yes	Greg Geno, (315) 386-4578
Click here to enter	Click here to enter	Click here to enter

Required Subcontractor Documents	
The Project Manager must verify that the following documents are in place for each subcontractor:	
Select one	☐ Subcontractor's Project/Site-specific SH&E Plan

Subcontractor 2	
	OR ☒ Subcontractor will work under AECOM's SH&E Plan and field personnel will sign the AECOM SH&E Plan Acknowledge Form

Select all that apply and have been verified	
☒	Copy of signed contract
☒	Project-specific purchase order for subcontractor
☐	Copy of the subcontractor's business license and training certificates (task specific)
☐	Copy of task specific THAs/Job Hazard Analyses (JHAs) and inspection/tailgate forms
☐	Competent Person documentation

Prequalification Status		
Supplier Status		**Action(s)**
☒ Approved		None – skip to the next subcontractor.
☐ Conditionally Approved		Complete and submit a Subcontractor Variance Form – Americas with this plan for approval.
☐ Pending Approval		Subcontractor must not be used until approved or conditionally approved.

Subcontractor 3		
Name of Subcontractor	Momentum Environmental, LLC	
Assigned Task	**High-Risk Task (Yes or No)**	**Contractor Site Supervisor Name and Number**
IDW Handling	Yes	Linda J. Grimmer, (716) 803-9823
Click here to enter	Click here to enter	Click here to enter

Required Subcontractor Documents	
The Project Manager must verify that the following documents are in place for each subcontractor:	
Select one	☐ Subcontractor's Project/Site-specific SH&E Plan **OR** ☒ Subcontractor will work under AECOM's SH&E Plan and field personnel will sign the AECOM SH&E Plan Acknowledge Form

Select all that apply and have been verified	
☒	Copy of signed contract
☒	Project-specific purchase order for subcontractor
☐	Copy of the subcontractor's business license and training certificates (task specific)
☐	Copy of task specific THAs/Job Hazard Analyses (JHAs) and inspection/tailgate forms
☐	Competent Person documentation

Prequalification Status		
Supplier Status		**Action(s)**
☐ Approved		None – skip to the next subcontractor.
☒ Conditionally Approved		PM to work Procurement to determine AECOM and Prime Contract minimum insurance limits based on specific scope of work and risk level.

Subcontractor 3		
☐ Pending Approval		Subcontractor must not be used until approved or conditionally approved.

8. Monitoring Performance

8.1 Safety Observations and Near Miss Reporting

1. Safety observations are a tool used by AECOM to identify both at-risk behaviors, including unsafe conditions and acts, and positive safety behaviors. These observations can be made informally during normal site operations when conditions or behaviors are addressed or as part of a more formal observation program. Employees may perform a formal safety observation on another AECOM employee or subcontractor.

2. Following the activity, the Observer must provide immediate one-on-one feedback to the Employee, noting the safe behaviors and at-risk behaviors identified during the observation. The Observer and the person being observed (employee or contractor) are required to discuss the identified barriers to safe behaviors and the potential solutions.

3. Formal Safety Observations must be entered into Vector EHS Management (a.k.a. IndustrySafe), or project-based system, where applicable. If an individual does not have access to a system, a member of the Regional SH&E Team must be contacted to obtain hard stock observation cards.

8.2 Corrective Actions for Non-Conformances

1. The intent of issuing non-conformances, observations and corrective and preventive actions is to confirm criteria and systems deviations are logged, actioned, and closed out as part of the continuous improvement process. When non-conformances are identified in audits, inspections, reviews, and observations, corrective actions should be created and tracked to completion in the appropriate online data management system (e.g., Vector EHS Management [a.k.a. IndustrySafe], or a project-based system).



2. The Project Manager, SH&E Manager, and Regional Management Team, as required, must document necessary follow-up actions, assign accountability for corrective actions, and confirm that all corrective actions are closed within the assigned timeframe. Corrective actions identified must be taken in a timely manner by the responsible parties who have been identified. Immediate corrective action must be taken for Imminent Danger. When it is not possible to immediately rectify non-conformances, interim actions must be implemented to prevent injury, illness, property loss, or impairment to the environment until planned/long-term corrective measures are implemented.

8.3 Incident Reporting and Response

Refer to Appendix A Emergency Response Plan.

8.4 Audits, Inspections, and Reviews

1. Refer to Monitoring SH&E Performance and Continuous Improvement – Americas for definitions of the different types of audits, inspections, and reviews.

9. Variance to SH&E Management System Requirement

The Project Manager request for variance to or waiver of any SH&E Management System requirement must provide an equal or greater level of protection, be substantiated with the relevant SH&E Plan and THA(s) for the activity seeking a variance, and must be documented using the SH&E Management System Variance Request – Americas or equivalent documentation.

10. Personal Acknowledgement

By signing below, the undersigned acknowledges that they, including managed subcontractors, have reviewed the AECOM SH&E Plan for the 91 Leighton Avenue off site. The undersigned people also acknowledge that they have been instructed in the contents of this document and understand the information pertaining to the specified work and will comply with the provisions contained therein. The undersigned people understand that they are **NOT** to perform any work that they have not been adequately trained for and that they are to stop work if it is unsafe to proceed. Finally, the undersigned people understand to notify the Site Supervisor or Site Safety Lead and the **Incident Hotline at 800-348-5046** for any incident, **including ANY injury even if no first aid or medical treatment is required.**

Print Name Clearly	Signature	Organization	Date
Click here to enter		Click here to enter	Click or tap to enter a date.
Click here to enter		Click here to enter	Click or tap to enter a date.
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Disclaimer: This SH&E Plan, and each of its provisions, is applicable only to, and for use only by, AECOM, its affiliates, and its subcontractors. Any use of this Plan by other parties, including, without limitation, third-party contractors on industrial sites or projects where AECOM is providing engineering, construction management, or similar services, without the express written permission of AECOM, will be at that party's sole risk, and AECOM Corporation shall have no responsibility. The existence and use of this SH&E Plan by AECOM shall not be deemed an admission or evidence of any acceptance of any safety responsibility by AECOM for other parties unless such responsibility is expressly assumed in writing by AECOM in a specific project contract.

Appendix A Emergency Response Plan

A.1 Phone List

All incidents and near misses, regardless of type and perceived severity, must be reported in accordance with SH&E Incident Response and Investigation – Americas.

Contact Type	Phone Number	Availability	Instructions
SH&E Incident Hotline	**1-800-348-5046**	24/7	**After the scene has been stabilized, immediately report all incidents** including any potential work-related injuries, illnesses, discomfort/pain, property damage, security issues, regulatory inspections, and environmental impacts/spills
AECOM Nurse Line Direct	**U.S.: 512-419-5016** **Canada:1-877-424-5256**	24/7	The SH&E Incident Hotline operator (number above) will transfer injured/ill employee to nurse. If the transfer fails or employee's condition worsens following initial consultation, call direct.

Resource Type	Phone #	Site-Specific Name	Address	Hours of Operation
Site Emergency Response	**911**	N/A	N/A	24/7
Note:	**If, during your injury reporting call to the Incident Hotline you could not speak with an AECOM or Workcare Nurse and feel your condition requires immediate attention, you should utilize the clinic identified below.**			
Clinic	(585) 441-3914	WellNow Urgent Care	235 Winton Rd N, Rochester, NY 14610	S-S 8AM-8PM
Hospital	(585) 341-6880	Highland Hospital	1000 South Ave, Rochester, NY 14620	24/7
First Aid/CPR Providers	TBD	TBD	On-site	During operational hours
Fire	(585) 428-6739	Rochester Fire Department	N/A	24/7
Police	(585) 428-9809	Rochester Police Department	N/A	24/7
U.S. Poison Control	**1-800-222-1222**	N/A	N/A	24/7

A.2 Additional Phone Numbers

Support Resource / Company	Name	Phone #
Fleet Management	Holman	(800) 227-2273
HazMat Shipping Emergency Response Support	INFO TRAC AECOM Account Number: 74984	(800) 535-5053

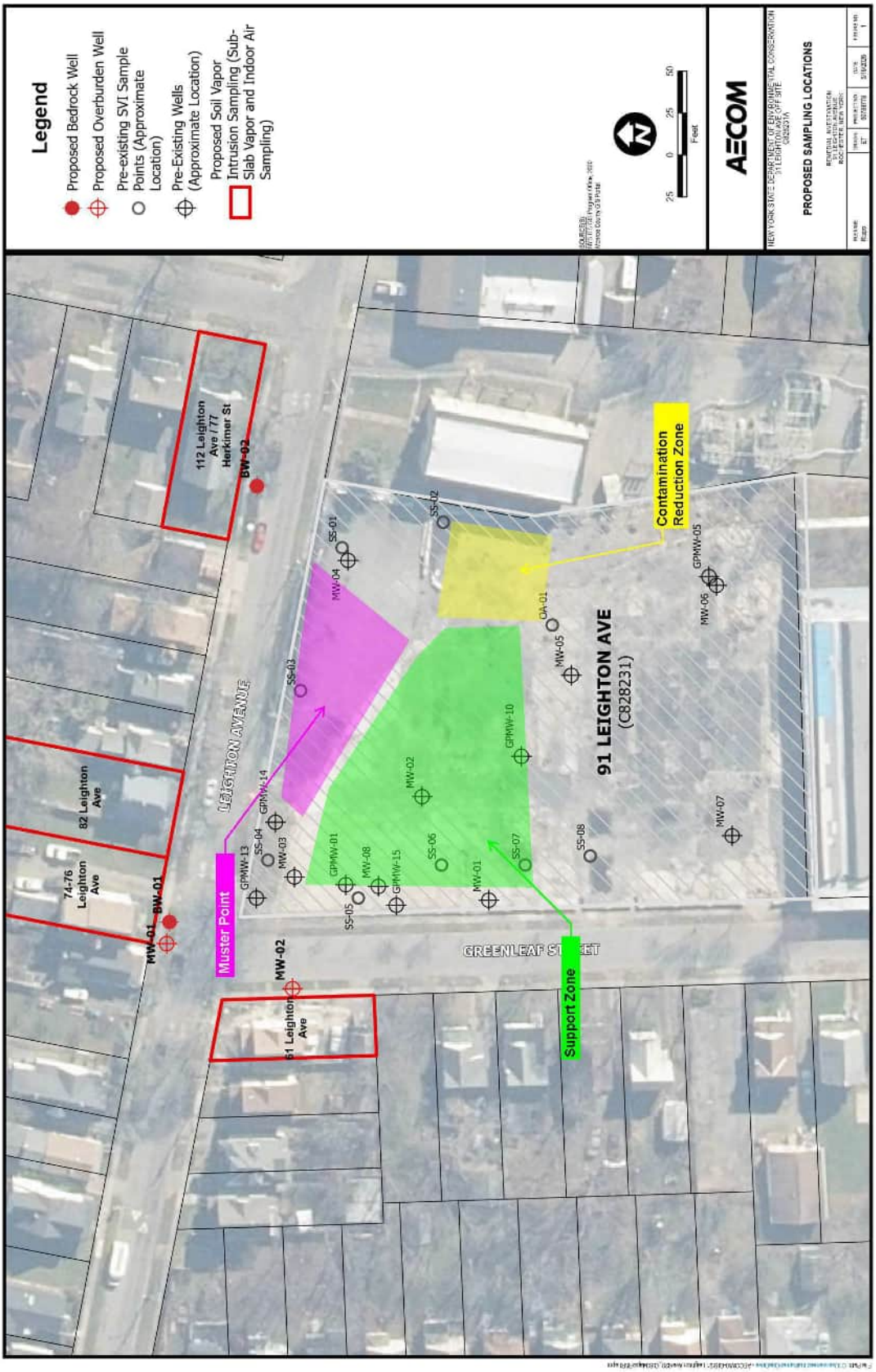
Utility and Pipeline Information	
Select one based on the scope of work.	
☐	Scope of work does NOT involve activities that could interfere with overhead or underground utilities or facilities.

X	Scope of work DOES involve activities that could interfere with overhead or underground utilities or facilities.

Utility Type	Name	Phone #
State One-Call System	N/A	811
Cable/Telecommunications	Spectrum	(833) 949-0036
Electric	RG&E	(800) 743-1701
Natural Gas	RG&E	(800) 743-1702
Sewer	Monroe County Department of Environmental Services, Pure Waters	(585) 753-7600
Water	City of Rochester Bureau of Water	(585) 428-5990

Note: Verify the above information against the 811 / Dig ticket prior to starting any activity that could impact overhead and/or underground utilities or facilities.

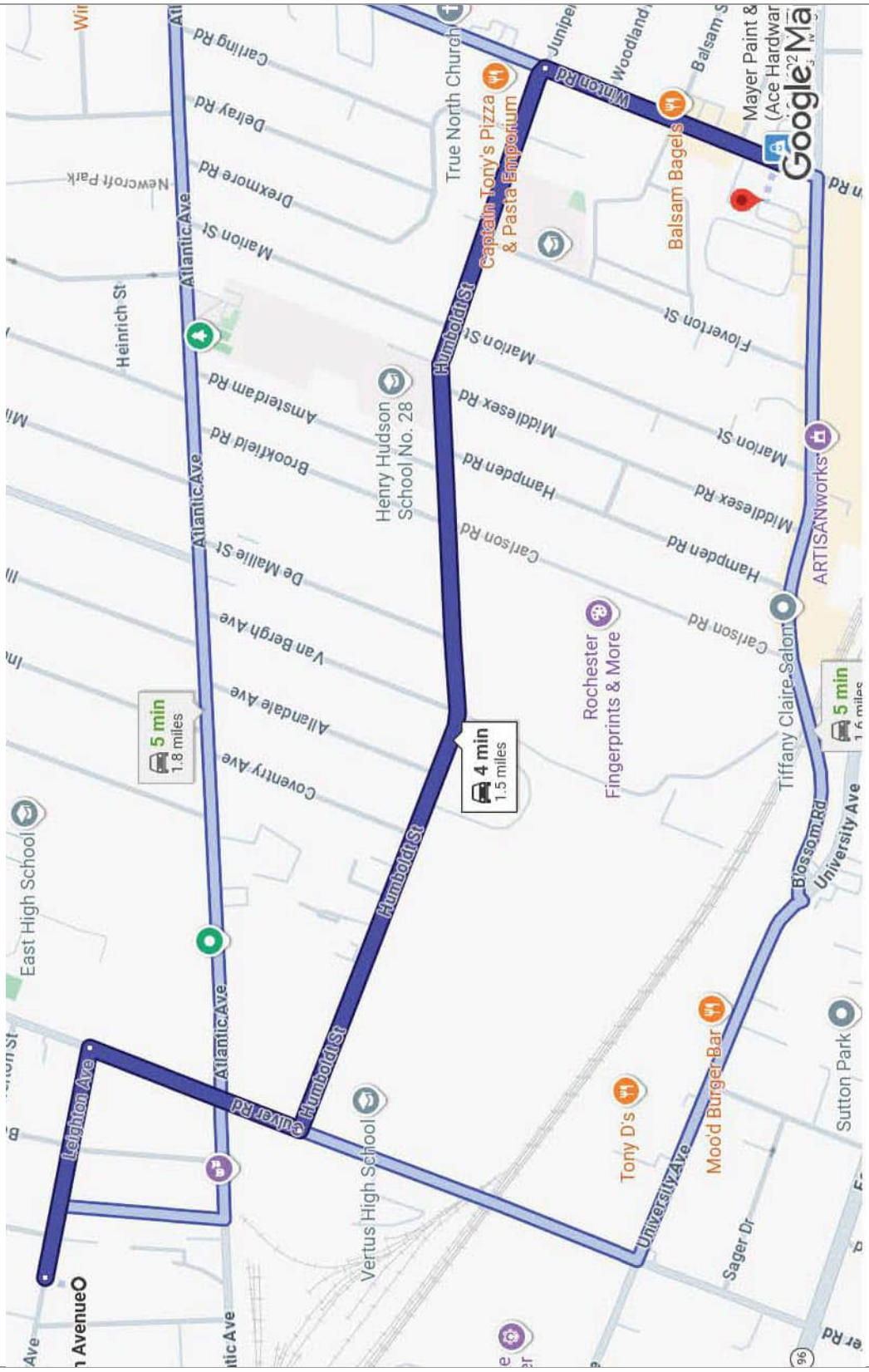
A.3 Location Emergency Map(s)



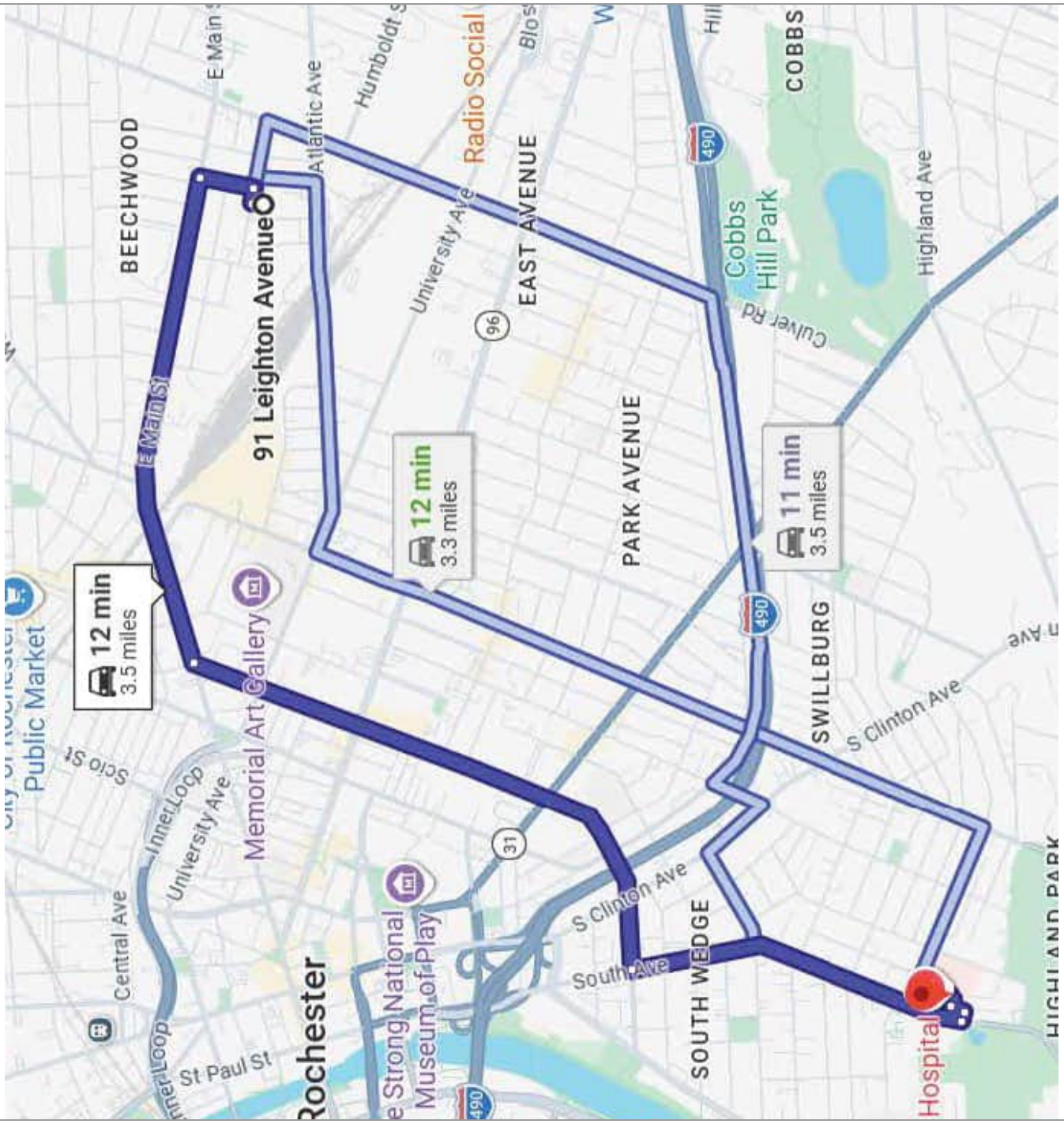
A.4 Site Emergency Equipment and Its Location

Item	Item Description	Location(s)
First Aid Kit(s)	ANSI Z308.1 Class A, Type III ANSI Z308.1 Class B, Type III	AECOM Field Vehicle
Automated External Defibrillator(s)	Standard AED	N/A
Fire Extinguisher(s)	2A:10B:C (5 lb. ABC) 4A:80B:C (10 lb. ABC) 4A:80B:C (10 lb. ABC) 8A:120B:C (20 lb. ABC)	AECOM Fleet Vehicle(s) Drill Rig or Support Vehicle Heavy Equipment Cabin(s) Hot Work Area(s)

A.5 Directions to Clinic



A.6 Directions to Hospital



A.7 Method(s) of Emergency Alarm

Vehicle Horn

A.8 Evacuation and Sheltering in Place

1. If a situation requires an evacuation or emergency muster/assembly, the pre-determined alarm must be initiated.
2. All personnel (e.g., employees, consultants, visitors) in the office requiring evacuation must immediately assemble at the designated muster point, assembly point or shelter-in-place as determined by the alarm or communication.

3. Employees accompanying visitors working directly with AECOM must escort the visitors to the muster point.
4. Elevators must not be used unless pre-arranged due to known circumstances.
5. The Site Supervisor or designee must take action to account for all personnel, including visitors (i.e., head count, roll call).
6. Upon evacuation or dismissal, only authorized or essential employees are allowed access to the facility or project area during an emergency. Other personnel must await further instruction (e.g., all clear and re-entry or further evacuation) from the Site Supervisor or designee.

A.9 Medical Emergency

1. Stop the work activity.
2. Assess the cause of the injury to avoid injury to yourself (e.g., live wires, gases, hazardous materials).
3. Do not move the casualty unless they remain in danger.
4. A First Aid Provider must designate an individual to call for medical assistance (e.g., 911, ambulance, site medic).
5. A First Aid Provider must designate an individual to retrieve the first aid kit and blankets.
6. Request assistance from other First Aid Providers, as necessary. Administer first aid:
    a. Assess responsiveness: ask permission.
    b. Send for medical help.
    c. Place casualty face up.
    d. Check airway, breathing and circulation (ABCs)
    e. Control severe bleeding.
7. If CPR is deemed necessary:
    a. Begin chest compressions at a rate of at least 100-120 compressions per minute.
    b. CPR shall be continued until:
        i. An AED is applied,
        ii. casualty begins to respond,
        iii. Another First Aid Provider takes over,
        iv. A medical responder takes over, or
        v. The Aid Provider is physically unable to continue.
8. If the casualty begins to breathe on their own, place them in the recovery position, monitor and treat for shock as appropriate.
9. The individual in communication with the designated medical assistance must attempt to answer any questions, stay on the line until information is verified and follow instructions.
10. Arrange for medical transport as needed. A designated individual should be positioned to direct medical transport to the casualty.
11. Personnel must await further instruction from the Site Supervisor or designee (e.g., resume activity).

A.10 Fire

1. Alert others in the area of the fire.

Sound the alarm or confirm that the applicable notification system is initiated.

All personnel must vacate the building or site and proceed to the muster point. DO NOT use elevators.

The Site Supervisor or designee must confirm that all personnel have exited.

Employees are not expected to extinguish a fire. However, if the fire is small enough to be contained and if trained to do so, employees can decide to attempt to extinguish a fire with the correct type of extinguisher, applying the contents from an upwind position. Remember PASS:

a. P – pull the pin.

b. A – aim the hose at the base of the fire.

c. S – squeeze the handle.

d. S – sweep from side to side until the fire is out or the extinguisher is empty

Employees must:

a. Retreat and call the local fire department if the fire cannot be contained or there is any concern of an extinguished fire reigniting. Give directions to the location; stay on the line until information is verified.

b. Never face away from a fire. Always back away until at a safe distance.

c. Stay low and close to the floor if smoke and heat are strong.

d. Never return a discharged fire extinguisher to its normal location. Take it out of service, tag the extinguisher for recharging, and replace it with a fully charged unit.

The Site Supervisor or designee must take action to account for all personnel, including visitors (e.g., head count, roll call).

A designated individual should be positioned to direct the fire truck to the fire location.

Personnel must await further instruction (e.g., all clear and re-entry or further evacuation) from the Site Supervisor or designee.

A.11 Workplace Violence

1. **Active Workplace Violence Event:** If you become aware of an active workplace violence incident posing a threat to AECOM employees, contractors, or visitors, immediately contact local emergency services using the appropriate emergency number. If you are in the vicinity of the incident, evacuate the area if it is safe to do so, or seek shelter where possible.

Potential for Workplace Violence: All AECOM employees are responsible for reporting any information related to potential workplace violence. Reports should be made to your manager, Human Resources, or through the AECOM Ethics and Compliance Hotline.

AECOM Workplace Violence Procedure: AECOM's Workplace Violence Procedure – Americas outlines the company's zero-tolerance policy toward workplace violence. It defines what constitutes workplace violence, details employee responsibilities, explains reporting mechanisms, and describes the procedures followed during investigations and follow-up actions**.**

Training: AECOM Global Security & Resilience (GSR) has a Field Security Briefing and Office Security Briefing available to offices and projects through Teams. Topics included in both trainings cover situational awareness, active shooter awareness, tips on how to identify someone who could be a threat and tips on how to de-escalate a situation. Active Shooter Awareness training is also available on AECOM University. Contact GSR@aecom.com for details or to schedule the training.

A.12 Spill, Leak, or Release of Hazardous Materials (HAZMAT)

1. Identify the product and assess the risk of injury, fire, or explosion.
2. If there is insufficient information on the product or inadequate PPE, move upwind if possible and leave the area immediately (initiate personnel evacuation if required).
3. Isolate the area and deny access to any unauthorized personnel.
4. Only if safe to do so, take measures to stop and control the spill, leak, or release.
5. Eliminate all ignition sources, if required (no smoking, flares, sparks / flames, engines running).
6. As applicable, designate an individual to notify the Emergency Response Coordinator or designee.
7. Consult the product Safety Data Sheet for accidental release / handling procedures.
8. If it is not possible to stop or control the release, call 911 or appropriate emergency services.
9. Tend to any injured personnel (follow Medical Emergency steps).
10. Personnel must await further instruction (e.g., further evacuation or resume activity) from the Site Supervisor or designee.

A.13 Vehicle Incident

The Employee(s) involved in a collision must:

1. Assess the situation to confirm everyone is safe and remove any vehicle occupants from harm's way if safe to do so.
2. Turn on the vehicle's flashers to warn other motorists.
3. Call or have someone else call the appropriate local emergency phone number (e.g., 911) immediately when necessary.
4. As appropriate, remain at the scene of a collision for police to arrive. If the scene is unsafe, immediately move to a safe place of refuge proximate to the incident.
5. As applicable, consider moving the vehicle out of the traffic flow if it is safe to do so. Do not operate a damaged vehicle if its:
    a. safety is questionable,
    b. operating condition is illegal per applicable local law, or
    c. condition is such that further damage would likely result from its operation.
6. Obtain:
    a. Names, phone numbers, and addresses of owner(s), driver(s), and occupants of the other car(s) involved.
    b. Other party's insurance company's name, address, phone number, policy number, and insurance agent.
    c. Names, phone numbers, and addresses of all witnesses.
    d. Photographs of the accident scene when safe to do so.
7. Do not discuss liability (e.g., who is at fault), agree to pay for damage, or sign a document related to an incident except as required by local law.
8. If requested, provide information to the police. Obtain the officer's jurisdiction, name, and badge number, as well as a copy of the police report.
9. If contacted by a third party, do not answer any questions. Immediately report this contact to the Project Manager and AECOM Legal.

A.14 Floods/Heavy Rain

1. If external to a building:
    a. Monitor conditions and escape routes.
    b. Monitor Regional Resiliency communications, television, radio, or other sources identified as reliable (e.g., social media, websites) for information, updates, and evacuation orders.
    c. Shut off electrical power and utilities if flooding is imminent.
    d. Implement measures to minimize rain or flood damage if time permits (e.g., stacking sandbags, clearing drainpipes, clearing culverts, confirming sump pump operation).
    e. If ordered to evacuate, do so immediately as directed. Evacuation should be to higher ground and/or appropriate shelter, as floodwaters often rise rapidly.
    f. Avoid walking through water-covered areas as hazards may not be visible.
    g. Watch for and avoid low-lying areas. Don't drive through flooded areas. If your vehicle stalls, abandon it immediately.
    h. Don't attempt to cross a flowing stream, or to swim to safety.
    i. Beware of wildlife displaced by floodwater.
    j. Do not return unless the Site Supervisor, designee, or authorities permit.
2. If internal to a building:
    a. Assume any electrical equipment that may not be disconnected, is live and should be treated as a potential electrocution threat.

b. Protect contents from damage by relocating them if time permits.

c. Begin cleanup operations as quickly as possible.

A.15 Wildfire and Wildfire Smoke

1. During a wildfire

a. The most important information will come from your local government. Authorities will let you know when you should leave to stay safe. If wildfire impacts your home, follow instructions from the local government. If wildfire impacts your office, follow instructions from AECOM and the local government. Your Human Resources/SH&E partners will reach out to confirm your safety.

b. All wildfire events will be monitored and responded to by the Regional Resilience Team. Employees should access AECOM's website and phone message systems for status or direction updates.

c. Do not return to a closed office until it is authorized by the Regional Resilience Team.

d. Follow SH&E and Facilities guidance for office re-entry.

2. During wildfire smoke

a. The Site Supervisor or designee must take steps to reduce or eliminate continued exposure to wildfire smoke as appropriate. Warning signs to consider include an individual's symptoms, intensity of exposure, air quality index levels, and exposure controls in place. Actions to take include but are not limited to:

i. Stop work;

ii. Reschedule work;

iii. Stay inside a building or vehicle with proper ventilation;

iv. Reduce the work schedule;

v. Contact the SH&E Manager for guidance; and

vi. Wear respiratory protection.

b. Air quality should be monitored using the appropriate national index (e.g., the U.S. Air Quality Index [AQI] or Canada's Air Quality Health Index [AQHI]) which provides real-time information on outdoor air pollution levels and associated health risks through government websites and mobile apps.

c. Symptoms of wildfire smoke-related illness can include:

i. Coughing, difficulty breathing, wheezing, shortness of breath, asthma attack, runny nose, sore throat, sinus pain, or pressure.

ii. Chest pain or discomfort; fast or irregular heartbeat; feeling weak, light-headed, faint, or dizzy; pain or discomfort in the jaw, neck, or back.

iii. Sudden numbness or weakness in the face, arm, or leg—especially on one side of the body; sudden confusion; trouble speaking or difficulty understanding speech; sudden trouble seeing in one or both eyes; sudden trouble walking, dizziness, loss of balance, or lack of coordination; sudden severe headache with no known cause.

iv. Headache, scratchy or irritated eyes, fatigue, or tiredness.

d. The following actions should be taken if an individual is experiencing a wildfire smoke exposure related illness:

i. Move individual to a safe location away from the hazards.

ii. Let the individual(s) rest and move them to an area of better air quality.

iii. The Employee must call the AECOM Incident Hotline (800-348-5046) if experiencing symptoms of wildfire smoke exposure and submit an incident report of the incident within 24 hours into IndustrySafe. In the event of a medical emergency related to smoke inhalation, call 911.

A.16 Hurricane

1. Monitor Regional Resiliency communications, television, radio, or other sources identified as reliable (e.g., social media, websites) for information, updates, and evacuation orders.
2. Monitor the progress of the storm and estimate the amount of time required to perform all essential tasks.
3. If ordered to evacuate, do so immediately.
4. Move valuables out of the area or to upper floors if located in a flood or storm surge zone.
5. Secure or store furniture, equipment, signs, or other objects outside the building.
6. If required to remain, stay inside and away from windows, doors, and outside walls. Watch for roof leaks, pipe breakage, fire, or structural damage. Workers should never remain alone.
7. During the height of the hurricane, personnel should remain in a place that has been identified as safe from wind and flood.
8. During a power failure, turn off electrical switches to prevent reactivation before necessary checks are completed.
9. Remember that a lull often signifies the storm's eye—not its end. Anyone riding out a hurricane should wait for authorities to announce that the danger has passed.

A.17 Lightning

1. Lightning can strike several miles/kilometers from its source, so early precautions are crucial. If thunderstorms are in the forecast, reassess your plans for outdoor activities.
2. If you can hear thunder, then you are close enough to the storm to be at risk. Use the 30/30 Rule to help you. If you can count 30 seconds or less between seeing lightning and hearing thunder, you should seek shelter immediately. Take cover and lower elevated equipment (e.g., booms) if possible.
3. Seek shelter inside a house, large building or motor vehicle and keep windows and doors shut. Stand clear from windows, doors and electrical appliances and avoid contact with piping, including sinks and faucets.
4. Unplug equipment well before a storm nears—never during.
5. Avoid contact with metal and water. If boating, head for shore or if the threat is immediate, crouch low in the boat.
6. If no shelter is readily available, stay clear of high ground, open spaces, trees, sheds and small or open buildings. If in a flat open field:
    a. Crouch as low as possible but do not lie flat
    b. Only the balls of the feet should contact the ground with heels together
    c. Bend forward with head down
    d. Cover ears with hands, elbows pointing down
    e. Maintain at least 17 feet (5 meters) between personnel
    f. Refer to Figure 1Figure 1 for a sketch of the lightning position described above.

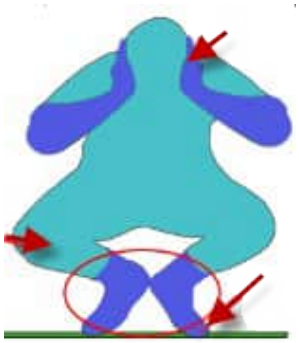


Figure 1. Lightning Position

7. Contact emergency services and First Aid Provider(s) if someone is struck by lightning.
8. Look for cardiopulmonary distress, broken bones, burns, and entry and exit wounds when treating lightning-related injuries.
9. Avoid contact with piping including sinks and faucets.
10. Check for and extinguish fires.
11. If power is lost, shut down equipment.

A.18 Tornado

1. Monitor Regional Resiliency communications, television, radio, or other sources identified as reliable (e.g., social media, websites) for information, updates, and evacuation orders.
2. Go to a center stairwell or corridor of the building's lowest level possible. Move away from the perimeter of the building and exterior glass.
3. Close any exterior office doors.
4. Sit or kneel down to protect yourself from a possible head injury.
5. Take shelter under a desk if there is no stairwell, basement, or other protected location.
6. Avoid seeking shelter in large open shop areas. Seek shelter in interior rooms, preferably with concrete surround. AVOID TAKING SHELTER IN ANY TRAILER UNIT OR VEHICLE.
7. Tornados generate considerable static electricity and can damage electrical lines, creating electrical shock hazards through telephone lines; therefore, do not use "land-line" telephone systems until they are rendered safe.
8. If the facility is so equipped, listen for information and directions via the Public Address system.
9. Follow the directions of the Site Supervisor or designee or Emergency Services personnel.
10. If outside, seek a safe place in a sturdy nearby building. As a last resort, take cover in a ditch or low-lying area away from trees; lie flat with hands covering head and neck.
11. If driving pull over, exit the vehicle and take cover in a ditch away from the vehicle as described above OR if flying debris is encountered, stay in the vehicle, seatbelt on, and cover your head with your hands, keeping your head below closed windows.

A.19 Earthquake

1. **If inside, DUCK, COVER, and HOLD:**
    a. Take cover under a desk or table, or sit or stand against an inside wall (not inside a doorway, unless you know it is strongly supported and load bearing).
    b. Hold tightly to the desk or table until the shaking stops.
    c. Move away from windows or objects that may fall and utilize suitable material to shield head and face if available.
    d. Do not run outside during the shaking.
    e. After the shaking has stopped, evacuate the building if structural damage is apparent (per local guidance; use stairs, not the elevator).
    f. Avoid use of the telephone. Replace telephone handsets shaken off the hook.
    g. Do not create an ignition source due to possible gas leaks.
2. **If outside:**
    a. Do not enter any building.
    b. Move clear of buildings, falling glass, utility poles, wires, and large trees.
    c. Get on the ground — DUCK, COVER, HOLD.

d. After the shaking stops, watch for falling glass, electrical wires, poles, and other debris.

3. **If driving:**
   a. Drive away from overpasses and underpasses.
   b. Stop in a safe place.
   c. Set the parking brake.
   d. Stay in the vehicle. If wires fall onto the vehicle, stay inside until rescued.
4. **Be prepared for aftershocks and fires.**
5. **Personnel must obtain or wait for instructions (i.e., all clear and re-entry or further evacuation) from the Site Supervisor, his or her designee, or Emergency Services personnel.**

A.20 Severe Weather Storms

1. Monitor Regional Resiliency communications, television, radio, or other sources identified as reliable (e.g., social media, websites) for information, updates, and road closures.
2. Consider requesting staff to work from home to reduce travel risk or sending staff home prior to the start of a storm.
3. Locate the emergency supplies, such as flashlights, water, and medical supplies.
4. If conditions deteriorate to the point of closure, confirm that employees know road conditions and that remaining on site may be the best decision.

A.21 Power Outage

1. If it is safe to do so, shut down any equipment or processes that could be hazardous if the power suddenly returns.

Ensure appropriate personnel have been notified if there are critical areas that require power.

Retrieve flashlights from emergency supplies.

If unsafe to continue working due to inadequate lighting or any other hazard, evacuation to the designated in-place shelter location should be initiated.

The Site Supervisor or designee must conduct a roll call to confirm all personnel are accounted for.

If it is unsafe to go to the in-place shelter location continue to the designated muster point.

If unable to proceed to the designated location (e.g., it is unsafe to leave the area due to inadequate lighting) inform other personnel of the situation and wait for assistance. Do not attempt to proceed unless there is immediate danger.

Personnel should await further instruction (i.e., all clear and re-entry or further evacuation) from the emergency response coordinator or designee.

A.22 Electrical Live Line Contact

1. All personnel must evacuate to the designated muster point if safely able to do so.
2. Establish the danger zone: 33-foot (10-meter) radius from anything in contact with the live line.
3. If contact was made while operating a vehicle or equipment, the operator should, if feasible:
   a. Remain on the equipment or inside the cab. All other personnel must keep away from the machine and any other applicable connected or contacted components such as rope or load.
   b. Try, unaided and without anyone approaching the machine, to back off the equipment until it is well clear of the power line.
   c. If the machine cannot be self-propelled away or disentangled from the line, remain inside the machine until the electrical authorities de-energize the circuit and confirm that conditions are safe.
   d. If the cable or equipment appears to be welded to the line do not try to back the equipment off. This could cause the line to whip or snap.

4. If hazards such as fire are present that require the operator to leave the equipment or vehicle, the operator must jump to the ground, taking critical care to keep both feet together and not fall or touch the equipment or ground with any other body part.

5. To leave the danger zone the individual must Hydro Shuffle* or bunny hop with both feet leaving and making contact with the ground at the same time. Hopping should be the secondary choice as the potential to fall is increased.
6. Notify emergency response coordinator or designee. Contact the electrical company.
7. Assess the scene. Lock out power supply if it is possible to do so safely. Identify potential hazards, such as fire, explosion, or slack lines away from the immediate area.
8. Take appropriate control measures to prevent further hazards if it is safe to do so.
9. Should it be determined that a worker is still within the hazard zone, establish whether a rescue can be safely attempted. Follow emergency rescue procedures if a rescue attempt will not put another life in danger.
10. Ensure any piece of equipment that has sustained a live line contact is inspected.

A.23 Gas Odor or Major Leak

1. If safe to do so, restrict ignition sources from the area (e.g., electrical devices, engines, smoking, etc.) from the area.
2. Leave the area immediately and warn others in the area to leave as well.
3. Sound the alarm or confirm applicable notification system is initiated.
4. All personnel must vacate the building or site and proceed to the Muster Point.
5. If gas is burning, call **911**. Give directions to the location; stay on the line until information is verified.
6. Notify the appropriate authorities (e.g., utility owner emergency line, client).
7. Provide responding utility and emergency personnel with any relevant information.
8. Personnel should await further instructions (i.e., all clear and re-entry or further evacuation) from the Site Supervisor or designee.

* Note on how to Hydro Shuffle: To avoid electrical shock keep both feet tightly together. Shuffle, using short steps where the heel of one foot never moves beyond the toe of the other foot. Hopping with both feet together can also prevent shock as you leave the hazard area.

Appendix B Pre-Task Forms

1. Assessment of SH&E Training Requirements – Americas
2. Competent Person Designation – Americas
3. Project Hazardous Materials Communication Plan – Americas
4. Project Hazardous Substance Exposure Control Plan – Americas
5. Utilities and Subsurface Clearance Checklist – Americas

Assessment of SH&E Training Requirements

S3AM-003-FM1

Instructions

1. **This form must be completed in accordance with SH&E Training – Americas S3AM-003-PR2.**
2. **This form should be used as a guideline for providing SH&E training to employees per the requirements of their role, in relation to the specific risks posed by their work activity, and in accordance with legal, client, and industry requirements. Other applicable region-, business line-, or project-specific training assessments should also be consulted.**
3. **The completed form must be retained in the employee or project files.**

If the assessment is for an individual		For project-based assessments, or optionally for individual assessments	
Employee	….	**Project Number**	60788778
Employee Email	….	**Project Location**	91 Leighton Avenue, Rochester, NY 14609

Required Training for All Employees

Applies?	Course Title	Regulatory	Frequency	Additional Information
☒	Core Curriculum	N	Annual	Based on regional training plans.
☒	Global SH&E Orientation	N	Within one week of starting at AECOM	Training will set the expectations of the AECOM Safety for Life program.
☒	New Employee SH&E Orientation	Y	Once	Accomplished via a combination of AECOM U modules and region-specific training plans.
☒	Emergency Preparedness Plan/ Emergency Action Plan	Y	As needed	For office personnel, this is covered as part of office-specific orientation. For field/site personnel, this is covered in project/site-specific orientation

Risk- and Role-Based Training

Applies?	Course Title	Regulatory	Frequency	Should You Attend?	Additional Information
SH&E Risk Assessment and Planning					
☒	Field Safety Training	N	Annual	Required for all employees performing field work who are not in the hazardous waste or mine safety training programs. This training is also required for any DCS Project Manager that manages projects where field work is performed.	Specific content and delivery method will depend on the office and the employees' expected work.
☒	• 10-Hour Construction Safety & Health Course • 30-hour Construction Safety & Health Course • Equivalent level of certification, with prior approval obtained by SH&E	N	Once	U.S. only: 1. You perform work that exposes you to active construction/demolition. 2. You perform work that exposes you to construction-like hazards. 3. As required by client or local law.	1. Project sites where we, our client, or another contractor (whether AECOM managed or not) are presently building, removing, or disassembling structures or digging excavations of any size by mechanical means. 2. On sites where the focus is NOT construction/ demolition, but where our work scope includes use of heavy machinery movement, work at heights, confined space, hot work, lifting/hoisting loads, and/or ground breaking (includes drill rig, direct push and vac truck use).

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Applies?	Course Title	Regulatory	Frequency	Should You Attend?	Additional Information
					3. Some jurisdictions, clients and/or controlling contractors require OSHA refresher training. Note: It is not applicable if your work area is separated from the construction/demolition with enough distance or physical barriers that fully prevent exposure of our team to those hazards. Note: If an AECOM employee is escorted by another employee, contractor, client, or third party, with training equivalent to 10-hour Construction training, for the entire duration of their site visit, 10-hour training for the escortee may not be required. The escort's level of training must be confirmed prior to conducting the site visit.
SH&E Incident Response and Investigation					
☐	Cardiac Pulmonary Resuscitation (CPR)	Y	As established by the training provider – typically biennial	Required: 1. For employees who are designated as first aid responders; 2. For employees who are performing high hazard activities (e.g., potential for falls, suffocation, electrocution, amputation) and medical attention is more than 4 minutes away; or 3. by client contract.	Acquire training from recognized source (e.g., Red Cross, American Heart).
☐	Automated External Defibrillator (AED)	Y	As established by the training provider	You are designated to be an AED user at an office or project site.	
☒	First Aid	Y	As established by the training provider – typically biennial	Required for 1. employees who are designated as first aid responders; 2. employees who are performing high hazard activities (e.g., potential for falls, suffocation, electrocution, amputation) and medical attention is more than 4 minutes away; or 3. required by client contract.	Acquire training from a recognized source (e.g., Red Cross, American Heart).
☐	Bloodborne Pathogens	Y	Annual	Required for employees designated as a first aid responder or others who have a potential bloodborne pathogen exposure.	May be included in first aid or CPR class.
☐	Fire Extinguisher	Y	Annual	You may be expected to use fire extinguishers (fixed facilities and project sites).	

Applies?	Course Title	Regulatory	Frequency	Should You Attend?	Additional Information
Safety Gear					
☐	Risk-Based Personal Protective Equipment	Y	Minimally once and then as required by procedure and/or regulation.	When PPE is required to complete the project/program.	Staff will receive adequate instruction on the correct use, limitations, and assigned maintenance duties for the equipment to be used. The following information, at a minimum, will be covered during PPE training: • What, when, and why PPE is required. • How to properly don, doff, adjust, and wear the PPE described. • The limitations of the PPE, including its expected useful life. • How to properly care for, maintain, and dispose of the PPE
Confined Spaces					
☐	Confined Space Entry Awareness	N	As needed	Employees who work around confined spaces but are not responsible for performing entry/authorizer/attendant duties.	Available online through AECOM U.
☐	Confined Space Entry (Performance Based)	Y	Once	You perform confined space entry/authorizer/attendant duties (including anyone performing non-entry rescue activities).	
☐	Confined Space Refresher	N	As needed	Recommended if you perform entry activities.	
☐	Confined Space Rescuer (Performance Based)	Y	Once	You may have to enter a confined space to perform a rescue.	
Driving					
☒	Vehicle/Driver Safety	N	Once	Required for all employees who drive on behalf of AECOM.	Generally completed upon hire by employees who may become authorized drivers. Available online through the AECOM U.
☐	Defensive Driving	N	Once, followed by refresher every three years	Required for all DCS employees who drive on behalf of AECOM.	National Safety Council, Alert Driving, Smith System or equivalent.
☐	Off-Highway Vehicle (OHV) Driving	N	As required	Required for all employees who operate an OHV.	Refer to local law and OHV manufacturer instructions.
Ground Disturbance					
☒	Excavations/Trenching Awareness	N	As needed	Employees who could potentially be exposed to or directly involved with excavation and trenching activities.	Available online through AECOM U.
☒	Competent Person – Excavations	Y	Once and as required by client or training provider	Required for employees serving the role of Competent Person. To be completed via formal training or documented experience reviewed and approved by SH&E.	Frequency may be established by an applicable standard
☐	Driller's Safety Training	N	Once and as required by client or training provider	Required for employees involved in overseeing drilling activities.	Frequency may be established by an applicable standard. Available online through AECOM U.
☐	24-Hour Surface Miner Training	Y	Once	You perform work at surface mine sites regulated by MSHA.	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.

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Applies?	Course Title	Regulatory	Frequency	Should You Attend?	Additional Information
Hand and Power Tools					
☒	Hand Safety Awareness	N	As needed	Recommended for employees who are required to work with various hand and/or power tools	Available online through AECOM U.
☒	Hand and Power Tool-Specific Training (Performance-based)	Y	As needed	Required for employees whose job duties include these activities.	This includes site-level training. Manufacturer's specifications must be reviewed and followed in addition to regulatory requirements.
Hazardous Energy Control					
☐	Lockout/Tagout Awareness – Affected Person	Y	Once; refresher as required by local law	You work with and around equipment that may need to be locked out/tagged out. (You are not responsible for applying tags/locks).	May be included in OSHA 10 or other classes
☐	Lockout/Tagout – Authorized Person	Y	Once; refresher as required by local law	You lock out or tag out machines or equipment in order to perform servicing or maintenance on that machine or equipment.	Specific to individual machines.
☐	Electrical Safety (Awareness level)	Y	Once	Employees who have potential exposures to electrical hazards but are not working on live electrical equipment (not including power tools)	Available online through AECOM U.
Heavy Equipment and Machines					
☐	Powered Industrial Trucks (Forklifts)	Y	Once	Your job assignments include operating a powered industrial truck (forklift).	Required more frequently if assessments indicate the need.
☒	Heavy Equipment Safety	N	As needed	You work around heavy equipment but are not operating them.	Available online through AECOM U. May be included as part of a 10- or 30- hour Construction Health and Safety course.
Railroads					
☐	Agency-Specific Roadway Worker Protection Training	Y	As required		
Underground Work					
☐	24-Hour New Surface Miner Training	Y	Once	You perform work at surface mine sites regulated by the U.S. Mine Safety and Health Administration (MSHA). Training is conducted by MSHA-approved instructors under MSHA-approved training plan.	
☐	Experienced Miner Training	Y	Once, followed by annual refreshers	You meet the MSHA definition of an “Experienced Miner.”	See Surface Miner and Underground Miner training for information on annual refreshers.
☐	8-Hour Surface Miner Training – Annual Refresher	Y	Annual	You perform work at surface mine sites regulated by MSHA.	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.
☐	40-Hour Underground Miner Training – New	Y	Once	You perform work in underground mine sites regulated by MSHA.	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.
☐	8-Hour Underground Miner Training – Annual Refresher	Y	Annual	You perform work in underground mine sites regulated by MSHA.	Training is conducted by MSHA-approved instructors under MSHA-approved training plan.

Applies?	Course Title	Regulatory	Frequency	Should You Attend?	Additional Information
Work at Height					
☐	Fall Protection – Awareness	Y	Once and as needed	You are able to recognize hazards to avoid areas where fall protection is needed.	May be included in OSHA 10 or other classes
☐	Fall Protection Authorized User	Y	Once and as needed	You perform duties at a locations where exposure to fall hazards and personal fall arrest systems are required.	
☐	Fall Protection – Competent	Y	Once and as needed	You review/approve fall protection plans. You supervise, implement and monitor fall protection programs.	
☐	Fall Protection – Qualified Person	Y	Once and as needed	You possess a recognized degree or professional certificate and can design/analyze fall protection systems via extensive knowledge, training, and experience.	
☐	Mobile Elevating Work Platform (MEWP) Training (Performance Based)	Y	Once	You are required to operate MEWPs such as bucket trucks, manlifts, and under bridge inspection units.	
☐	Under Bridge Inspection Units (Awareness Level}	N	Once	You are required to occupy/operate Under Bridge Inspection Units (UBIUs) or to manage a project involving UBIUs.	Available online through AECOM U. This training is an AECOM requirement and not a substitute for ANSI/SAIA A92.24-2018 training requirements adopted by AECOM.
Work On, In, and Near Water					
☐	U.S. Coast Guard Safe Boating Course or equivalent	N	Once	Required if you operate watercraft.	
☐	Water and Ice Safety Awareness	N	Annually	Recommended if you work over or near water.	
☐	Marine Trash and Debris Awareness and Limitation	Y	Annual	You work on contract operations for lessees and/or operators of oil and gas operations in the Gulf of Mexico.	Provided by lessee or operator.
Biological and Wildlife					
☒	Biological Hazards	N	As required	Employees potentially exposed to wildlife or poisonous plants.	Available online through AECOM U.
☒	Bloodborne Pathogens	Y	Annually, as required	Employees working in areas that may expose them to human bodily fluids (waste treatment plants, sanitary sewers, etc.).	Available online through AECOM U.
☐	Bear Aware	N	As required	Employees working in areas with known bear populations.	Available online through AECOM U.
Ergonomics					
☐	Ergonomics Self-Assessment	N	Once	For Employees who work in a home office, AECOM office, or project office.	Generally completed upon hire or change in assignment. Available online through the AECOM U.
Fitness for Duty					
☒	Fitness for Duty	N	Once, refresher as needed.	Recommended for applicable field projects (i.e., safety sensitive, night work, etc.)	Available online through AECOM U.
☐	Reasonable Suspicion for Supervisors	N	Once, refresher as needed.	For People Managers.	Available online through AECOM U.

Applies?	Course Title	Regulatory	Frequency	Should You Attend?	Additional Information
Injury and Illness Claims Management					
☐	Injury and Illness Claims Management Flow	N	As required	Required for Employees who sustain an injury or illness that involves claims management.	Available online through AECOM U.
Heat and Cold Stress					
☒	Heat Stress	N	Once, refresher as required by local law	For employees that might be exposed to heat stress	Can be completed via AECOM U or other approved training, including 10-/30-hour Construction Health and Safety courses.
☒	Cold Stress	N	Once, refresher as required by local law	For employees that might be exposed to cold stress.	Can be completed via AECOM U or other approved training, including 10-/30-hour Construction Health and Safety courses.
Noise					
☒	Hearing Conservation	Y	Annual	Employees exposed to noise ≥ 85 decibels averaged over an 8-hour day, or who otherwise utilize hearing protectors.	Project-specific hearing conservation training and available online through AECOM U.
Radiological					
☐	Nuclear Density Gauge Operator	Y	Contact your Business Group Radiation Safety Officer for region-specific training requirements	You operate nuclear density gauges / densometers.	Troxler or equivalent training.
☐	Nuclear Density Gauge Transporter	Y		You transport nuclear density gauges / densometers.	Hazardous Materials shipping - ground and/or air.
☐	Radiation Worker (Nuclear Energy Worker)	Y		You may require non-routine or short-term unescorted access to radiological controlled areas (excluding High Radiation Areas and Airborne Radiation Areas), or you work in areas where radioactive materials are stored.	Occupational dose limits apply.
☐	Radiation Safety Officer	Y		You are designated as a Radiation Safety Officer.	
Respirator Usage					
☒	Respiratory Protection	Y	Annual	Required for any employee who may be required to wear a respirator.	May be included in HAZWOPER refresher training
☐	Self-Contained Breathing Apparatus (SCBA)/Cascade Systems	Y	Once	Required for any employee required to wear SCBAs or to operate a supplied air system.	Part of Project Safety training as needed.
Hazardous Substances and Communication					
☒	40-Hour Hazardous Waste Operations	Y	Once	Anyone performing work or expected to perform at hazardous waste sites or treatment, storage, and disposal facilities or those responding to emergency releases of hazardous substances.	Training must have a 'hands-on' component (i.e., donning/doffing PPE). Any exceptions must be approved by a Regional SH&E Manager.
☒	8-Hour Hazardous Waste Operations – Refresher	Y	Annual	Only attend if you have completed the 40-Hour Hazardous Waste Operations training - see above.	When offered as a combination of online modules and classroom instruction, online modules must be completed prior to the classroom portion for participants to receive credit. Both portions (online and classroom) need to be completed within the same calendar year.

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Applies?	Course Title	Regulatory	Frequency	Should You Attend?	Additional Information
☐	8-Hour Hazardous Waste Operations – Supervisor	Y	Once	Required for anyone serving as the site supervisor or overseeing subcontractor activities at a hazardous waste site.	When offered as a combination of online modules and classroom instruction, online modules must be completed prior to the classroom portion for participants to receive credit. Both portions (online and classroom) need to be completed within the same calendar year.
☐	Anhydrous Ammonia Awareness	Y	Once - refresher as required by local law	You perform work where you may be potentially exposed to anhydrous ammonia. This may include tasks associated with industrial refrigeration equipment or piping, petroleum refineries, and agricultural fertilizer.	Available online through AECOM U and provided by Vector Solutions.
☐	Asbestos Awareness	Y	Once; refresher as required by local law	You perform work where you work in areas that contain or may contain asbestos and have the potential to disturb the asbestos-containing material	Available online through AECOM U.
☐	Asbestos Inspector	Y	Annual	You perform asbestos sampling tasks.	
☐	Asbestos Planner	Y	Annual	You serve as the project asbestos planner.	
☐	Cadmium Awareness	Y	Once, followed by annual refreshers		Available through AECOM U – Vector Solutions.
☐	Crystalline Silica Awareness	Y	Once; refresher as required by local law	You perform work where you may be potentially exposed to silica.	Available through AECOM U – Vector Solutions.
☒	Hazard Communication	Y	Initially and if hazards change	Required for anyone who is potentially exposed to/works with hazardous chemicals.	Training must occur before any work with hazardous chemicals. Included (as needed) in safety orientation. After the initial training, required updates will typically be handled as part of project-specific safety training.
☐	Hazardous Materials Shipping	Y	Every 3 years	Required for anyone who packages, labels, transports, completes paperwork for, or offers for shipment, hazardous materials/dangerous goods.	
☐	Hot Work	Y	Once	Your job duties include these activities.	
☐	Hydrogen Sulfide (H2S) Alive	Y	Annual	For employees performing ground disturbance activities in the oil and gas industries.	
☐	Hydrogen Sulfide (H2S) Awareness	Y	Annual	For employees performing ground disturbance activities who are at risk of hydrogen sulfide exposure, but do not work in the oil or gas industry	
☐	Laboratory Safety (Awareness Level)	Y	Once	You work in a laboratory.	Available through AECOM U – Vector Solutions.
☐	Lead Awareness	Y	Once - refresher as required by local law	You perform work where you may be potentially exposed to lead.	
☐	Lead Project Designer	Y	Every 3 years	You are a lead project designer.	
☐	Lead Risk Assessor	Y	Every 3 years	You are a project lead risk assessor inspector.	

Applies?	Course Title	Regulatory	Frequency	Should You Attend?	Additional Information
☐	Substance Specific	Y	Once	Any U.S. employee potentially exposed to a substance covered by the 29 CFR substance specific regulations.	Includes Ammonia, Benzene, Cadmium, Chromium (VI), Hydrogen Sulfide, Silica and Lead. Offered as part of project-specific training.
☐	Waste Specialist	Y	Once with annual refresher	You are responsible for waste management at a small or large quantity generator facility.	
☐	Workplace Hazardous Materials Information System (WHMIS)	Y	Annual	You are assigned to a Canadian facility and work with or around hazardous materials.	Canadian Hazard Communications
Highway and Road Work					
☐	Flagger Training	Y	Once	Anytime a worker is responsible for directing or controlling traffic on a construction site, road maintenance project, or any other area where they need to manage vehicular or pedestrian flow	Available through external vendor approved by SH&E Manager.
☒	Work Zone Safety (Awareness Level)	N	Once	Work on or adjacent to roadway live traffic.	Available online through AECOM U.

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Utilities and Subsurface Clearance Checklist

S3AM-303-FM4

Instructions

1. **This form must be used to document the identification of all underground and overhead utilities and to carefully plan work locations to avoid any potential for inadvertent contact with them. See Ground Disturbance – Americas S3AM-303-PR2 for more information.**
2. **The form must be completed, reviewed, and signed by the Project Manager.**
3. **Once completed, this form must be retained in the project files.**

Details					
Location	....	**Project #**	60788778	**Date & Time**	....
Manager	....	**Contractor (if applicable)**	....	**Weather**	....
Client	NYCDEC	**Inspector**	....		
Notes	....				

Part 1 and Part 2 must be completed prior to any intrusive subsurface work. DO NOT DISTURB GROUND if a "No" answer to any of the Part 1 questions has not been initialed as authorized by the AECOM Manager.

For any exceptions to any of the requirements of the utility clearance process, SH&E Management System Variance Request – Americas S3AM-215-FM2 must be completed and approved.

Part 1

a.	Permits and Access Agreements	Yes	No	N/A
i.	Have all appropriate permits and agreements been identified and obtained (e.g., client, drilling, encroachment, working near railroads, etc.)?	☐	☐	☐
ii.	Have all client requirements been identified and obtained?	☐	☐	☐
iii.	If working off site is (are) site access agreement(s) executed?	☐	☐	☐

b.	Identification and Mapping of Utility and Subsurface Structures	Yes	No	N/A
i.	Is a site plan showing proposed subsurface locations and utility locations attached to this check list?	☐	☐	☐
ii.	Have above-/below-ground utilities and subsurface installations been investigated (Part 2 of this form)?	☐	☐	☐
iii.	Have all federal/state/provincial/territorial and other "One Call" providers marked their facilities or otherwise notified AECOM that they do not have any facilities near the proposed subsurface/intrusive locations?	☐	☐	☐
iv.	Have you identified what utilities are *not* included in the "One Call" provider system?	☐	☐	☐
v.	As noted in the exception at the bottom of Section V of this checklist, has a utility locating contractor performed geophysical and/or other surveys of the proposed subsurface/intrusive locations?	☐	☐	☐

c.	Site Walk	Yes	No	N/A
Has a site walk been performed that includes the following:		☐	☐	☐

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c.	Site Walk	Yes	No	N/A
i.	Reviewing all planned intrusive locations?	☐	☐	☐
ii.	Adjusting locations away from subsurface utilities and installations?	☐	☐	☐
iii.	Determining the appropriate utility clearance activities for each location?	☐	☐	☐
iv.	Determining the presence and location of overhead utilities and obstructions?	☐	☐	☐
v.	Walking around perimeter of the site to observe physical hazards?	☐	☐	☐
vi.	Visually surveying approximately 50 feet (15.2 meters) from the perimeter of the site to observe physical hazards and a 50-foot (15.2-meter) radius from each proposed subsurface location?	☐	☐	☐
vii.	Visually verifying that each of the proposed locations does not lie on a line connecting two similar manhole covers (e.g., sanitary sewer or storm drain)?	☐	☐	☐
viii.	Visually verifying that the ground in the vicinity of each of the proposed subsurface locations has not subsided, been excavated and patched, gives the appearance it may be covering a former trench (e.g., linear cracks, sagging curbs, linear re-pavements, etc.), and does not lie on a line with any water, gas, electrical meters, utility cleanouts, or other utility boxes in the surrounding areas?	☐	☐	☐

d.	Proposed Subsurface Investigation Locations	Yes	No	N/A
i.	Are all of the proposed subsurface locations at least 5 feet (1.5 meters) from any identified subsurface utility?	☐	☐	☐
ii.	Are all of the proposed subsurface locations at least 7 feet (2.1 meters) from the pad surrounding any underground storage tanks (USTs) shown on the Site Plan?	☐	☐	☐

Note: These setback distances are a minimum; government regulations and utility requirements may dictate a greater setback distance

e.	Utility Clearance Investigation Location Confirmation*	Yes	No	N/A
i.	Have the hand clearance/tolerance zones of subsurface locations been observed and utilities exposed through the use of non-destructive techniques as follows? Hand/non-destructive technique clearance should be extended if locations of deep utilities and structures are not known. In non-urban areas, hand clearing should be conducted if possible and according to local requirements.	☐	☐	☐
ii.	For soil borings/monitoring wells, excavated to a minimum of 5 feet (1.5 meters) below ground surface using non-mechanical methods?	☐	☐	☐

Comments:

....

Documentation supplied by One Call or private utility and installation locators, including email or written field confirmation/maps of mark-out requests and status must accompany this form. If this form is supporting multiple ground disturbance activities, a copy of this completed form should be provided to each activity.

Part 2					
Public Utility Locate (One Call)		**Prior Locate Ticket#**	....		
Date Called	.....	**Called By**	....	**Valid Until**	....
Ticket Number	....	**Area Requested to Be Cleared**	....		

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Part 2			
Private Utility Locate		**Prior Locate Ticket#**	….
Company Performing Locate	….	**Date Completed**	…..
Area(s) Requested to Be Cleared (including distance around marked locations)	….		
Method(s) Used (e.g., GPR, EM)	….		
Confirm Area(s) Cleared	….		

One Call Utilities					
Utility	**Notified by**	**Comments**	**Field Observation – Marked (mains & services)**		
			Yes	**No**	**Above**
Electric (Red)	☐ One Call ☐ Other	….	☐	☐	☐
Gas/Petroleum Pipeline (Yellow)	☐ One Call ☐ Other	….	☐	☐	NA
Sewer/Drainage (Green)	☐ One Call ☐ Other	….	☐	☐	NA
Water (Blue)	☐ One Call ☐ Other	….	☐	☐	NA
Communications (Orange)	☐ One Call ☐ Other	….	☐	☐	☐
Other ….	☐ One Call ☐ Other	….	☐	☐	☐
Were all circuits on during subsurface checks if the checks were for identifying energized lines (e.g., circuits on timers or light sensing switches)?			☐	☐	NA

Utilities Not Identified by One Call (Includes both Public and Private along with Regional and Site Utilities)						
Utility (Colors may vary)	**Owner / Contact / Phone #**	**Notified**		**Field Observation - Marked**		
		Yes	**No**	**Yes**	**No**	**Above**
Communications: (Orange) TV, computer, phone, cell towers, site communication, cameras, security, etc.	….	☐	☐	☐	☐	☐
Electricity: (Red) Mains / Supplies / Interior / Exterior (signs, fuel pumps, low voltage security perimeters, gates, property light posts, equipment, substations, etc.)	….	☐	☐	☐	☐	☐
Gas: (Yellow) Mains / Supplies / Equipment / Pipelines (Natural, Process, Oil, Crude, Refined (Gas, Diesel, Jet), etc.)	….	☐	☐	☐	☐	☐
Steam: (Yellow)	….	☐	☐	☐	☐	☐

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Utilities Not Identified by One Call (Includes both Public and Private along with Regional and Site Utilities)						
Utility (Colors may vary)	Owner / Contact / Phone #	Notified		Field Observation - Marked		
		Yes	No	Yes	No	Above
Structures: Possible horizontally installed facilities, vaults, basements, tunnels, sub-grade structures, foundations, overhead obstructions, underground parking, etc.	....	☐	☐	☐	☐	☐
UST Systems (Tanks / piping / electric)	....	☐	☐	☐	☐	NA
Sewer: (Green) Sanitary, storm, combined, septic, drainage (parking, buildings, fields), irrigation	....	☐	☐	☐	☐	NA
Water: (Blue) Process, Plant, potable, well, cooling, return/makeup, fire, sprinkler, landscape irrigation, reclaim (Purple) other	....	☐	☐	☐	☐	☐
Other: Abandoned lines, invisible dog fences, shopping cart perimeter monitoring, traffic lights	....	☐	☐	☐	☐	☐

Project Manager Review and Approval		
....		....
Project Manager Name	**Signature**	**Date/Time**

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Drill Site Safety Inspection Checklist

S3AM-303-FM3

Instructions

1. **This form is to be completed in accordance with Ground Disturbance – Americas S3AM-303-PR2.**
2. **Each shift must inspect all applicable items. If an unsatisfactory condition (fail) is observed, suspend the operation of the equipment, and report the condition to the site supervisor immediately.**
3. **Submit a safety observation each day before leaving the project site.**
4. **The completed form must be retained in the project files.**

Details	
Site / Project Name	....
Name of Inspector	....
Date and Time Inspected	....

Checklist		Yes	No	N/A
a.	**Morning**			
i.	Did a daily safety meeting occur and were all parties engaged and fit for duty?	☐	☐	☐
ii.	Did the driller complete their rig inspection checklist?	☐	☐	☐
iii.	Has equipment and Personal Protective Equipment (PPE) been verified, including the spill kit, fire extinguisher, first aid kit?	☐	☐	☐
iv.	Have drill rig emergency shut-off switches been verified to be functioning?	☐	☐	☐
b.	**Site Set/Rig Up**			
i.	Have overhead lines been identified and accidental contact controlled?	☐	☐	☐
ii.	Are paint markings for underground utilities still visible?	☐	☐	☐
iii.	Is the rig at the correct drill location, with GPS/maps/etc. checked?	☐	☐	☐
iv.	Is there plastic under the rig?	☐	☐	☐
v.	Is site control in place, such as cones and tape, as well as fencing?	☐	☐	☐
vi.	If needed, are leveling jacks in place/rig leveled/cribbing in place?	☐	☐	☐
vii.	Are line of fire hazards identified?	☐	☐	☐
c.	**Drilling**			
i.	Are augers/rods stored properly (e.g., not leaning on rig or truck)?	☐	☐	☐
ii.	Are spoils being removed from borehole safely?	☐	☐	☐
iii.	Are rods removed from the winchline when not in use (e.g., not left strung)?	☐	☐	☐
iv.	Are drillers communicating with each other (e.g., all hands clear when using wrenches and rotating augers)?	☐	☐	☐
v.	Are loads secured on forklifts?	☐	☐	☐
vi.	Are loads 50 pounds (22.7 kilograms) or greater either team or mechanically lifted?	☐	☐	☐
vii.	Are gloves and safety glasses in use?	☐	☐	☐

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Checklist		Yes	No	N/A
viii.	Are dust masks used when mixing grouting?	☐	☐	☐
ix.	Are five (5) minutes taken after lunch and before cleanup for a safety check-in?	☐	☐	☐
x.	Are three (3) points of contact used when entering/exiting equipment?	☐	☐	☐
xi.	Are drums properly labelled?	☐	☐	☐
xii.	Has equipment been observed for leaks of hydraulic fluid, fuel, etc.?	☐	☐	☐
d.	**Decontamination**			
i.	Has decontamination occurred per the approved location-specific safety plan?	☐	☐	☐
e.	**End of Day**			
i.	Is the borehole covered?	☐	☐	☐
ii.	Has feedback been provided to drillers?	☐	☐	☐
iii.	Has the plan been made for the next workday?	☐	☐	☐

Comments

....

Inspector Review and Approval

....		....
Inspector Name	Signature	Date/Time

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Project Hazardous Materials Communication Plan

S3AM-110-FM2

Instructions

1. **This form, or equivalent, is to be completed in accordance with Hazardous Substances and Communication – Americas S3AM-110-PR2.**
2. **This form, or equivalent, must be completed and attached as an appendix as part of the Project-Specific SH&E Plan – Americas S3AM-209-FM2 when the project scope of work requires chemical materials (i.e., hazardous materials/substance and/or Materials of Trade) to be brought onto the site to perform work.**
3. **Materials to be brought to the Site by AECOM and/or its subcontractors and chemical hazards that will be encountered on the Site must have a Safety Data Sheet (SDS) maintained in an accessible location for workers to review.**
4. **Applicable SDSs must be attached to this form.**
5. **The completed form must be retained in the project files as part of the project-specific SH&E plan.**

Materials to be brought or encountered on the Site will include the following (add rows as necessary):

	Chemical Name	Purpose/use/source
1.	Hydrogen Chloride	Bottleware Preservative
2.	Nitric acid	Bottleware Preservative
3.	Isobutylene	Cal Gas
4.	Alconox	Detergent
5.	Gasoline	Generator Fuel
6.	Trichloroethene	Possible Contaminant
7.		
8.		
9.		
10.		
11.		

The applicable SDSs are attached to this form below:

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Project Hazardous Substance Exposure Control Plan

S3AM-110-FM3

Instructions

1. **This form, or equivalent, is to be completed in accordance with Hazardous Substances and Communication – Americas S3AM-110-PR2.**
2. **This form must be completed and attached as an appendix to the Project-Specific SH&E Plan Template – Americas S3AM-209-FM2 only when there is a potential for employee exposure to any chemicals listed in the table below. This determination should be based on information obtained from historical investigations and other relevant sources indicating that the chemicals may be present at elevated concentrations at the site. when any chemicals listed in the table below are known or suspected to be present at elevated concentrations at the site based on information obtained from historical investigations and other sources.**
3. **For the first table, add rows as necessary and delete rows of the chemicals not applicable to your project.**
4. **For Occupational Exposure Limits to Chemical and Biological Agents in other Canadian provincial or territorial areas refer to the applicable jurisdictional legislation.**
5. **The completed form must be retained in the project files as part of the project-specific SH&E plan.**

Materials to be brought or encountered on the Site will include the following:

Note 1: **Max. Conc.** = Maximum Concentration | **PEL** = Permissible Exposure Limit | **TLV** = Threshold Limit Value | **IP** = Ionization Potential | **eV** = Electron Volt | **mg** = milligrams | **µg** = micrograms | **cm^3** = centimeters cubed | **m^3** = meters cubed | **f** = fiber | **ppm** = parts per million

Note 2: Examples of media include but are not limited to soil, groundwater, vapor, and fumes.

Note 3: Exposure routes could be dermal (absorption), ingestion, inhalation, and injection.

Chemical Name	Media (list all that apply)	Exposure Route(s)	Max. Conc. Observed at Site	PEL– U.S. OSHA (Cal/OSHA or Canadian province where noted)	TLV	IP (eV)
Trichloroethene (TCE)[1]	Soil, Groundwater	Inhalation	….	0.2 ppm	10 ppm	9.45

Exposure Monitoring Needs Assessment

During the performance of the scope of work, there is a reasonable potential for exposure to chemical hazards. These may originate from materials brought on site, constituents of concern present in environmental media under investigation, or simultaneous operations conducted by the property owner or third parties. Such exposures could result in vapors, fumes, aerosols, mists, or airborne particulates/dusts approaching permissible exposure limits. Therefore, the worker exposure monitoring measures to be implemented are described below.

Industrial Hygiene Sampling

☒ Industrial hygiene (IH) sampling will **NOT** be used as part of worker exposure monitoring

☐ Industrial hygiene (IH) sampling **WILL** be used as part of worker exposure monitoring. IH sampling will consist of ____.

Point Source Monitoring

☐ Direct-read instruments will **NOT** be used to collect point source readings to guide field investigation and sample selection.

☒ One or more direct-read instruments **WILL** be used to collect point source readings, as a standard industry practice, to guide field investigation and sample selection. These readings are **NOT** representative of worker exposure.

Instrument Selection

[1] EPA limit for TCE: 0.2 ppm

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Worker exposure monitoring will be conducted using a combination of direct-read instruments and industrial hygiene sampling methods, as outlined below. Monitoring will take place within the work area to detect the presence and relative levels of toxic substances. All monitoring activities will be performed in accordance with the work permit and Task Hazard Analysis (THA). Instruments used on site must be intrinsically safe to prevent fire or explosion.

Instrument	Manufacturer/Model	Hazard Detected/Measured
☒ Photo Ionization Detector (PID)	**RAE Systems mii-RAE** **Photovac Microtip** **Hnu Model Hnu (min. 10.6 eV bulb)**	Petroleum hydrocarbons Organic solvents
☒ Particulate Monitor	MIE Model PDM-3 mini-RAM	Aerosols, mist, dust, and fumes

Instrument Calibration/Bump Checks

Direct-read instruments must be calibrated prior to use each day following the procedure outlined by the manufacturer in the instrument manual. Calibration results shall be documented in a digital or hardcopy field form or logbook. Full calibration records from the instrument provider (i.e., rental company) shall be retained in the central project file.

Direct-Read Instrument Monitoring Procedures and Action Levels

The monitoring procedures shown below are general guidelines for sampling activities. In general, readings are considered actionable if sustained readings are observed for 5 minutes or more or if intermittent peaks are seen more than 1 time the action level. A reading more than action level outlined below will require additional ventilation (natural or mechanical) for 30 minutes, followed by re-monitoring.

Parameter	Zone Location and Monitoring Interval	Action Level	Response Activity
☒ **Volatile Organic Compounds** (VOCs) and Volatile Hydrocarbons (total by PID)	Breathing zone, continuously during tasks where exposure to VOCs and volatile hydrocarbons is possible	<5 ppm	Continue monitoring, may continue work in required PPE

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		5- 25 ppm (sustained for 5 minutes)	**STOP WORK** and notify PM. Investigate the cause of elevated VOC measurements and identify measures to reduce concentrations (cover impacted soils, ventilation, etc.). Work activities shall only continue once levels have decreased to or below 5 units above background. If levels continue above 5 units, only individuals who are medically qualified to wear respiratory protection are permitted to continue work activities with Project Manager approval. Don Level C PPE (organic vapor respirator cartridges), continue monitoring, and initiate continuous air monitoring for benzene.
		> 25 ppm (sustained for 5 minutes)	Cease work, exit, and contact the Site Safety Lead, Site Supervisor, and Project Manager.
☒ **VOCs and Volatile Hydrocarbons** (total by PID)	Edge of Exclusion Zone. See guidance in NYSDOH's Generic Community Air Monitoring Plan (**Attached**).	See guidance in NYSDOH's Generic Community Air Monitoring Plan (**Attached**).	
☒ **Dust not otherwise classified** (total by aerosol monitor)	Edge of Exclusion Zone. See guidance in NYSDOH's Generic Community Air Monitoring Plan (**Attached**).	See guidance in NYSDOH's Generic Community Air Monitoring Plan (**Attached**).	

Instrument Recordkeeping

Instrument readings collected for the purpose of monitoring or determining worker exposure will include the date, time, activity being performed, location, and result/reading. Results will be recorded at the following frequency:

Decontamination

Contact with chemicals and/or contaminated/impacted materials while performing field activities may occur. All practical steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities. All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone (CRZ). Decontamination procedures, solutions and equipment are summarized in the table(s) below.

Site Map and Controls

See Appendix A.3

Personnel Decontamination

Procedure	Decontamination Solution	Equipment & Materials Needed
Remove disposable PPE	N/A	Container for used PPE
Wash hands after work and before eating, drinking, smoking, or touching unprotected skin.	Soap and Potable Water	Paper towels or sanitary wipes

Equipment Decontamination

Equipment Type	Decontamination Solution	Procedure
Respirator	Alconox solution and deionized water	Washing: Disassemble and wash with an Alconox solution in deionized water. A stiff bristle (not wire) brush may be used. Rinsing: Rinse in deionized water to remove all traces of detergent. This is important to prevent dermatitis. Disinfecting: Thoroughly rinse or immerse in a sanitizer provided by the manufacturer. Final Rinsing: Rinse thoroughly in clean water to remove all traces of disinfectant. Drying: Drain and dry by hanging by the straps from racks or by towel drying with clean, soft cloths or paper towels.
Water quality meter, oil/water interface probe, down-hole water sampling pumps, reusable sampling tools/ equipment		Washing: Disassemble and wash with an Alconox solution in deionized water. Rinsing: Rinse in deionized water to remove all traces of detergent
Drilling & Heavy Equipment/ Tools	High-pressure steam cleaner	Apply steam cleaner to used equipment/ tools

Waste Management

AECOM and AECOM subcontractor activities that generate waste on behalf of our client must be appropriately managed and disposed of in accordance with regulatory requirements. The following waste streams/products are anticipated to be generated by the project scope of work and be handling, management and disposed of as outlined in the table below.
DELETE THIS SECTION IF NO WASTE WILL BE GENERATED

Summary of Investigation and Site Activities Derived Waste

Waste Streams/Products	Handling and Disposal Procedures
Soil/ Rock Cuttings	Stored in 55-gallon steel DOT drums staged at 91 Leighton Ave., pending waste characterization and transport off site to approved facility for treatment/ disposal
Drill Water	
Well Development/ Purge Water	

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Medical Surveillance

Medical surveillance is required for employees who:

1. Are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;
2. All employees who wear a respirator for 30 days or more a year.
3. All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and
4. Members of HAZMAT teams.

Based on potential exposures is supplemental medical surveillance appropriate?	☐ Yes (contact a SH&E Manager for assistance) ☒ No

The applicable SDSs are attached to this form below:

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Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

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

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

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

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

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

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

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

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

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

Particulate Monitoring, Response Levels, and Actions

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

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

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

December 2009

Appendix 1B
Fugitive Dust and Particulate Monitoring

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

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

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

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

(a) Objects to be measured: Dust, mists or aerosols;
(b) Measurement Ranges: 0.001 to 400 mg/m3 (1 to 400,000 :ug/m3);
(c) Precision (2-sigma) at constant temperature: +/- 10 :g/m3 for one second averaging; and +/- 1.5 g/m3 for sixty second averaging;
(d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
(e) Resolution: 0.1% of reading or 1g/m3, whichever is larger;
(f) Particle Size Range of Maximum Response: 0.1-10;
(g) Total Number of Data Points in Memory: 10,000;
(h) Logged Data: Each data point with average concentration, time/date and data point number
(i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
(j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
(k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
(l) Operating Temperature: -10 to 50^{o} C (14 to 122^{o} F);
(m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

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

5. The action level will be established at 150 ug/m3 (15 minutes average). While conservative,

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

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM10 at or above the action level. Since this situation has the potential to allow for the migration of contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

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

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

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

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

Safety Data Sheet

Material Name: Gasoline All Grades

SDS No. 9950
US GHS

Synonyms: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

* * * Section 1 - Product and Company Identification * * *

Manufacturer Information

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

Phone: 732-750-6000 Corporate EHS
Emergency # 800-424-9300 CHEMTREC
www.hess.com (Environment, Health, Safety Internet Website)

* * * Section 2 - Hazards Identification * * *

GHS Classification:

Flammable Liquid - Category 2
Skin Corrosion/Irritation - Category 2
Germ Cell Mutagenicity - Category 1B
Carcinogenicity - Category 1B
Toxic to Reproduction - Category 1A
Specific Target Organ Toxicity (Single Exposure) - Category 3 (respiratory irritation, narcosis)
Specific Target Organ Toxicity (Repeat Exposure) - Category 1 (liver, kidneys, bladder, blood, bone marrow, nervous system)
Aspiration Hazard - Category 1
Hazardous to the Aquatic Environment – Acute Hazard - Category 3

GHS LABEL ELEMENTS

Symbol(s)



Signal Word

DANGER

Hazard Statements

Highly flammable liquid and vapour.
Causes skin irritation.
May cause genetic defects.
May cause cancer.
May damage fertility or the unborn child.
May cause respiratory irritation.
May cause drowsiness or dizziness.
Causes damage to organs (liver, kidneys, bladder, blood, bone marrow, nervous system) through prolonged or repeated exposure.
May be fatal if swallowed and enters airways.
Harmful to aquatic life.

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.
Wear protective gloves/protective clothing/eye protection/face protection.
Wash hands and forearms thoroughly after handling.
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Do not breathe mist/vapours/spray.
Use only outdoors or in well-ventilated area.
Do not eat, drink or smoke when using this product.
Avoid release to the environment.

Response

In case of fire: Use water spray, fog, dry chemical fire extinguishers or hand held fire extinguisher.
IF ON SKIN (or hair): Wash with plenty of soap and water. Remove/Take off immediately all contaminated clothing and wash before reuse. If skin irritation occurs, get medical advice/attention.
IF exposed or concerned: Get medical advice/attention.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a poison center or doctor/physician if you feel unwell.
Get medical advice/attention if you feel unwell.
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. Do not induce vomiting.

Storage

Store in a well-ventilated place.
Keep cool. Keep container tightly closed.
Store locked up.

Disposal

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 3 - Composition / Information on Ingredients * * *

CAS #	Component	Percent
86290-81-5	Gasoline, motor fuel	100
108-88-3	Toluene	1-25
106-97-8	Butane	<10
1330-20-7	Xylenes (o-, m-, p- isomers)	1-15
95-63-6	Benzene, 1,2,4-trimethyl-	<6
64-17-5	Ethyl alcohol	0-10
100-41-4	Ethylbenzene	<3
71-43-2	Benzene	0.1-4.9

110-54-3	Hexane	0.5-4

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes

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.

First Aid: Skin

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or with waterless hand cleanser. Obtain medical attention if irritation or redness develops.

First Aid: Ingestion

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. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

First Aid: Inhalation

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

* * * Section 5 - Fire Fighting Measures * * *

General Fire Hazards

See Section 9 for Flammability Properties.

Vapors may be ignited rapidly 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.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

Extinguishing Media

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or gaseous extinguishing agent.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration.

Unsuitable Extinguishing Media

None

Fire Fighting Equipment/Instructions

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment. Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing. 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 fire fighting foam.

* * * Section 6 - Accidental Release Measures * * *

Recovery and Neutralization

Carefully contain and stop the source of the spill, if safe to do so.

Materials and Methods for Clean-Up

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Caution, flammable vapors may accumulate in closed containers.

Emergency Measures

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Personal Precautions and Protective Equipment

Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

Environmental Precautions

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 fire fighting 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.

Prevention of Secondary Hazards

None

* * * Section 7 - Handling and Storage * * *

Handling Procedures

USE ONLY AS A MOTOR FUEL.
DO NOT SIPHON BY MOUTH

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

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 Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents."

Storage Procedures

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. 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 "Cleaning Petroleum Storage Tanks".

Incompatibilities

Keep away from strong oxidizers.

* * * Section 8 - Exposure Controls / Personal Protection * * *

Component Exposure Limits

Gasoline, motor fuel (86290-81-5)

ACGIH: 300 ppm TWA
500 ppm STEL

Toluene (108-88-3)

ACGIH: 20 ppm TWA
OSHA: 200 ppm TWA; 375 mg/m3 TWA
150 ppm STEL; 560 mg/m3 STEL
NIOSH: 100 ppm TWA; 375 mg/m3 TWA
150 ppm STEL; 560 mg/m3 STEL

Butane (106-97-8)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases: Alkane C1-4)
OSHA: 800 ppm TWA; 1900 mg/m3 TWA
NIOSH: 800 ppm TWA; 1900 mg/m3 TWA

Xylenes (o-, m-, p- isomers) (1330-20-7)

ACGIH: 100 ppm TWA
150 ppm STEL
OSHA: 100 ppm TWA; 435 mg/m3 TWA
150 ppm STEL; 655 mg/m3 STEL

Benzene, 1,2,4-trimethyl- (95-63-6)

NIOSH: 25 ppm TWA; 125 mg/m3 TWA

Ethyl alcohol (64-17-5)

ACGIH: 1000 ppm STEL
OSHA: 1000 ppm TWA; 1900 mg/m3 TWA
NIOSH: 1000 ppm TWA; 1900 mg/m3 TWA

Ethylbenzene (100-41-4)

ACGIH: 20 ppm TWA
OSHA: 100 ppm TWA; 435 mg/m3 TWA
125 ppm STEL; 545 mg/m3 STEL
NIOSH: 100 ppm TWA; 435 mg/m3 TWA
125 ppm STEL; 545 mg/m3 STEL

Benzene (71-43-2)

ACGIH: 0.5 ppm TWA
2.5 ppm STEL
Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA: 5 ppm STEL (Cancer hazard, Flammable, See 29 CFR 1910.1028, 15 min); 0.5 ppm Action Level; 1 ppm TWA
NIOSH: 0.1 ppm TWA
1 ppm STEL

Hexane (110-54-3)

ACGIH: 50 ppm TWA
Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA: 500 ppm TWA; 1800 mg/m3 TWA
NIOSH: 50 ppm TWA; 180 mg/m3 TWA

Engineering Measures

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

Personal Protective 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.

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.

Personal Protective Equipment: Hands

Gloves constructed of nitrile, neoprene, or PVC are recommended.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

Personal Protective Equipment: Skin and Body

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. Consult manufacturer specifications for further information.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	Translucent, straw-colored or light yellow	**Odor:**	Strong, characteristic aromatic hydrocarbon odor. Sweet-ether like
Physical State:	Liquid	**pH:**	ND
Vapor Pressure:	6.4 - 15 RVP @ 100 °F (38 °C) (275-475 mm Hg @ 68 °F (20 °C)	**Vapor Density:**	AP 3-4
Boiling Point:	85-437 °F (39-200 °C)	**Melting Point:**	ND
Solubility (H2O):	Negligible to Slight	**Specific Gravity:**	0.70-0.78
Evaporation Rate:	10-11	**VOC:**	ND
Percent Volatile:	100%	**Octanol/H2O Coeff.:**	ND
Flash Point:	-45 °F (-43 °C)	**Flash Point Method:**	PMCC
Upper Flammability Limit (UFL):	7.6%	**Lower Flammability Limit (LFL):**	1.4%
Burning Rate:	ND	**Auto Ignition:**	>530°F (>280°C)

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will not occur.

Conditions to Avoid

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources.

Incompatible Products

Keep away from strong oxidizers.

Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

* * * Section 11 - Toxicological Information * * *

Acute Toxicity

A: General Product Information

Harmful if swallowed.

B: Component Analysis - LD50/LC50

Gasoline, motor fuel (86290-81-5)

Inhalation LC50 Rat >5.2 mg/L 4 h; Oral LD50 Rat 14000 mg/kg; Dermal LD50 Rabbit >2000 mg/kg

Toluene (108-88-3)

Inhalation LC50 Rat 12.5 mg/L 4 h; Inhalation LC50 Rat >26700 ppm 1 h; Oral LD50 Rat 636 mg/kg; Dermal LD50 Rabbit 8390 mg/kg; Dermal LD50 Rat 12124 mg/kg

Butane (106-97-8)

Inhalation LC50 Rat 658 mg/L 4 h

Xylenes (o-, m-, p- isomers) (1330-20-7)
Inhalation LC50 Rat 5000 ppm 4 h; Inhalation LC50 Rat 47635 mg/L 4 h; Oral LD50 Rat 4300 mg/kg; Dermal LD50 Rabbit >1700 mg/kg

Benzene, 1,2,4-trimethyl- (95-63-6)
Inhalation LC50 Rat 18 g/m3 4 h; Oral LD50 Rat 3400 mg/kg; Dermal LD50 Rabbit >3160 mg/kg

Ethyl alcohol (64-17-5)
Oral LD50 Rat 7060 mg/kg; Inhalation LC50 Rat 124.7 mg/L 4 h

Ethylbenzene (100-41-4)
Inhalation LC50 Rat 17.2 mg/L 4 h; Oral LD50 Rat 3500 mg/kg; Dermal LD50 Rabbit 15354 mg/kg

Benzene (71-43-2)
Inhalation LC50 Rat 13050-14380 ppm 4 h; Oral LD50 Rat 1800 mg/kg

Hexane (110-54-3)
Inhalation LC50 Rat 48000 ppm 4 h; Oral LD50 Rat 25 g/kg; Dermal LD50 Rabbit 3000 mg/kg

Potential Health Effects: Skin Corrosion Property/Stimulativeness

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

Potential Health Effects: Eye Critical Damage/ Stimulativeness

Moderate irritant. Contact with liquid or vapor may cause irritation.

Potential Health Effects: Ingestion

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.

Potential Health Effects: Inhalation

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

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.

Respiratory Organs Sensitization/Skin Sensitization

This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity

This product may cause genetic defects.

Carcinogenicity

A: General Product Information

May cause cancer.

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

B: Component Carcinogenicity

Gasoline, motor fuel (86290-81-5)

ACGIH: A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

Toluene (108-88-3)

ACGIH: A4 - Not Classifiable as a Human Carcinogen
IARC: Monograph 71 [1999]; Monograph 47 [1989] (Group 3 (not classifiable))

Xylenes (o-, m-, p- isomers) (1330-20-7)

ACGIH: A4 - Not Classifiable as a Human Carcinogen
IARC: Monograph 71 [1999]; Monograph 47 [1989] (Group 3 (not classifiable))

Ethyl alcohol (64-17-5)

ACGIH: A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans
IARC: Monograph 100E [in preparation] (in alcoholic beverages); Monograph 96 [2010] (in alcoholic beverages) (Group 1 (carcinogenic to humans))

Ethylbenzene (100-41-4)

ACGIH: A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans
IARC: Monograph 77 [2000] (Group 2B (possibly carcinogenic to humans))

Benzene (71-43-2)

ACGIH: A1 - Confirmed Human Carcinogen
OSHA: 5 ppm STEL (Cancer hazard, Flammable, See 29 CFR 1910.1028, 15 min); 0.5 ppm Action Level; 1 ppm TWA
NIOSH: potential occupational carcinogen
NTP: Known Human Carcinogen (Select Carcinogen)
IARC: Monograph 100F [in preparation]; Supplement 7 [1987]; Monograph 29 [1982] (Group 1 (carcinogenic to humans))

Reproductive Toxicity

This product is suspected of damaging fertility or the unborn child.

Specified Target Organ General Toxicity: Single Exposure

This product may cause drowsiness or dizziness.

Specified Target Organ General Toxicity: Repeated Exposure

This product causes damage to organs through prolonged or repeated exposure.

Aspiration Respiratory Organs 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.

* * * Section 12 - Ecological Information * * *

Ecotoxicity

A: General Product Information

Very toxic to aquatic life with long lasting effects. Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

Gasoline, motor fuel (86290-81-5)

Test & Species		Conditions
96 Hr LC50 Alburnus alburnus	119 mg/L [static]	
96 Hr LC50 Cyprinodon variegatus	82 mg/L [static]	
72 Hr EC50 Pseudokirchneriella subcapitata	56 mg/L	
24 Hr EC50 Daphnia magna	170 mg/L	

Toluene (108-88-3)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	15.22-19.05 mg/L [flow-through]	1 day old
96 Hr LC50 Pimephales promelas	12.6 mg/L [static]	
96 Hr LC50 Oncorhynchus mykiss	5.89-7.81 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	14.1-17.16 mg/L [static]	
96 Hr LC50 Oncorhynchus mykiss	5.8 mg/L [semi-static]	
96 Hr LC50 Lepomis macrochirus	11.0-15.0 mg/L [static]	
96 Hr LC50 Oryzias latipes	54 mg/L [static]	
96 Hr LC50 Poecilia reticulata	28.2 mg/L [semi-static]	
96 Hr LC50 Poecilia reticulata	50.87-70.34 mg/L [static]	
96 Hr EC50 Pseudokirchneriella subcapitata	>433 mg/L	
72 Hr EC50 Pseudokirchneriella subcapitata	12.5 mg/L [static]	
48 Hr EC50 Daphnia magna	5.46 - 9.83 mg/L [Static]	
48 Hr EC50 Daphnia magna	11.5 mg/L	

Xylenes (o-, m-, p- isomers) (1330-20-7)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	13.4 mg/L [flow-through]	

96 Hr LC50 Oncorhynchus mykiss	2.661-4.093 mg/L [static]
96 Hr LC50 Oncorhynchus mykiss	13.5-17.3 mg/L
96 Hr LC50 Lepomis macrochirus	13.1-16.5 mg/L [flow-through]
96 Hr LC50 Lepomis macrochirus	19 mg/L
96 Hr LC50 Lepomis macrochirus	7.711-9.591 mg/L [static]
96 Hr LC50 Pimephales promelas	23.53-29.97 mg/L [static]
96 Hr LC50 Cyprinus carpio	780 mg/L [semi-static]
96 Hr LC50 Cyprinus carpio	>780 mg/L
96 Hr LC50 Poecilia reticulata	30.26-40.75 mg/L [static]
48 Hr EC50 water flea	3.82 mg/L
48 Hr LC50 Gammarus lacustris	0.6 mg/L

Benzene, 1,2,4-trimethyl- (95-63-6)

Test & Species	Conditions
96 Hr LC50 Pimephales promelas	7.19-8.28 mg/L [flow-through]
48 Hr EC50 Daphnia magna	6.14 mg/L

Ethyl alcohol (64-17-5)

Test & Species	Conditions
96 Hr LC50 Oncorhynchus mykiss	12.0 - 16.0 mL/L [static]
96 Hr LC50 Pimephales promelas	>100 mg/L [static]
96 Hr LC50 Pimephales promelas	13400 - 15100 mg/L [flow-through]
48 Hr LC50 Daphnia magna	9268 - 14221 mg/L
24 Hr EC50 Daphnia magna	10800 mg/L
48 Hr EC50 Daphnia magna	2 mg/L [Static]

Ethylbenzene (100-41-4)

Test & Species	Conditions
96 Hr LC50 Oncorhynchus mykiss	11.0-18.0 mg/L [static]
96 Hr LC50 Oncorhynchus mykiss	4.2 mg/L [semi-static]
96 Hr LC50 Pimephales promelas	7.55-11 mg/L [flow-through]
96 Hr LC50 Lepomis macrochirus	32 mg/L [static]
96 Hr LC50 Pimephales promelas	9.1-15.6 mg/L [static]
96 Hr LC50 Poecilia reticulata	9.6 mg/L [static]
72 Hr EC50 Pseudokirchneriella subcapitata	4.6 mg/L
96 Hr EC50 Pseudokirchneriella subcapitata	>438 mg/L
72 Hr EC50 Pseudokirchneriella subcapitata	2.6 - 11.3 mg/L [static]

96 Hr EC50 Pseudokirchneriella subcapitata	1.7 - 7.6 mg/L [static]
48 Hr EC50 Daphnia magna	1.8 - 2.4 mg/L

Benzene (71-43-2)

Test & Species	Conditions
96 Hr LC50 Pimephales promelas	10.7-14.7 mg/L [flow-through]
96 Hr LC50 Oncorhynchus mykiss	5.3 mg/L [flow-through]
96 Hr LC50 Lepomis macrochirus	22.49 mg/L [static]
96 Hr LC50 Poecilia reticulata	28.6 mg/L [static]
96 Hr LC50 Pimephales promelas	22330-41160 µg/L [static]
96 Hr LC50 Lepomis macrochirus	70000-142000 µg/L [static]
72 Hr EC50 Pseudokirchneriella subcapitata	29 mg/L
48 Hr EC50 Daphnia magna	8.76 - 15.6 mg/L [Static]
48 Hr EC50 Daphnia magna	10 mg/L

Hexane (110-54-3)

Test & Species	Conditions
96 Hr LC50 Pimephales promelas	2.1-2.98 mg/L [flow-through]
24 Hr EC50 Daphnia magna	>1000 mg/L

Persistence/Degradability

No information available.

Bioaccumulation

No information available.

Mobility in Soil

No information available.

* * * Section 13 - Disposal Considerations * * *

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations.

Disposal of Contaminated Containers or Packaging

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 14 - Transportation Information * * *

Component Marine Pollutants

This material contains one or more of the following chemicals required by US DOT to be identified as marine pollutants.

Component	CAS #	
Gasoline, motor fuel	86290-81-5	DOT regulated marine pollutant

DOT Information

Shipping Name: Gasoline
UN #: 1203 **Hazard Class:** 3 **Packing Group:** II
Placard:



* * * Section 15 - Regulatory Information * * *

Regulatory Information

A: Component Analysis

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Toluene (108-88-3)
SARA 313: 1.0 % de minimis concentration
CERCLA: 1000 lb final RQ; 454 kg final RQ

Xylenes (o-, m-, p- isomers) (1330-20-7)
SARA 313: 1.0 % de minimis concentration
CERCLA: 100 lb final RQ; 45.4 kg final RQ

Benzene, 1,2,4-trimethyl- (95-63-6)
SARA 313: 1.0 % de minimis concentration

Ethylbenzene (100-41-4)
SARA 313: 0.1 % de minimis concentration
CERCLA: 1000 lb final RQ; 454 kg final RQ

Benzene (71-43-2)
SARA 313: 0.1 % de minimis concentration
CERCLA: 10 lb final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule); 4.54 kg final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule)

Hexane (110-54-3)

SARA 313: 1.0 % de minimis concentration
CERCLA: 5000 lb final RQ; 2270 kg final RQ

SARA Section 311/312 – Hazard Classes

Acute Health	Chronic Health	Fire	Sudden Release of Pressure	Reactive
X	X	X	--	--

Component Marine Pollutants

This material contains one or more of the following chemicals required by US DOT to be identified as marine pollutants.

Component	CAS #	
Gasoline, motor fuel	86290-81-5	DOT regulated marine pollutant

State Regulations

Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	**CAS**	**CA**	**MA**	**MN**	**NJ**	**PA**	**RI**
Gasoline, motor fuel	86290-81-5	No	No	No	No	Yes	No
Toluene	108-88-3	Yes	Yes	Yes	Yes	Yes	No
Butane	106-97-8	Yes	Yes	Yes	Yes	Yes	No
Xylenes (o-, m-, p- isomers)	1330-20-7	Yes	Yes	Yes	Yes	Yes	No
Benzene, 1,2,4-trimethyl-	95-63-6	No	Yes	Yes	Yes	Yes	No
Ethyl alcohol	64-17-5	Yes	Yes	Yes	Yes	Yes	No
Ethylbenzene	100-41-4	Yes	Yes	Yes	Yes	Yes	No
Benzene	71-43-2	Yes	Yes	Yes	Yes	Yes	No
Hexane	110-54-3	No	Yes	Yes	Yes	Yes	No

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.
WARNING! This product contains a chemical known to the state of California to cause reproductive/developmental effects.

Component Analysis - WHMIS IDL

The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

Component	CAS #	Minimum Concentration
Toluene	108-88-3	1 %
Butane	106-97-8	1 %
Benzene, 1,2,4-trimethyl-	95-63-6	0.1 %
Ethyl alcohol	64-17-5	0.1 %
Ethylbenzene	100-41-4	0.1 %
Benzene	71-43-2	0.1 %
Hexane	110-54-3	1 %

Additional Regulatory Information

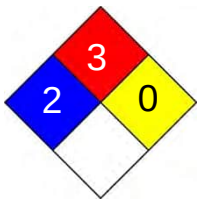
Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Gasoline, motor fuel	86290-81-5	No	DSL	EINECS
Toluene	108-88-3	Yes	DSL	EINECS
Butane	106-97-8	Yes	DSL	EINECS
Xylenes (o-, m-, p- isomers)	1330-20-7	Yes	DSL	EINECS
Benzene, 1,2,4-trimethyl-	95-63-6	Yes	DSL	EINECS
Ethyl alcohol	64-17-5	Yes	DSL	EINECS
Ethylbenzene	100-41-4	Yes	DSL	EINECS
Benzene	71-43-2	Yes	DSL	EINECS
Hexane	110-54-3	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

NFPA® Hazard Rating

Health	2
Fire	3
Reactivity	0



HMIS® Hazard Rating

Health	2	Moderate
Fire	3	Serious
Physical	0	Minimal
		*Chronic

Key/Legend

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act; ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration., NJTSR = New Jersey Trade Secret Registry.

Literature References

None

Other Information

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 Sheet

MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations

SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**ALCONOX®**
CHEMICAL FAMILY NAME:	Detergent.
PRODUCT USE:	Critical-cleaning detergent for laboratory, healthcare and industrial applications
U.N. NUMBER:	Not Applicable
U.N. DANGEROUS GOODS CLASS:	Non-Regulated Material
SUPPLIER/MANUFACTURER'S NAME:	Alconox, Inc.
ADDRESS:	30 Glenn St., Suite 309, White Plains, NY 10603. USA
EMERGENCY PHONE:	**TOLL-FREE in USA/Canada** 800-255-3924
	International calls 813-248-0585
BUSINESS PHONE:	914-948-4040
DATE OF PREPARATION:	May 2011
DATE OF LAST REVISION:	February 2008

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS

Non-Regulated

CANADA (WHMIS) SYMBOLS



EUROPEAN and (GHS) Hazard Symbols



Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1
EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 207-638-8 Index# 011-005-00-2
EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

GHS Hazard Classification(s):

Eye Irritant Category 2A

Hazard Statement(s):

H319: Causes serious eye irritation

Precautionary Statement(s):

P260: Do not breath dust/fume/gas/mist/vapors/spray
P264: Wash hands thoroughly after handling
P271: Use only in well ventilated area.
P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):

[Xi] Irritant

Risk Phrases:
R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:
S8: Keep container dry
S22: Do not breath dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS: ACUTE: Eye, respiratory System, Skin CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard *JIS Z 7250: 2000*.

SECTION 4 - FIRST-AID MEASURES

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 MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing dificulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

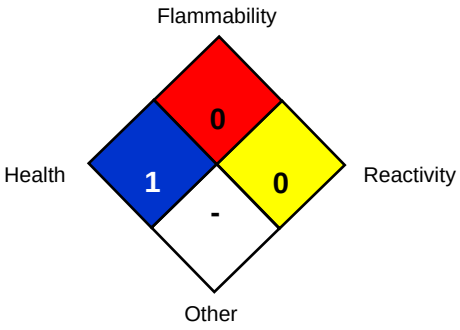
RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT: Not Flammable
AUTOIGNITION TEMPERATURE: Not Applicable
FLAMMABLE LIMITS (in air by volume, %): Lower (LEL): NA Upper (UEL): NA
FIRE EXTINGUISHING MATERIALS: As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This product is non-flammable and has no known explosion hazards.
Explosion Sensitivity to Mechanical Impact: Not Sensitive.
Explosion Sensitivity to Static Discharge: Not Sensitive
SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM



HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD (BLUE)	1
FLAMMABILITY HAZARD (RED)	0
PHYSICAL HAZARD (YELLOW)	0

PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8

For Routine Industrial Use and Handling Applications

Hazard Scale: **0** = Minimal **1** = Slight **2** = Moderate **3** = Serious **4** = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.
SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m³	5 mg/m³	5 mg/m³
Sodium Carbonate	497-19-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable
DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)
MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m³ 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m³ 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.
IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.
SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.
REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.
ENVIRONMENTAL STABILITY: No Data available at this time.
EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.
PROPER SHIPPING NAME: Non-Regulated Material
HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable
UN IDENTIFICATION NUMBER: Not Applicable
PACKING GROUP: Not Applicable.
DOT LABEL(S) REQUIRED: Not Applicable
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable
MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:
This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:
This product is not classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):
This product is not classified as Dangerous Goods, by rules of IATA:

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:
This product is not classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

This product is not classified by the United Nations Economic Commission for Europe to be dangerous goods.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health: Yes Chronic Health: No Fire: No Reactivity: No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory if Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftliste List of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

Disclaimer: To the best of Alconox, Inc. knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness is not guaranteed and no warranties of any type either express or implied are provided. The information contained herein relates only to this specific product.

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-inplace. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

SAFETY DATA SHEET

Hydrogen Chloride

Section 1. Identification

GHS product identifier : Hydrogen Chloride

Chemical name : Hydrogen chloride

Other means of identification :

Product use : Synthetic/Analytical chemistry.

Synonym :

SDS # : 001028

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 : GASES UNDER PRESSURE - Compressed gas
ACUTE TOXICITY (inhalation) - Category 3
SKIN CORROSION/IRRITATION - Category 1
SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 1
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3

GHS label elements

Hazard pictograms :



Signal word : Danger

Hazard statements : Contains gas under pressure; may explode if heated.
Toxic if inhaled.
Causes severe skin burns and eye damage.
Causes serious eye damage.
May cause respiratory irritation.

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.

Prevention : Wear protective gloves. Wear eye or face protection. Wear protective clothing. Use only outdoors or in a well-ventilated area. Avoid breathing gas. Wash hands thoroughly after handling.

Section 2. Hazards identification

Response : IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or physician. IF SWALLOWED: Immediately call a POISON CENTER or physician. Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. Wash contaminated clothing before reuse. Immediately call a POISON CENTER or physician. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or physician.

Storage : Store locked up. Protect from sunlight when ambient temperature exceeds 52°C/125°F. 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 : Hydrogen chloride

Other means of identification :

CAS number/other identifiers

CAS number : 7647-01-0

Product code : 001028

Ingredient name	%	CAS number
hydrogen chloride	100	7647-01-0

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 : Get medical attention immediately. Call a poison center or physician. 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. Chemical burns must be treated promptly by a physician.

Inhalation : Get medical attention immediately. Call a poison center or physician. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. 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. 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 : Get medical attention immediately. Call a poison center or physician. Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician. 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

Section 4. First aid measures

Eye contact : Causes serious eye damage. Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : Toxic if inhaled. May cause respiratory irritation.

Skin contact : Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.

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

Eye contact : Adverse symptoms may include the following:, pain, watering, redness

Inhalation : Adverse symptoms may include the following:, respiratory tract irritation, coughing

Skin contact : Adverse symptoms may include the following:, pain or irritation, redness, blistering may occur

Ingestion : Adverse symptoms may include the following:, stomach pains

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. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
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.

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 : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not breathe gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

Section 6. Accidental release measures

For emergency responders : If specialised 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".

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.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. 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. Do not breathe gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Empty containers retain product residue and can be hazardous. 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.

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). Store locked up. Keep container tightly closed and sealed until ready for use. 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).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
hydrogen chloride	**ACGIH TLV (United States, 3/2015).** C: 2 ppm **NIOSH REL (United States, 10/2013).** CEIL: 7 mg/m³ CEIL: 5 ppm **OSHA PEL (United States, 2/2013).** CEIL: 7 mg/m³ CEIL: 5 ppm **OSHA PEL 1989 (United States, 3/1989).** CEIL: 7 mg/m³ CEIL: 5 ppm

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.

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: chemical splash goggles and/or face shield. If inhalation hazards exist, a full-face respirator may be required instead.

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.

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 : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. 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. [Liquefied compressed gas.]

Color : Colorless. Yellowish.

Molecular weight : 36.46 g/mole

Molecular formula : Cl-H

Boiling/condensation point : -85°C (-121°F)

Melting/freezing point : -114°C (-173.2°F)

Critical temperature : 51.45°C (124.6°F)

Odor : Pungent.

Odor threshold : Not available.

pH : Not available.

Flash point : [Product does not sustain combustion.]

Burning time : Not applicable.

Burning rate : Not applicable.

Evaporation rate : Not available.

Flammability (solid, gas) : Not available.

Lower and upper explosive (flammable) limits : Not available.

Section 9. Physical and chemical properties

Vapor pressure : 613 (psig)

Vapor density : 1.3 (Air = 1)

Specific Volume (ft ^{3}/lb) : 10.5263

Gas Density (lb/ft ^{3}) : 0.095

Relative density : Not applicable.

Solubility : Soluble in the following materials: cold water.

Solubility in water : Not available.

Partition coefficient: n-octanol/water : 0.25

Auto-ignition temperature : Not available.

Decomposition temperature : Not available.

SADT : Not available.

Viscosity : Not applicable.

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 : No specific data.

Incompatible materials : No specific data.

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

Product/ingredient name	Result	Species	Dose	Exposure
hydrogen chloride	LC50 Inhalation Gas. LC50 Inhalation Gas.	Rat Rat	3124 ppm 1562 ppm	1 hours 4 hours

IDLH : 50 ppm

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
hydrogen chloride	Eyes - Mild irritant Skin - Mild irritant	Rabbit Human	- -	0.5 minutes 5 milligrams 24 hours 4 Percent	- -

Sensitization

Not available.

Mutagenicity

Not available.

Section 11. Toxicological information

Carcinogenicity

Not available.

Classification

Product/ingredient name	OSHA	IARC	NTP
hydrogen chloride	-	3	-

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
hydrogen chloride	Category 3	Not applicable.	Respiratory tract irritation

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Causes serious eye damage. Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : Toxic if inhaled. May cause respiratory irritation.

Skin contact : Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:, pain, watering, redness

Inhalation : Adverse symptoms may include the following:, respiratory tract irritation, coughing

Skin contact : Adverse symptoms may include the following:, pain or irritation, redness, blistering may occur

Ingestion : Adverse symptoms may include the following:, stomach pains

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 : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Section 11. Toxicological information

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.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
hydrogen chloride	Acute LC50 240000 µg/l Marine water Acute LC50 282 ppm Fresh water	Crustaceans - Carcinus maenas - Adult Fish - Gambusia affinis - Adult	48 hours 96 hours

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
hydrogen chloride	0.25	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

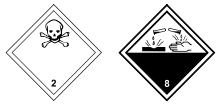
Other adverse effects : No known significant effects or critical hazards.

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.

Section 14. Transport information

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1050	UN1050	UN1050	UN1050	UN1050
UN proper shipping name	HYDROGEN CHLORIDE, ANHYDROUS	HYDROGEN CHLORIDE, ANHYDROUS	HYDROGEN CHLORIDE, ANHYDROUS	HYDROGEN CHLORIDE, ANHYDROUS	HYDROGEN CHLORIDE, ANHYDROUS
Transport hazard class(es)	2.3 (8) 	2.3 (8) 	2.3 (8) 	2.3 (8) 	2.3 (8) 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	Inhalation hazard zone C **Reportable quantity** 5000 lbs / 2270 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. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: Forbidden. **Special provisions** 3	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2), 2.40-2.42 (Class 8). **Explosive Limit and Limited Quantity Index** 0 **ERAP Index** 25 **Passenger Carrying Ship Index** Forbidden **Passenger Carrying Road or Rail Index** Forbidden **Special provisions** 38	-	-	**Passenger and Cargo Aircraft**Quantity limitation: 0 Forbidden **Cargo Aircraft Only** Quantity limitation: 0 Forbidden

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

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 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): This material is listed or exempted.

Clean Water Act (CWA) 311: Hydrogen chloride

Clean Air Act (CAA) 112 regulated toxic substances: Hydrogen chloride

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Section 15. Regulatory information

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) : Listed

SARA 302/304

Composition/information on ingredients

Name	%	EHS	SARA 302 TPQ		SARA 304 RQ	
			(lbs)	(gallons)	(lbs)	(gallons)
hydrogen chloride	100	Yes.	500	-	5000	-

SARA 304 RQ : 5000 lbs / 2270 kg

SARA 311/312

Classification : Sudden release of pressure
Immediate (acute) health hazard

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
hydrogen chloride	100	No.	Yes.	No.	Yes.	No.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	Hydrogen chloride	7647-01-0	100
Supplier notification	Hydrogen chloride	7647-01-0	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.

International regulations

International lists

National inventory

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 : 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.

Section 15. Regulatory information

Canada

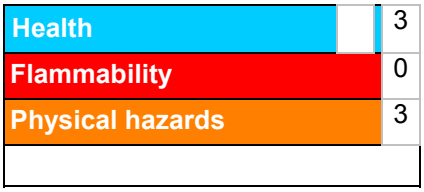
WHMIS (Canada) : Class A: Compressed gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).
Class E: Corrosive material

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).
Class E: Corrosive material

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 are not required on SDSs 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 mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

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
Press. Gas Comp. Gas, H280	According to package
Acute Tox. 3, H331	On basis of test data
Skin Corr. 1, H314	Expert judgment
Eye Dam. 1, H318	Expert judgment
STOT SE 3, H335	Expert judgment

History

Date of printing : 6/24/2016

Date of issue/Date of revision : 6/24/2016

Section 16. Other information

Date of previous issue : No previous validation

Version : 0.01

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 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Indicates information that has changed from previously issued version.

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.

Fisher Scientific

Part of Thermo Fisher Scientific

SAFETY DATA SHEET

Creation Date 12-Mar-2009 **Revision Date** 28-Nov-2016 **Revision Number** 5

1. Identification

Product Name **Nitric acid (65 - 70%)**

Cat No. : **A198C-212, A200-212, A200-212LC, A200-500, A200-500LC, A200-612GAL, A200C-212, A200S-212, A200S-212LC, A200S-500, A200SI-212, A467-1, A467-2, A467-250, A467-500, A483-212; S719721**

Synonyms Azotic acid; Engraver's acid; Aqua fortis

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
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)

Oxidizing liquids	Category 3
Corrosive to metals	Category 1
Skin Corrosion/irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements
May intensify fire; oxidizer
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation



Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep/Store away from clothing/ other combustible materials
Take any precaution to avoid mixing with combustibles
Keep only in original container
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in corrosive resistant polypropylene container with a resistant inliner
Store in a dry place
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
None identified

3. Composition / information on ingredients

Component	CAS-No	Weight %
Nitric acid	7697-37-2	65 - 70
Water	7732-18-5	30 - 35

4. First-aid measures

General Advice Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing before re-use. Call a physician immediately.

Inhalation If breathing is difficult, give oxygen. 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. Remove from exposure, lie down. Call a physician immediately.

Ingestion Do not induce vomiting. Never give anything by mouth to an unconscious person. Clean mouth with water. Call a physician immediately.

Most important symptoms/effects Causes burns by all exposure routes. Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media CO_2, dry chemical, dry sand, alcohol-resistant foam.

Unsuitable Extinguishing Media No information available

Flash Point Not applicable
Method - No information available

Autoignition Temperature No information available

Explosion Limits
Upper No data available
Lower No data available

Oxidizing Properties Oxidizer

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. The product causes burns of eyes, skin and mucous membranes. Oxidizer: Contact with combustible/organic material may cause fire. May ignite combustibles (wood paper, oil, clothing, etc.).

Hazardous Combustion Products
Nitrogen oxides (NOx) Thermal decomposition can lead to release of irritating gases and vapors
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
4	0	0	OX

6. Accidental release measures

Personal Precautions Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Use personal protective equipment.

Environmental Precautions Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Sweep up and shovel into suitable containers for disposal.

7. Handling and storage

Handling Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Do not ingest. Do not breathe vapors or spray mist. Keep away from clothing and other combustible materials.

Storage Keep containers tightly closed in a cool, well-ventilated place. Do not store near combustible materials.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Nitric acid	TWA: 2 ppm STEL: 4 ppm	(Vacated) TWA: 2 ppm (Vacated) TWA: 5 mg/m³ (Vacated) STEL: 4 ppm (Vacated) STEL: 10 mg/m³ TWA: 2 ppm TWA: 5 mg/m³	IDLH: 25 ppm TWA: 2 ppm TWA: 5 mg/m³ STEL: 4 ppm STEL: 10 mg/m³

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Nitric acid	TWA: 2 ppm TWA: 5.2 mg/m³ STEL: 4 ppm STEL: 10 mg/m³	TWA: 2 ppm TWA: 5 mg/m³ STEL: 4 ppm STEL: 10 mg/m³	TWA: 2 ppm STEL: 4 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

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. Tightly fitting safety goggles. Face-shield.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Keep away from food, drink and animal feeding stuffs. When using, do not eat, drink or smoke. Contaminated work clothing should not be allowed out of the workplace. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes and clothing. For environmental protection remove and wash all contaminated protective equipment before re-use. Wear suitable gloves and eye/face protection.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Clear Colorless, Light yellow
Odor	Strong Acrid
Odor Threshold	No information available
pH	< 1.0 (0.1M)
Melting Point/Range	-41 °C / -41.8 °F
Boiling Point/Range	Not applicable
Flash Point	Not applicable

Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	0.94 kPa (20°C)
Vapor Density	No information available
Specific Gravity	1.40
Solubility	miscible
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	HNO3
Molecular Weight	63.02

10. Stability and reactivity

Reactive Hazard Yes

Stability Oxidizer: Contact with combustible/organic material may cause fire.

Conditions to Avoid Incompatible products. Combustible material. Excess heat. Exposure to air or moisture over prolonged periods.

Incompatible Materials Combustible material, Strong bases, Reducing agents, Metals, Powdered metals, Organic materials, Aldehydes, Alcohols, Cyanides, Ammonia, Strong reducing agents

Hazardous Decomposition Products Nitrogen oxides (NOx), Thermal decomposition can lead to release of irritating gases and vapors

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Dermal LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Vapor LC50 Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Nitric acid	Not listed	Not listed	LC50 = 2500 ppm. (Rat) 1h
Water	-	Not listed	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes severe burns by all exposure routes

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
Nitric acid	7697-37-2	Not listed	Not listed	Not listed	Not listed	Not listed
Water	7732-18-5	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 Respiratory system
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Nitric acid	Not listed	LC50: = 72 mg/L, 96h (Gambusia affinis)	Not listed	Not listed

Persistence and Degradability Miscible with water Persistence is unlikely based on information available.
Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Nitric acid	-2.3

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.

14. Transport information

DOT

UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group II

TDG

UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group II

IATA

UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group II

IMDG/IMO

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Nitric acid	X	X	-	231-714-2	-		X	X	X	X	X
Water	X	X	-	231-791-2	-		X	-	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Nitric acid	7697-37-2	65 - 70	1.0

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	Yes

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Nitric acid	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Nitric acid	-	TQ: 500 lb

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
Nitric acid	1000 lb	1000 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Nitric acid	X	X	X	X	X
Water	-	-	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 contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Nitric acid	2000 lb STQ

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class
C Oxidizing materials
E Corrosive material
D2B Toxic materials



16. Other information

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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

Isobutylene

Section 1. Identification

GHS product identifier : Isobutylene

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene); 1, 1-Dimethylethylene; Isopropylidenemethylene; iso-Butene; i-Butene; 2-Methylpropylene; 2-Methyl-2-propene; 2-Methyl-1-propene

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene); 1, 1-Dimethylethylene; Isopropylidenemethylene; iso-Butene; i-Butene; 2-Methylpropylene; 2-Methyl-2-propene; 2-Methyl-1-propene

SDS # : 001031

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

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 displace oxygen and cause rapid suffocation.

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 : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Protect from sunlight. Store in a well-ventilated place.

Disposal : Not applicable.

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 : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene); 1, 1-Dimethylethylene; Isopropylidenemethylene; iso-Butene; i-Butene; 2-Methylpropylene; 2-Methyl-2-propene; 2-Methyl-1-propene

Product code : 001031

CAS number/other identifiers

CAS number : 115-11-7

Ingredient name	%	CAS number
Isobutylene	100	115-11-7

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 if irritation occurs.

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 adverse health effects persist or are severe. 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. Get medical attention if symptoms occur. 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

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.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

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

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".

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. Avoid breathing gas. 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. Avoid contact with eyes, skin and clothing. 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.

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). 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
Isobutylene	**ACGIH TLV (United States, 3/2017).** TWA: 250 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.

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

Section 8. Exposure controls/personal 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. [Compressed gas.]

Color : Colorless.

Odor : Characteristic.

Odor threshold : Not available.

pH : Not available.

Melting point : -140.7°C (-221.3°F)

Boiling point : -6.9°C (19.6°F)

Critical temperature : 144.75°C (292.6°F)

Flash point : Closed cup: -76.1°C (-105°F)

Evaporation rate : Not available.

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.

Lower and upper explosive (flammable) limits : Lower: 1.8%
Upper: 9.6%

Vapor pressure : 24.3 (psig)

Vapor density : 1.94 (Air = 1)

Specific Volume (ft ^{3}/lb) : 6.6845

Gas Density (lb/ft ^{3}) : 0.1496 (25°C / 77 to °F)

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 0.26 g/l

Partition coefficient: n-octanol/water : 2.34

Auto-ignition temperature : 465°C (869°F)

Decomposition temperature : Not available.

Viscosity : Not applicable.

Flow time (ISO 2431) : Not available.

Molecular weight : 56.12 g/mole

Aerosol product

Heat of combustion : -45029034 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

Product/ingredient name	Result	Species	Dose	Exposure
Isobutylene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

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.

Section 11. Toxicological information

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 : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

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.

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
Isobutylene	2.34	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Section 12. Ecological information

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.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1055	UN1055	UN1055	UN1055	UN1055
UN proper shipping name	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE
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 : **Limited quantity** Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: 150 kg.
Special provisions 19, 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 Ship Index Forbidden
Passenger Carrying Road or Rail Index Forbidden
Special provisions 29

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 Air Act (CAA) 112 regulated flammable substances: Isobutylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not 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.

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

State regulations

Massachusetts : This material is listed.

New York : This material is not listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

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): Not determined.

Malaysia : Not determined.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Section 15. Regulatory information

Taiwan : This material is listed or exempted.

Thailand : Not determined.

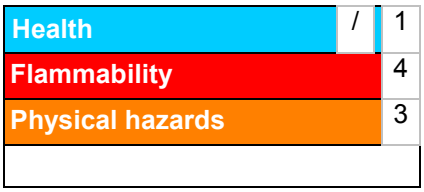
Turkey : Not determined.

United States : This material is listed or exempted.

Viet Nam : Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1 GASES UNDER PRESSURE - Liquefied gas	Expert judgment Expert judgment

History

Date of printing : 5/10/2018

Date of issue/Date of revision : 5/10/2018

Date of previous issue : 7/11/2016

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

Section 16. Other information

as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

SAFETY DATA SHEET according to the OSHA Hazard Communication Standard

Version 8.13
Revision Date 07/14/2026
Print Date 07/15/2026

SECTION 1. IDENTIFICATION

1.1 Product identifiers

Product name : Trichloroethylene

Product Number : 133124
Brand : Aldrich
Index-No. : 602-027-00-9
CAS-No. : 79-01-6

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

Restrictions on use : After June 16, 2025, this chemical/product is and can only be domestically manufactured, imported, processed, or distributed in commerce for the following purposes until the following prohibitions take effect: (1) Processing as an intermediate a) for the manufacture of HFC–134a until June 18, 2033, and b) for all other processing as a reactant/intermediate until December 18, 2026; (2) Industrial and commercial use as a solvent for open-top batch vapor degreasing until December 18, 2025; (3) Industrial and commercial use as a solvent for closed-loop batch vapor degreasing until December 18, 2025, except for industrial and commercial use in batch vapor degreasing for land-based DoD defense systems by Federal agencies and their contractors until December 18, 2029, and except for industrial and commercial use as a solvent for closed-loop batch vapor degreasing necessary for rocket engine cleaning by Federal agencies and their contractors until December 18, 2031, and except for industrial and commercial use of TCE in closed-loop and open-top batch vapor degreasing for essential aerospace parts and components and narrow tubing used in medical devices until December 18, 2031, and except for industrial and commercial use as a solvent for closed-loop batch vapor degreasing for rayon fabric scouring for end use in rocket booster nozzle production by Federal agencies and their contractors until December 18, 2034; (4) Industrial and commercial use in processing aid (a) for lithium battery separator manufacturing until December 18, 2029, and (b) for

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lead-acid battery separator manufacturing until December 18, 2044, and (c) for specialty polymeric microporous sheet material manufacturing until December 18, 2039, and (d) in process solvent used in battery manufacture; in process solvent used in polymer fiber spinning, fluoroelastomer manufacture and Alcantara manufacture; in extraction solvent used in caprolactam manufacture; and in precipitant used in beta-cyclodextrin manufacture until December 18, 2026; (5) Industrial and commercial uses for vessels of the Armed Forces and their systems, and in the maintenance, fabrication, and sustainment for and of such vessels and systems until December 18, 2034; and (6) Industrial and commercial use for laboratory use (a) for essential laboratory activities until December 18, 2074 and (b) for asphalt testing and recovery using manual centrifuge processes until December 18, 2029 and for asphalt testing and recovery until December 18, 2034.

1.3 Details of the supplier of the safety data sheet

Company	:	Sigma-Aldrich Inc. 3050 SPRUCE ST ST. LOUIS MO 63103 UNITED STATES
Telephone	:	+1 314 771-5765
Fax	:	+1 800 325-5052

1.4 Emergency telephone number

Emergency Phone #	:	800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2. HAZARDS IDENTIFICATION

GHS classification in accordance with the OSHA Hazard Communication Standard (29 CFR 1910.1200)

Hazards for the product as supplied

Skin irritation	:	Category 2
Eye irritation	:	Category 2A
Skin sensitisation	:	Sub-category 1B
Germ cell mutagenicity	:	Category 2
Carcinogenicity	:	Category 1B
Specific target organ toxicity - single exposure	:	Category 3 (Central nervous system)
Short-term (acute) aquatic hazard	:	Category 3

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Long-term (chronic) aquatic hazard	:	Category 3

Other hazards

None known.

GHS label elements

Hazard pictograms :



Signal word : Danger

Hazard statements :
H315 Causes skin irritation.
H317 May cause an allergic skin reaction.
H319 Causes serious eye irritation.
H336 May cause drowsiness or dizziness.
H341 Suspected of causing genetic defects.
H350 May cause cancer.
H412 Harmful to aquatic life with long lasting effects.

Precautionary statements :

Prevention:

P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P261 Avoid breathing mist or vapours.
P264 Wash skin thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P272 Contaminated work clothing must not be allowed out of the workplace.
P273 Avoid release to the environment.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.

Response:

P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P312 IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/ doctor if you feel unwell.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308 + P313 IF exposed or concerned: Get medical advice/ attention.
P333 + P313 If skin irritation or rash occurs: Get medical advice/ attention.
P337 + P313 If eye irritation persists: Get medical advice/ attention.
P362 Take off contaminated clothing and wash before

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reuse.

Storage:

P403 + P233 Store in a well-ventilated place. Keep container tightly closed.
P405 Store locked up.

Disposal:

P501 Dispose of contents/ container to an approved waste disposal plant.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance / Mixture : Substance

CAS-No. : 79-01-6

Components

Chemical name	CAS No./Unique ID	Concentration (% w/w)	Trade secret
trichloroethylene	79-01-6*	>= 90 - <= 100	-

* Indicates that the identifier is a CAS No.
Actual concentration is withheld as a trade secret

SECTION 4. FIRST AID MEASURES

General advice : Show this safety data sheet to the doctor in attendance.

If inhaled : After inhalation: fresh air. Call in physician.

In case of skin contact : In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower. Consult a physician.

In case of eye contact : After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed : After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

Most important symptoms and effects, both acute and delayed : The most important known symptoms and effects are described in the labelling (see section 2 GHS label elements) and/or in section 11

Protection of first-aiders : For personal protection see section 8.

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Notes to physician	:	No data available

SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	:	For this substance/mixture no limitations of extinguishing agents are given.
Specific hazards during fire fighting	:	Not combustible. Ambient fire may liberate hazardous vapours.
Hazardous combustion products	:	Carbon oxides Hydrogen chloride gas
Specific extinguishing methods	:	No data available
Further information	:	Suppress (knock down) gases/vapours/mists with a water spray jet. Prevent fire extinguishing water from contaminating surface water or the ground water system.
Special protective equipment for fire-fighters	:	Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Advice for non-emergency personnel: Do not breathe vapours, aerosols. Avoid substance contact. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert. Advice for emergency responders: Wear appropriate personal protective equipment, as

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indicated in Section 8.

Environmental precautions	:	Do not let product enter drains.
Methods and materials for containment and cleaning up	:	Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up carefully with liquid-absorbent material (e.g. Chemizorb®). Dispose of properly. Clean up affected area.

SECTION 7. HANDLING AND STORAGE

For precautions see section 2 GHS label elements

Advice on safe handling	:	Work under hood. Do not inhale substance/mixture. Avoid generation of vapours/aerosols.
Further information on storage conditions	:	Tightly closed. Keep in a well-ventilated place. Keep locked up or in an area accessible only to qualified or authorised persons.
Storage class	:	6.1D, Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects
Recommended storage temperature	:	Recommended storage temperature see product label.
Further information on storage stability	:	Light sensitive. Handle and store under inert gas.
Packaging material	:	Suitable material: Any Metal Drum

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Ingredients with workplace control parameters

Components	CAS-No.	Value type (Form of exposure)	Control parameters / Permissible concentration	Basis
trichloroethylene	79-01-6	TWA	10 ppm	ACGIH
		STEL	25 ppm	ACGIH
		TWA	100 ppm	OSHA Z-2
		CEIL	200 ppm	OSHA Z-2

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		Peak	300 ppm (5 mins. in any 2 hrs.)	OSHA Z-2
		TWA	50 ppm 270 mg/m3	OSHA P0
		STEL	200 ppm 1,080 mg/m3	OSHA P0
		ECEL-TWA (Inhalation exposure)	0.2 ppm 1.07 mg/m3	TSCA ECEL

Biological occupational exposure limits

Components	CAS-No.	Control parameters	Biological specimen	Sampling time	Permissible concentration	Basis
trichloroethylene	79-01-6	Trichloroacetic acid	Urine	End of shift at end of workweek	15 mg/l	ACGIH BEI
		Trichloroethanol	In blood	End of shift at end of workweek	0.5 mg/l	ACGIH BEI

Engineering measures : No data available

Personal protective equipment

Respiratory protection : required when vapours/aerosols are generated. Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Recommended Filter type: : Filter A (acc. to DIN 3181) for vapours of organic compounds

The entrepeneur has to ensure that maintenance, cleaning and testing of respiratory protective devices are carried out according to the instructions of the producer. These measures have to be properly documented.

Hand protection
Material : Viton®
Break through time : 480 min

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Glove thickness	:	0.7 mm
Protective index	:	Full contact
Manufacturer	:	Vitoject® (KCL 890 / Aldrich Z677698, Size M)
Material	:	Nitrile rubber
Break through time	:	10 min
Glove thickness	:	0.4 mm
Protective index	:	Splash contact
Manufacturer	:	Camatril® (KCL 730 / Aldrich Z677442, Size M)
Remarks	:	This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN 16523-1 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).

Eye protection	:	Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Safety glasses
Skin and body protection	:	protective clothing
Hygiene measures	:	Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	liquid (68 °F / 20 °C, 1,013 hPa)
Colour	:	colourless
Odour	:	characteristic
Odour Threshold	:	28 ppm
pH	:	No data available
Melting point/ range	:	-120.6 °F / -84.8 °C Method: lit.
Boiling point/boiling range	:	188.1 °F / 86.7 °C Method: lit.

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Flash point	:	Method: closed cup, closed cup does not flash
Evaporation rate	:	No data available
Flammability (solid, gas)	:	No data available
Flammability (liquids)	:	The product is not flammable.
Burning rate	:	No data available
Self-ignition	:	770.0 °F / 410.0 °C
Upper explosion limit / Upper flammability limit	:	Upper explosion limit > 99 %(V) (Saturation - at high volume fractions, explosion turns into a decomposition reaction)
Lower explosion limit / Lower flammability limit	:	Lower explosion limit 7.9 %(V)
Vapour pressure	:	81.3 hPa (68.0 °F / 20.0 °C)
Relative vapour density	:	No data available
Relative density	:	1.46 (68 °F / 20 °C)
Density	:	1.463 g/mL (77 °F / 25 °C) Method: lit.
Solubility(ies) Water solubility	:	1.1 g/l (68 °F / 20 °C) pH: 7
Partition coefficient: n-octanol/water	:	log Pow: 2.53 (68 °F / 20 °C) pH: 7 Bioaccumulation is not expected.
Autoignition temperature	:	770 °F / 410 °C (ca. 1,013 hPa)
Decomposition temperature	:	No data available
Viscosity Viscosity, dynamic	:	0.58 mPa.s (68 °F / 20 °C)
Viscosity, kinematic	:	No data available
Flow time	:	No data available
Explosive properties	:	Not classified as explosive.

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Oxidizing properties	:	none
Molecular weight	:	131.39 g/mol
Particle characteristics		
Particle size	:	No data available

SECTION 10. STABILITY AND REACTIVITY

Reactivity	:	No data available
Chemical stability	:	The product is chemically stable under standard ambient conditions (room temperature) .
Possibility of hazardous reactions	:	Violent reactions possible with: Oxygen (as liquefied gas) Alkaline earth metals alkali amides semimetallic hydrogen compounds perchloric acid Light metals aluminium chloride Strong oxidizing agents potassium nitrate Risk of explosion with: Alkali metals Aluminium Barium alkali hydroxides Lithium magnesium Powdered metals sodium amide Strong oxidizing agents nitrogen dioxide Boranes Oxygen with alkali hydroxides Oxygen with Pressure Risk of ignition or formation of inflammable gases or vapours with: Titanium Beryllium Epoxy constituents
Conditions to avoid	:	no information available

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Incompatible materials	:	No data available
Hazardous decomposition products	:	In the event of fire: see section 5

SECTION 11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
Oral: No data available
LC50 Inhalation - Rat - male - 4 h - 67.41 mg/l

Remarks: (ECHA)
LD50 Dermal - Rabbit - > 20,000 mg/kg
Remarks: (RTECS)

Skin corrosion/irritation
Skin - Rabbit
Result: Skin irritation - 4 h
(OECD Test Guideline 404)
Remarks: Classified according to Regulation (EU) 1272/2008, Annex VI (Table 3.1/3.2)
Remarks: Drying-out effect resulting in rough and chapped skin.

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Eye irritation - 24 h
Remarks: (RTECS)
Classified according to Regulation (EU) 1272/2008, Annex VI (Table 3.1/3.2)

Respiratory or skin sensitization
Local lymph node assay (LLNA) - Mouse
Result: positive
(OECD Test Guideline 429)

Germ cell mutagenicity
Suspected of causing genetic defects.
Test Type: Ames test
Test system: S. typhimurium
Metabolic activation: Metabolic activation
Method: OECD Test Guideline 471
Result: negative
Test Type: In vitro mammalian cell gene mutation test
Test system: mouse lymphoma cells
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 476
Result: negative
Test Type: Chromosome aberration test in vitro
Test system: Chinese hamster ovary cells
Metabolic activation: with and without metabolic activation
Result: negative
Remarks: (ECHA)

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Test Type: in vivo assay
Species: Mouse

Result: negative
Remarks: (ECHA)

Carcinogenicity
Presumed to have carcinogenic potential for humans

IARC: 1 - Group 1: Carcinogenic to humans (trichloroethylene)

NTP: Known - Known to be human carcinogen (trichloroethylene)

OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
May cause drowsiness or dizziness. - Central nervous system
Remarks: Classified according to Regulation (EU) 1272/2008, Annex VI (Table 3.1/3.2)

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

11.2 Additional Information

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, Exposure to and/or consumption of alcohol may increase toxic effects., Gastrointestinal disturbance, Kidney injury may occur., narcosis
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12. ECOLOGICAL INFORMATION

Ecotoxicity

Components:

trichloroethylene:

Toxicity to fish	:	LC50 (Jordanella floridae): 28.3 mg/l End point: mortality Exposure time: 96 h Test Type: flow-through test Analytical monitoring: yes Method: US-EPA
Toxicity to algae/aquatic plants	:	ErC50 (Chlamydomonas reinhardtii (green algae)): 36.5 mg/l

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Exposure time: 72 h
Analytical monitoring: yes
Remarks: (ECHA)

Toxicity to fish (Chronic toxicity)	:	NOEC (Jordanella floridae (flagfish)): 5.76 mg/l End point: mortality Exposure time: 10 d Test Type: flow-through test Analytical monitoring: yes Remarks: (ECHA)
Toxicity to microorganisms	:	EC50 (activated sludge): 260 mg/l Exposure time: 3 h Test Type: static test Method: OECD Test Guideline 209

Persistence and degradability

Components:

trichloroethylene:

Biodegradability	:	aerobic Inoculum: activated sludge Result: Not readily biodegradable. Biodegradation: 19 % Exposure time: 28 d Method: OECD Test Guideline 301D

Bioaccumulative potential

Components:

trichloroethylene:

Bioaccumulation	:	Species: Lepomis macrochirus Bioconcentration factor (BCF): 17 Exposure time: 14 d
Partition coefficient: n-octanol/water	:	log Pow: 2.53 (68 °F / 20 °C) pH: 7 Remarks: Bioaccumulation is not expected.

Mobility in soil

No data available

Other adverse effects

No data available

Endocrine disrupting properties

No data available

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SECTION 13. DISPOSAL CONSIDERATIONS

Disposal methods

Waste from residues	:	Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself.

SECTION 14. TRANSPORT INFORMATION

International Regulations

IATA-DGR

UN/ID No.	:	UN 1710
Proper shipping name	:	Trichloroethylene
Class	:	6.1
Packing group	:	III
Labels	:	Division 6.1 - Toxic substances
Packing instruction (cargo aircraft)	:	663
Packing instruction (passenger aircraft)	:	655

IMDG-Code

UN number	:	UN 1710
Proper shipping name	:	TRICHLOROETHYLENE
Class	:	6.1
Packing group	:	III
Labels	:	6.1
EmS Code	:	F-A, S-A
Marine pollutant	:	no

Transport in bulk according to IMO instruments

Not applicable for product as supplied.

National Regulations

49 CFR

UN/ID/NA number	:	UN 1710
Proper shipping name	:	Trichloroethylene
Class	:	6.1
Packing group	:	III
Labels	:	Division 6.1 - Toxic substances
ERG Code	:	160
Marine pollutant	:	no
Poison Inhalation Hazard	:	No

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Special precautions for user

The transport classification(s) provided herein are for informational purposes only, and solely based upon the properties of the unpackaged material as it is described within this Safety Data Sheet. Transportation classifications may vary by mode of transportation, package sizes, and variations in regional or country regulations.

SECTION 15. REGULATORY INFORMATION

CERCLA Reportable Quantity

Components	CAS-No.	Component RQ (lbs)	Calculated product RQ (lbs)
trichloroethylene	79-01-6	100	100
trichloroethylene	79-01-6	100	100 (D040)

SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 302 Extremely Hazardous Substances Threshold Planning Quantity

This material does not contain any components with a section 302 EHS TPQ.

SARA 311/312 Hazards : Acute Health Hazard
Chronic Health Hazard

SARA 313 : The following components are subject to reporting levels established by SARA Title III, Section 313:

trichloroethylene	79-01-6	>= 90 - <= 100 %

US State Regulations

Massachusetts Right To Know

trichloroethylene 79-01-6

Pennsylvania Right To Know

trichloroethylene 79-01-6

Maine Chemicals of High Concern

Product does not contain any listed chemicals

Vermont Chemicals of High Concern

Product does not contain any listed chemicals

Washington Chemicals of High Concern

Product does not contain any listed chemicals

California Prop. 65

WARNING: This product can expose you to chemicals including trichloroethylene, which is/are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov. **The components of this product are reported in the following inventories:**

US TSCA : All substances listed as active on the TSCA inventory

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TSCA list

The following substance(s) is/are subject to a Significant New Use Rule:

trichloroethylene	79-01-6	See 40 CFR § 721.10851; Final Rule

After June 16, 2025, this chemical/product is and can only be domestically manufactured, imported, processed, or distributed in commerce for the following purposes until the following prohibitions take effect: (1) Processing as an intermediate a) for the manufacture of HFC–134a until June 18, 2033, and b) for all other processing as a reactant/intermediate until December 18, 2026; (2) Industrial and commercial use as a solvent for open-top batch vapor degreasing until December 18, 2025; (3) Industrial and commercial use as a solvent for closed-loop batch vapor degreasing until December 18, 2025, except for industrial and commercial use in batch vapor degreasing for land-based DoD defense systems by Federal agencies and their contractors until December 18, 2029, and except for industrial and commercial use as a solvent for closed-loop batch vapor degreasing necessary for rocket engine cleaning by Federal agencies and their contractors until December 18, 2031, and except for industrial and commercial use of TCE in closed-loop and open-top batch vapor degreasing for essential aerospace parts and components and narrow tubing used in medical devices until December 18, 2031, and except for industrial and commercial use as a solvent for closed-loop batch vapor degreasing for rayon fabric scouring for end use in rocket booster nozzle production by Federal agencies and their contractors until December 18, 2034; (4) Industrial and commercial use in processing aid (a) for lithium battery separator manufacturing until December 18, 2029, and (b) for lead-acid battery separator manufacturing until December 18, 2044, and (c) for specialty polymeric microporous sheet material manufacturing until December 18, 2039, and (d) in process solvent used in battery manufacture; in process solvent used in polymer fiber spinning, fluoroelastomer manufacture and Alcantara manufacture; in extraction solvent used in caprolactam manufacture; and in precipitant used in beta-cyclodextrin manufacture until December 18, 2026; (5) Industrial and commercial uses for vessels of the Armed Forces and their systems, and in the maintenance, fabrication, and sustainment for and of such vessels and systems until December 18, 2034; and (6) Industrial and commercial use for laboratory use (a) for essential laboratory activities until December 18, 2074 and (b) for asphalt testing and recovery using manual centrifuge processes until December 18, 2029 and for asphalt testing and recovery until December 18, 2034.

The following substance(s) is/are subject to TSCA 12(b) export notification requirements:

trichloroethylene	79-01-6

SECTION 16. OTHER INFORMATION

Full text of other abbreviations

ACGIH	:	USA. ACGIH Threshold Limit Values (TLV)
ACGIH BEI	:	ACGIH - Biological Exposure Indices (BEI)
OSHA P0	:	USA. Table Z-1-A Limits for Air Contaminants (1989 vacated values)
OSHA Z-2	:	USA. Occupational Exposure Limits (OSHA) - Table Z-2
TSCA ECEL	:	TSCA Existing Chemical Exposure Limit
ACGIH / TWA	:	8-hour, time-weighted average

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operates as MilliporeSigma in the US and Canada

ACGIH / STEL	:	Short-term exposure limit
OSHA P0 / TWA	:	8-hour time weighted average
OSHA P0 / STEL	:	Short-term exposure limit
OSHA Z-2 / TWA	:	8-hour time weighted average
OSHA Z-2 / CEIL	:	Acceptable ceiling concentration
OSHA Z-2 / Peak	:	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift
TSCA ECEL / ECEL-TWA	:	Existing Chemical Exposure List (TWA)

AIIC - Australian Inventory of Industrial Chemicals; ASTM - American Society for the Testing of Materials; bw - Body weight; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CMR - Carcinogen, Mutagen or Reproductive Toxicant; DIN - Standard of the German Institute for Standardisation; DOT - Department of Transportation; DSL - Domestic Substances List (Canada); ECx - Concentration associated with x% response; EHS - Extremely Hazardous Substance; ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; ERG - Emergency Response Guide; GHS - Globally Harmonised System; GLP - Good Laboratory Practice; HMIS - Hazardous Materials Identification System; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory concentration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemical Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organisation; ISHL - Industrial Safety and Health Law (Japan); ISO - International Organisation for Standardisation; KECI - Korea Existing Chemicals Inventory; LC50 - Lethal Concentration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; MSHA - Mine Safety and Health Administration; n.o.s. - Not Otherwise Specified; NFPA - National Fire Protection Association; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NTP - National Toxicology Program; NZIoC - New Zealand Inventory of Chemicals; OECD - Organisation for Economic Co-operation and Development; OPPTS - Office of Chemical Safety and Pollution Prevention; PBT - Persistent, Bioaccumulative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substances; (Q)SAR - (Quantitative) Structure Activity Relationship; RCRA - Resource Conservation and Recovery Act; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals; RQ - Reportable Quantity; SADT - Self-Accelerating Decomposition Temperature; SARA - Superfund Amendments and Reauthorization Act; SDS - Safety Data Sheet; TCSI - Taiwan Chemical Substance Inventory; TECI - Thailand Existing Chemicals Inventory; TSCA - Toxic Substances Control Act (United States); UN - United Nations; UNRTDG - United Nations Recommendations on the Transport of Dangerous Goods; vPvB - Very Persistent and Very Bioaccumulative

The information is believed to be correct but is not exhaustive and will be used solely as a guideline, which is based on current knowledge of the chemical substance or mixture and is applicable to appropriate safety precautions for the product. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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Revision Date : 07/14/2026

US / EN

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Appendix C Field Forms

1. Task Hazard Assessment – Americas
2. Daily Safety Meeting – Americas
3. Heat Stress Monitoring Log – Americas
4. Vehicle Inspection Checklist – Americas
5. Off-Highway Vehicle Inspection – Americas
6. Drill Site Safety Inspection Checklist – Americas

Task Hazard Assessment

S3AM-209-FM6

Instructions

1. **This form or other applicable region- or business line-specific form is to be completed in accordance with SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.**
2. **Task Hazard Assessments (THA)s are required for any field work involving AECOM activities outside of the office and must be used onsite to review site hazards and confirm necessary controls are in place.**
3. **The THA must be reviewed in its entirety and modified at the work site (as needed) immediately prior to commencement of work to account for actual conditions and any changes (weather, scope of work, simultaneous operations, etc.). All necessary revisions must be written on the THA.**
4. **Acknowledgement of THAs must be recorded via electronic or physical signature as part of the Daily Safety Meeting – refer to Daily Safety Meeting – Americas.**
5. **The completed form must be retained in the project files.**

Project Name and Number	Click or tap here to enter text.91 Leighton Avenue Off-Site, 60788778....	**Overall Risk (Highest Post-Mitigation Risk)**	LOW
Task Name	General Hazards	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDOT

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☒ Yes – Specify HHT procedure number(s) and any permits/plans:	See Appendix D

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☒ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☐ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated	Choose 1 or 2 as required: ☒ Nitrile ☐ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Click or tap here to enter text.

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt?* *What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Trip to the site	Route hazards/accident	M	Consider the safest method of travel – use public transport where available and practical. Choose the safest routes Avoid conspicuous displays of personal valuables. Only use licensed local taxis – check before you travel. Request the taxi driver not to use a mobile phone while driving.	L
On-Site Edits:				
Manual Handling	Get injured when handling tools or equipment	M	Minimize or avoid manual handling activities and loads. When having to transport and lift items: ○ Be aware of potential back injuries and ensure correct techniques for lifting and bending are used. Use lifting aids where practical, e.g., trolleys. Do not lift more than 50 pounds – evaluate maximum. weight to lift depending on activity. Use proper tools for each task. Avoid using tools in bad conditions; replace them if observed. Use proper gloves Get help from co-workers as needed.	L
On-Site Edits:				

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Any	Fatigue Management	M	Identify factors in the workplace that may contribute to fatigue. Inform employees of potential fatigue-producing activities and how to manage them. Re-evaluate work tasks periodically to control fatigue. Monitor employees for the signs and symptoms of fatigue. Provide employees with sufficient breaks for food, water, and rest throughout the workday. Calling for unscheduled breaks/meals where fatigue factors are evident may be necessary. Getting adequate, undisturbed, regular, and consistent amounts of sleep each night. A minimum of 7 hours is recommended. Eating well-balanced and nutritious meals at regular intervals. Ensuring adequate consumption of water throughout the day.	L
On-Site Edits:				

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Any	Slips, Trips and Falls.	M	Slip-Trip-Fall hazards are common at field sites due to various obstructions, weather conditions, and human error. While it is difficult to eliminate all slip-trip-fall hazards, the risk of injury can be minimized by using safe work practices and following the procedures outlined below: • Keep cell phone camera and clipboard/writing items tucked in your pants and/or safety vest pocket. • Avoid uneven terrain and wet surfaces • Keep the work area free of obstructions • Plan your path and watch where you step • Monitor work area for good housekeeping practices. • Be alert to weather conditions. • Use designated walkways and routes. • Wear appropriate safety footwear – with good grip, ankle support, toe and mid sole protection, etc. • Ensure there is sufficient light for the tasks being undertaken. • Hold the handrail when using stairs. • Avoid stepping on debris, loose sheets, temporary hole covers or manhole covers. • Do not undertake tasks whilst walking; e.g. note taking / talking on mobile phone. • Review site conditions including areas of uneven pavement, oily staining, tight openings, stairs, etc. , do not run. • Stay off steep hillside, loose soils/gravel on a hill or parking lot, and stained/wet areas. • Stay proper distance from open service pits on main floor level (no closer than 6 ft from edge)	L
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt?* *What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Any	Unknown hazardous activities and site arrangements	H	• Liaise with those in charge of the site regarding current key site hazards and other work activities. • Attend site induction (if provided) and adhere to site rules and instructions. Sign in and out as required by site security. Stay with your guide (if provided) and follow their instruction in case of any emergency. • Ensure you are familiar with alarms and evacuation procedures and assembly points for the location. • Ensure correct PPE is worn. • If any site hazards are not covered in the JSA or have changed, complete a THA card and brief the team. • Use '4Sight' before starting each task. Use 'Stop Work Policy' – if you feel uncomfortable about anything, stop and resolve the issue before starting work.	L
On-Site Edits:				

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Any	Weather Related hazards	M	Monitor weather conditions and changes to weather during work. In inclement weather a review of the tasks and procedures should be made, and if necessary work should be stopped and advice sought from the PM prior to re-commencing activities. Heat and **cold stress** may vary based upon work activities, PPE/clothing selection, geographical locations, and weather conditions. To reduce the potential of developing heat/cold stress, be aware of the signs and symptoms of heat/cold stress and watch fellow employees for signs of heat/cold stress. Use vehicles or covered area for shelter and take breaks as needed In **hot weather** keep hydrated, prevent over exposure to the sun with clothing or use of sun cream and take frequent breaks out of the sun. Use the "buddy system" to monitor effects of heat stress Create shaded work areas if appropriate Use a strong sunscreen and wear a full-brimmed hat when in the sun to protect the back of the neck and shoulders In **cold/wet weather**, be aware of potentially slippery surfaces (wet or icy). Wear warm / waterproof clothing and take breaks in a warm location. In **inclement weather** stop work if necessary and seek advice sought from the PM prior to re-commencing activities.	L
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*		**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Any		Personal Security	H	• Assess area and potential risk of confrontation prior to starting work and only begin work if considered safe to do so. • Avoid potentially confrontational situations. Remain calm and do not raise voice. • Avoid carrying valuable items. • Keep mobile phones, cameras etc., out of general sight when not in use. • Report incidences of strangers entering the site to security or the client. • Avoid capturing the general public in photographs – ask their permission to be photographed. If you feel threatened, stop work, leave site, retreat to a safe place and telephone the project manager / police.	L
On-Site Edits:					

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Any	Biological Hazards – (diseases, insects, animals, etc.)	M	Mosquitos, poisonous plants, and other biological hazards will most likely be present on or around the site where work will be performed. It is important for AECOM personnel to follow the outlined procedures below: • Identify relevant biological hazards • Wear long sleeves/ trousers/ gloves to cover the body as far as possible • Tape them in case it is assessed necessary. • Use insect repellents to reduce potential for bites. • Ensure Tetanus and other relevant inoculations are current. • Be aware of surrounding elements and do your best to avoid places hazards might be present • Speak up if you see any person that might be in danger from a biological hazard • Implement body inspections for ticks when field work is completed in areas where they are prevalent. • All cuts and grazes will be covered with a suitable dressing before going on site. • Always wash face and hands before drinking or eating. • Do not attempt to manually clear debris or items at ground level or in vegetation - keep hands / arms away from areas where used syringe needles may be present. • Avoid contact with hazardous plants. • Remain vigilant for bulls, dogs, and other animals in the work area. • If flu-like symptoms experienced after contact with static bodies of water, visit doctor and make aware of possible contact with Weil's disease.	L
On-Site Edits:				

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Driving - Vehicle	Vehicle accident	H	• Driver to be fully licensed and comply with all driving and safety regulations. • Driving online modules or hands-on defensive driver course. • Leave enough time to arrive at your destination without hurrying • Use defensive driving techniques. Maintain situational awareness. Allow sufficient stopping distance between vehicles. • Understand procedures for breakdown assistance and have appropriate contact numbers available for summoning assistance. • Stay away from flooded roadways – Turnaround • Use caution when entering roadways • Check vehicle safety equipment (use approved vehicle). Use defensive driving techniques, avoid distracted driving; no use of mobile communication devices when driving (driving includes time spent in traffic or while stopped at red lights or stop signs). GPS units and GPS units on smart phones may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their eyes off the road; rest stops when needed. ANSI Class 2, retro-reflective vest in the vehicle. • Secure all loads, including equipment within the vehicle • Wear seat belts at all times • Select appropriate vehicle for the task (vans have a bulkhead between the rear and passenger cabins). • Vehicle to be checked before setting off and to correct any noted deficiencies: o lights, mirrors, tires, windscreen, etc. are fully operational. o The vehicle is roadworthy and appears in good mechanical order; • Where the hire vehicle is found to be unsuitable it should not be accepted and a suitable replacement requested. • Make sure each vehicle is equipped with a first aid kit • Drivers will not operate vehicles when fatigued or under the influence of alcohol or medication. A 15-minute break at least every 2 hours is recommended - more breaks will be taken if the driver feels tired. No employee should operate a vehicle if they have worked 14 consecutive hours within a 24-hour period. Refer to • S3AM-009-PR1 Fatigue Management. • Cars will be parked so as not to cause a hazard or obstruction and in accordance with site or local parking requirements. • When practicable, drivers will always reverse park or choose a space that they can drive out of in a forward direction. • Check the parking area before maneuvering / seek assistance in maneuvering if needed.	M
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*		**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
On-Site Edits:					
On-Site Edits:					
Additional Notes					

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All Employees

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

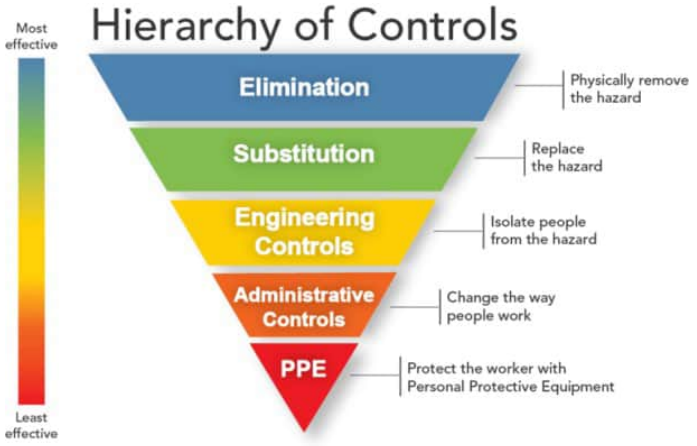
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Probability	Severity				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	25	20	15	10	5
4 – Probable	20	16	12	8	4
3 – Occasional	15	12	9	6	3
2 – Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Supervisor or equivalent
10 to 25 (High)	Risk requires the approval of the Project Manager & SH&E Director

Send THA improvement suggestions to
DCSA.THA.Library@AECOM.com
Include a copy of the new THA or a photo of the THA modifications as appropriate.

Severity – Potential Consequences				
	People	Property Damage	Environmental Impact	Public Image/Reputation
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

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Americas

Task Hazard Assessment

S3AM-209-FM6

Instructions

1. **This form or other applicable region- or business line-specific form is to be completed in accordance with SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.**
2. **Task Hazard Assessments (THA)s are required for any field work involving AECOM activities outside of the office and must be used onsite to review site hazards and confirm necessary controls are in place.**
3. **The THA must be reviewed in its entirety and modified at the work site (as needed) immediately prior to commencement of work to account for actual conditions and any changes (weather, scope of work, simultaneous operations, etc.). All necessary revisions must be written on the THA.**
4. **Acknowledgement of THAs must be recorded via electronic or physical signature as part of the Daily Safety Meeting – refer to Daily Safety Meeting – Americas.**
5. **The completed form must be retained in the project files.**

Project Name and Number	91 Leighton Avenue Off-Site, 60788778	**Overall Risk (Highest Post-Mitigation Risk)**	HIGH
Task Name	Temporary Traffic Control	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☐ Yes – Specify HHT procedure number(s) and any permits/plans:	Click or tap here to enter text.

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☐ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☐ Class 2 ☒ Class 3	Choose 1 or more as required: ☒ Work boots ☒ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated ☐ Other - Specify: ….	Choose 1 or 2 as required: ☐ Nitrile ☒ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical ☐ Other - Specify: ….	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Temporary Traffic Control Devices (TTCD)

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Pre-Planning	Struck by Vehicles / Causing Third Party Vehicle Accidents	**M**	Have a Traffic Control Plan (TCP) - Communicate the plan to all involved and affected workers - In addition to the traffic hazards, hazards associated with the highway or road work tasks shall be addressed via written THAs. Employees shall be appropriately trained to the potential exposures to highway and road hazards and the applicable control measures	**L**
	Inadequate Traffic Control Plan		Traffic accommodation shall be provided BEFORE the work starts and shall be maintained until the work is completed. All TCP Plans should be reviewed by a qualified person, even where AECOM is not controlling the site.	
	Simultaneous Operations		Where there are several projects, vehicle routes and communication must be coordinated between contractors.	
On-Site Edits:				
Identify and Assess	Critical injuries caused by vehicle collision upon slowing onto secure location.	**M**	Activate vehicle warning lights and begin slowing vehicle early.	**L**
	Critical injuries caused by being struck from behind when parked on the shoulder or further.		Do not pull over where rear view visibility is poor (curves, overhead obstructions, trees etc.). Select area with enough room to exit the vehicle and have an emergency escape route for errant vehicles. Set parking brake and always keep seatbelt on, even when parked.	
	Vehicle damage from getting stuck in mud or being on steep slopes		Observe ground cover and obstructions on shoulder and avoid steep or muddy conditions. Set your parking brake and turn your wheels away from the direction of the slope.	
On-Site Edits:				

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!					
Job Steps *List all steps required to perform a task in the sequence they are performed*		**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Exiting the vehicle upon parking		Sustaining critical injuries caused by being struck by moving traffic while exiting the vehicle.	**H**	Observe traffic flow prior to exiting the vehicle. Exit vehicle when there is a break in traffic. Walk toward rear of vehicle, watch oncoming traffic. Walk immediately to protected side of vehicle and access tools and equipment from protected side. Never stand directly in front of vehicle, leave minimum 50ft of buffer between you and the front of the vehicle.	**M**
		Straining back or other lower body injury caused by unsafe terrain, loose footing, slips or falls.		Assess the terrain, slopes greater the 30 degrees require fall protection. Assess work area for unprotected ledges or parapet style walls that are less than 42" require additional fall protection if fall distance is greater than 4' or 6' depending on location.	
		Bruise, strain, or fracture to body from slip, trip or fall from carrying too much equipment at one time or uneven surfaces		Avoid heavy brush/grass. Wear insect repellent and poisonous plant barrier creams, as well as disposable coveralls, gloves and boot covers.	
On-Site Edits:					
Unload traffic control equipment from rear of work truck		Critical injuries caused by being struck by moving traffic	**H**	Continue warning lights/beacons. Face traffic, monitor general traffic patterns. Walk in protected areas where possible (behind guard rails). Leave an emergency egress route in case of an errant vehicle.	**H**
		Bruising or broken finger due to getting caught in a pinch point in the vehicle or tailgate.		Avoid placing hands near the sides or bottom of the tailgate and other collapsible parts of traffic control devices, tools, etc. Wear leather or Kevlar gloves.	
		Bruise, strain, or fracture to body from slip, trip or fall from carrying too much equipment at one time or uneven surfaces		Never carry more than 4 cones, fewer if 4 could impede visibility or limits movement. Never lift more than you are capable of lifting safely and use good body mechanics. Inspect your walking path to assure it is clear, notice any changes in walking surfaces and make adjustments to your gait to accommodate for changes.	
On-Site Edits:					

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Deploying temporary traffic control devices (cones and light weight signage)	4a. Critical injuries caused by being struck by moving traffic while deploying traffic control devices	H	Face and monitor moving traffic. Leave an emergency egress route in case of an errant vehicle. If you cannot maintain view of on-coming traffic stop work and obtain help from a spotter. Place traffic control in a sequence that offers greatest protection from moving traffic, typical the devices further from the work zone are placed first. Set-up may be adjusted to increase protection, but TCP elements should never be removed of modified in a way that decreases protection.	M
	4b. Straining back or other parts of body due to improperly lifting or moving heavy objects.		Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds. If removing from the back of a truck, slide the case to the tailgate and lift from tailgate, not over the side of the truck bed.	
On-Site Edits:				
Verifying traffic control set up	Critical injuries caused by being struck by errant vehicles in the work zone.	H	Maintain constant vigilance. Verify that all access roads driveways, parking areas, emergency use areas within the work zone are protected with TTCD.	M
	Misdirection and confusion resulting in unsafe traffic conditions due to incorrect or insufficient set up of traffic control.		Assure that the TTCD are spaced appropriate for the speeds of the motoring public, shorten distance between cones if speeds are slower than anticipated. Increase number of (and distance of) advance warning signs if drivers fail to yield or slow to traffic control set up.	
	Misdirection or confusion in workflow by unintended interaction with public in the work zone.		Make verbal contact with other workers or the public in the areas to alert them to your presence and orientate them to the work zone. Do not rely on eye contact as a means of communication.	
On-Site Edits:				

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Recovering temporary traffic control devices (cones and light weight signage)	Critical injuries caused by being struck by moving traffic while deploying traffic control devices	H	Face and monitor moving traffic. Leave an emergency egress route in case of an errant vehicle. If you cannot maintain view of on-coming traffic stop work and obtain help from a spotter. Place traffic control in a sequence that offers greatest protection from moving traffic, typical the devices further from the work zone are placed first. Set-up may be adjusted to increase protection, but TCP elements should never be removed of modified in a way that decreases protection.	M
	Straining back or other parts of body due to improperly lifting or moving heavy objects.		Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds. If removing from the back of a truck, slide the case to the tailgate and lift from tailgate, not over the side of the truck bed.	
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Working within area protected by traffic control measures	Collision with other drivers	H	Stay away from the outer limits of the work zone. Position vehicles to create a protective barrier on site. Comply with direction given by the qualified person. Workers should generally face looking toward oncoming traffic and look out for each other. Walk behind guardrail/barriers where possible. Road crossings shall be avoided as much as possible. If employee needs to cross the road, then it will be made at ninety degrees angles to traffic flow. ANSI Class 3 high visibility retro-reflective clothing is required, as well as safety glasses, hard hat and safety-toed boots.	L
	Line of sight (Fire) hazards		Ensure the operator or driver is aware of your presence and activities. Remain in the operator's direct line of sight and avoid blind spots. Approach areas with operating equipment only from directions clearly visible to the operator. Maintain a safe distance from the swing radius and be prepared for sudden movements of heavy machinery. Listen attentively for backup alarms and warning signals. Never turn your back on operating equipment. Do not walk or work beneath suspended loads under any circumstances. Refrain from using cell phones, texting, or wearing personal headsets when near heavy equipment. Stay alert to changing conditions that may shift the Line of Fire zone, such as wind gusts or falling objects. Conduct a thorough job site walk-down to identify missing or inadequate safety measures like barricades, equipment guards, and excavation shoring. Be aware of crush points—never stand between two stationary vehicles or between moving equipment and fixed objects.	
	Pedestrians safety in/near worksite		Clearly indicate and close work area so pedestrians will stay away. Provide a separated walkway or flagger for pedestrian movement if passage through work zones is required or unavoidable.	
	Slips Trips, Falls		Plan your path and review road conditions including areas of uneven pavement, oily staining, etc. Avoid uneven terrain, wet surfaces or stepping on debris present on the road. Keep the work area free of obstructions and monitor work area for good housekeeping practices. Do not jump over the guardrail and wear safety footwear with good grip. Ensure there is sufficient light for the tasks being undertaken. Do not undertake tasks whilst walking; e.g. note taking / talking on mobile phone.	
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*		**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
7.	Working along roadsides in temporary work zones not protected by cones or traffic barriers	8a. Struck by vehicle or vehicle intrusion into work area	H	Utilize a two-vehicle protective strategy. Choose only vehicles equipped with amber flashing/oscillating light bars and 4-point flashing strobes. Pull off to as far on the side of the road as possible or find another safe location. Use a flashing amber warning light on the vehicle(s). Designate one person to constantly monitor oncoming traffic while others work. When exiting the vehicle on the driver's side, the driver (and rear driver's-side passenger) will use their right hand to open the door, thus ensuring their body position enhances looking over the shoulder and as far down the roadway as possible before opening the vehicle door. When traffic conditions prohibit safe egress on the driver's side, consider using the passenger side doors to exit and enter the vehicle. To maximize the depth of the lateral buffer between pedestrians and live traffic, pull as far from the shoulder as possible away from live traffic. Maintain at least three car lengths between team vehicles parked along the shoulder of the roadway in order to provide a crash protective barrier for pedestrian work occurring in the shoulder ahead. Never stand between two stopped vehicles or in front of any stopped vehicle. Always work ahead of but to the side of (at a 2 o'clock position) any vehicle stopped on the roadside. Always have your escape route from traffic intrusion into the work zone planned out. Often the safest escape path is to run towards the nearest shoulder, however site-specific traffic barriers such as guardrail may provide the most protection. Evaluate each work location for escape routes before setting up your work area.	M
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Additional Notes				
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All Employees

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

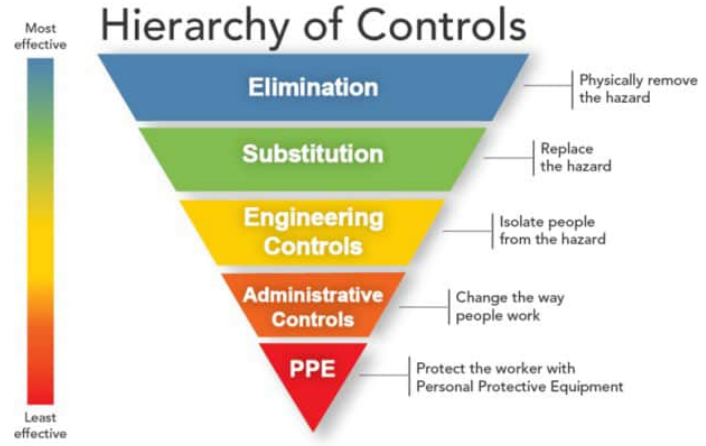
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Probability	Severity				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	25	20	15	10	5
4 – Probable	20	16	12	8	4
3 – Occasional	15	12	9	6	3
2 – Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Supervisor or equivalent
10 to 25 (High)	Risk requires the approval of the Project Manager & SH&E Director

Send THA improvement suggestions to
DCSA.THA.Library@AECOM.com
Include a copy of the new THA or a photo of the THA modifications as appropriate.

Severity – Potential Consequences				
	People	Property Damage	Environmental Impact	Public Image/Reputation
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

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Americas

Task Hazard Assessment

S3AM-209-FM6

Instructions

1. **This form or other applicable region- or business line-specific form is to be completed in accordance with SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.**
2. **Task Hazard Assessments (THA)s are required for any field work involving AECOM activities outside of the office and must be used onsite to review site hazards and confirm necessary controls are in place.**
3. **The THA must be reviewed in its entirety and modified at the work site (as needed) immediately prior to commencement of work to account for actual conditions and any changes (weather, scope of work, simultaneous operations, etc.). All necessary revisions must be written on the THA.**
4. **Acknowledgement of THAs must be recorded via electronic or physical signature as part of the Daily Safety Meeting – refer to Daily Safety Meeting – Americas.**
5. **The completed form must be retained in the project files.**

Project Name and Number	91 Leighton Avenue Off-Site, 60788778	**Overall Risk (Highest Post-Mitigation Risk)**	MEDIUM
Task Name	Air Knifing	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☒ Yes – Specify HHT procedure number(s) and any permits/plans:	See Appendix D

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☒ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☐ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated	Choose 1 or 2 as required: ☒ Nitrile ☐ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Click or tap here to enter text.

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Identify/Lockout Utilities	Electrocution/contact with energized electrical lines	H	Locate all sources of electricity to site parking lights, air compressor, vacuum, car wash, and ID sign and if possible de-energize lines by using locks and tags. • Call public utility locating service prior to initiating work activities. • Use private locating service to mark out areas on private property. • Verify location of utility marks; do not perform intrusive work if utility location marks cannot be found or if marks are destroyed. Preserve utility marks as much as possible. Call to have utilities remarked if unsure as to their location • If lockout/tagout procedures are used, notify all affected employees on-site of the de-energized condition. Verify all public and private utility mark outs.	L
On-Site Edits:				
Position Rig	Injury from or damage to overhead utilities from direct contact with or proximity to (arcing)	H	Check area for hazards. • While moving the rig on site, keep a minimum 4 foot clearance under any electrical lines. • While planning the working position of the rig, keep a minimum 10 foot clearance away from any electrical lines. • Use a spotter when backing.	M
	Rig stuck in soft/slippery ground		Choose the most level path for travel with the rig. • If needed, consider the use of wood, sand, or crushed stone to create a stable working/traveling platform.	
	Intrusion by 3rd parties		Observe the site pedestrian and vehicular traffic patterns. Use cones, flags, and caution tape to establish traffic control and exclusion zones.	
	Stabilize Vehicles		Chock wheels on all vehicles and trailers.	
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Remove concrete or asphalt by use of jackhammer to open/ cut concrete/asphalt at location	Vibrational or contact injuries and excessive noise	H	Wear leather or vibration-absorbing gloves, safety glasses, face shield, hearing protection, and a hard hat. • Use shovels to push debris out of way. • Follow manufacturer's operating procedures for equipment. • Have a stable stance; feet shoulder width apart, hold jackhammer lightly and balanced. • Do not wear excessively loose, baggy clothing or jewelry. • Take a 10-minute break every hour of operation during operation of jackhammer to prevent vibration/repetitive motion injuries.	L
	Fire/explosion from sparks igniting a fuel/vapor source		If sparks are generated within 35 feet of a vapor source (i.e., an operating pump island) a Hot Work permit must be furnished and air monitoring must take place throughout the cutting procedure if the possibility of flammable vapors exists.	
	Struck-by injury from disconnected pressurized air lines/hoses		All hose connections must be secure. All lines should be inspected prior to use. Locking pins and whip checks must be used for all connections that could fail or become disconnected causing the hose to "whip."	
On-Site Edits:				
Air knife operation ***Note:*** *If any evidence of pea stone is observed during any subsurface activity,* ***STOP WORK*** *and notify the project manager immediately.*	Bodily injury or hearing damage from air compressor and associated air lines.	H	Safety glasses, hearing protection, and work gloves must be worn at all times when compressor is running. • Keep hands and clothing away from rotating machinery. • All hose connections must be secure. All lines should be inspected prior to use. Locking pins and whip checks must be used for all connections that could fail or become disconnected causing the hose to "whip." • Ensure hopper door is securely fastened before work begins. • Ensure all personnel on site know how to shut down machine in case of an emergency. • If dust is generated by operation, use water spray to control. *Note: Staff must ensure that prior to turning on the air compressor that it is confirmed that the air knife is manned and that the air valve is closed.*	M

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	Personal injury and property damage from contact with high pressure jet and associated flying debris		Do not spray persons with high-pressure jet. • Ensure air lance is equipped with a metal guard attachment, near the nozzle, that is capable of shielding the operator from airborne debris exiting the excavation. • A face shield and safety glasses shall be worn in addition to the Level D PPE within a 10 foot area where high-pressure jet is being utilized. Use caution when using high-pressure jet assembly around known underground utilities. • Do not direct high-pressure jet at one point for long periods of time; continually rotate high-pressure spray assembly. • Do not use unit indoors. • Pull the trigger while turning off the machine to make sure piping is not under pressure. • Inform all personnel of restricted area and do not permit unauthorized individuals (i.e., those not properly trained [40-hour OSHA training, etc.] or wearing appropriate PPE) access to the exclusion zone. • If in the vicinity of known pedestrian traffic, use a spotter to alert crew to stop operations to allow pedestrian to pass.	
	Exposure to or ignition of elevated levels of gasoline vapors		If there is any gasoline odor or if air knifing activities are occurring in an impacted area, monitoring with a PID and LEL meter is required. Action levels are defined in the HASP.	
	Equipment damage/failure due to cold temperatures		When temperatures drop below 20˚F or when the water used to conduct subsurface clearance freezes, subsurface clearance should stop until warmer temperatures occur or the safe operation of the machinery is no longer impacted.	
	Injury from or damage to overhead utilities from direct contact with or proximity to (arcing)		Maintain a distance of at least 10 feet from energized overhead power line. For other overhead lines such as phone or cable lines, if there is a chance of contacting and/or damaging the lines, the appropriate service company should be contacted so that the lines can be relocated or protected.	
On-Site Edits:				

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Vacuum operation	Personal injury (burns, pinch points, cuts, hearing damage) from vacuum blower		Keep hands, clothing, and equipment an arms length away from rotating machinery, inlet and discharge openings. • Avoid contact with blower casing and associated piping; may cause major skin burns on contact. • Ensure guards are in place on external moving parts. • Develop suction line vacuum break mechanism in the event of a vacuum emergency (object caught by the suction hose). • Wear hearing protection when unit is operational	
	Fire/explosion from ignition of elevated vapors		Air monitoring must take place on ungrounded Vac-Trons • If LEL levels of breathing zone or working zone (air which is traveling through the Vac-Tron) air exceeds 10%, **STOP WORK**. • Vac-Tron is not to be used to vacuum free-phase petroleum products or soils saturated with petroleum products	
	Injury from or damage to overhead utilities from direct contact with or proximity to (arcing		Maintain a distance of at least 10 feet from energized overhead power line. For other overhead lines such as phone or cable lines, if there is a chance of contacting and/or damaging the lines, the appropriate service company should be contacted so that the lines can be relocated or protected.	
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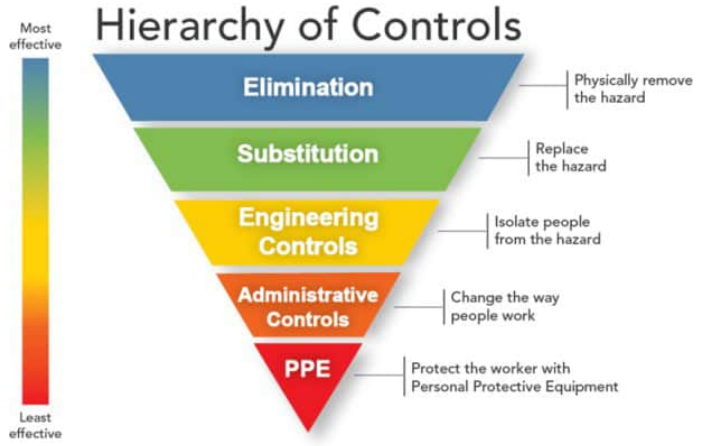
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Americas

Task Hazard Assessment

S3AM-209-FM6

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Project Name and Number	91 Leighton Avenue Off-Site, 60788778	**Overall Risk (Highest Post-Mitigation Risk)**	MEDIUM
Task Name	Soil Sampling with Hand Auger	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☒ Yes – Specify HHT procedure number(s) and any permits/plans:	See Appendix D

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☒ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☐ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated	Choose 1 or 2 as required: ☒ Nitrile ☐ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Click or tap here to enter text.

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Setup equipment	Cuts or hand injuries from pinch points	L	Inspect for broken welds on auger. If broken welds or cracks – STOP WORK. Wear cut resistant gloves at all times and avoid handling the sharp edges of the auger cup. Keep face, hands, fingers, and feet out of the line of fire of moving parts and tools	L
	Back strain/ overexertion when unloading equipment		Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds. If removing from the back of a truck, slide the case to the tailgate and lift from tailgate and not from the side of the truck bed	
On-Site Edits:				
Advancing hand auger	Contacting utilities causing serious personal injury or death.	H	Ensure subsurface clearance protocol and permit requirements are being followed before beginning work. Turn the auger slowly and if refusal is met, remove the auger from the borehole and inspect the cause of refusal. If a utility, pea gravel, or non-native fill material is encountered, STOP WORK and call the PM.	M
	Back strain or pulled muscle from rotating hand auger.		Do not yank on the auger handle. Do not turn at waist, turn with arms and shoulders, keep feet square and lift with legs, do not work with arms above head. Take breaks and rotate work. Use short extensions as you advance to avoid.	
	Injury from slip, trip, fall		Clear the work area of trip hazards. Walk around bore hole, never over it and cover hole with delineator when unattended.	
	Injury to eyes from flying debris.		If it is windy, stand upwind and switch to goggles to prevent dirt entering eye	
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Collecting soil samples	Contact with contaminated soil	M	Use clean sampler to touch soil. Wear nitrile gloves over the cut resistant gloves at all times. If nitrile tears, stop work and replace glove. For samples with high volatile organics content (PID in breathing zone is constantly above site limits stated in HASP (>5 ppm)) wear breathing protection as stated in HASP. Change Nitriles between samples to avoid cross contamination	L
	Cut from handling auger, sampling tools, jars		Inspect containers before and during filling. Do not use if chipped or cracked. Pack containers in coolers so that they will not shift (spacers/ packing materials as needed). Do not over pack coolers.	
	Muscle strain in back or legs from bending over or squatting		Evaluate work surface height (see if chair/ table needed) and sample jar placement to eliminate ergonomic issues. Avoid squatting and bending	
On-Site Edits:				
Adding extensions to auger	Cuts or hand injuries from pinch points	H	Avoid placing hands near connection points of extensions and avoid the sharp edges of the auger cup. Wear cut resistant gloves at all times	L
	Striking another person		Check that the swing radius of the auger is clear before moving it	
	Contacting overhead structure		Before raising the auger vertically, verify that no overhead lines or structures are present **STOP WORK** and move if electrical lines are in the area	
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Breakdown and decontaminate equipment	Contact with contaminants and cut hazards	M	Inspect before handling for chips or cracks in glass containers. Wear nitrile gloves over cut resistant gloves. If nitrile tears, stop work and replace glove.	L
	Breaking a sample container resulting in cut, or contact with contents/preservatives		Handle containers with care and position over padded or soft surface in case it slips from hand. Place in packing materials that will protect against collisions.	
	Striking another person		Before disassembling auger, verify that no one is in the swing radius	
On-Site Edits:				
On-Site Edits:				
Additional Notes				

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All Employees

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

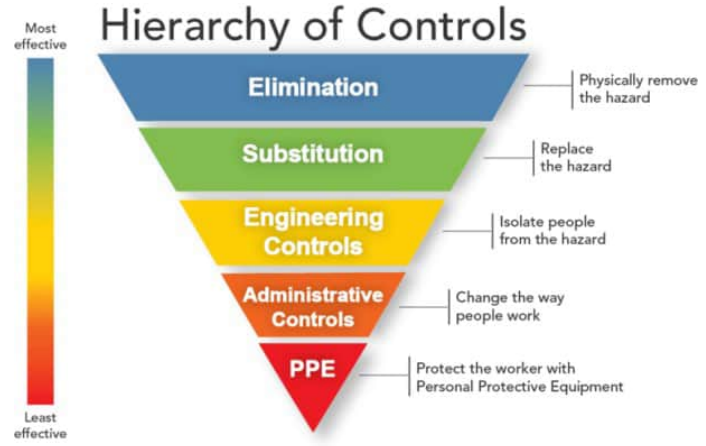
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- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Probability	Severity				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	25	20	15	10	5
4 – Probable	20	16	12	8	4
3 – Occasional	15	12	9	6	3
2 – Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Supervisor or equivalent
10 to 25 (High)	Risk requires the approval of the Project Manager & SH&E Director

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Include a copy of the new THA or a photo of the THA modifications as appropriate.

Severity – Potential Consequences				
	People	Property Damage	Environmental Impact	Public Image/Reputation
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

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Task Hazard Assessment

S3AM-209-FM6

Instructions

1. **This form or other applicable region- or business line-specific form is to be completed in accordance with SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.**
2. **Task Hazard Assessments (THA)s are required for any field work involving AECOM activities outside of the office and must be used onsite to review site hazards and confirm necessary controls are in place.**
3. **The THA must be reviewed in its entirety and modified at the work site (as needed) immediately prior to commencement of work to account for actual conditions and any changes (weather, scope of work, simultaneous operations, etc.). All necessary revisions must be written on the THA.**
4. **Acknowledgement of THAs must be recorded via electronic or physical signature as part of the Daily Safety Meeting – refer to Daily Safety Meeting – Americas.**
5. **The completed form must be retained in the project files.**

Project Name and Number	91 Leighton Avenue Off-Site, 60788778	**Overall Risk (Highest Post-Mitigation Risk)**	MEDIUM
Task Name	Oversight of Drilling Activities	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☒ Yes – Specify HHT procedure number(s) and any permits/plans:	See Appendix D.

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☒ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☐ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated	Choose 1 or 2 as required: ☒ Nitrile ☐ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Click or tap here to enter text.

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Mobilization	Striking unidentified underground utilities	H	Call public utility locating service prior to initiating work activities. Use private locating service to mark out areas on private property. Verify location of utility marks; do not perform intrusive work if utility location marks cannot be found or if marks are destroyed. Preserve utility marks as much as possible. Call to have utilities remarked if unsure as to their location.	L
	Striking overhead utilities		Follow the requirements of S3AM-322-PR1 Overhead Lines. Verify adequate clearance of all drilling locations prior to setting up at drilling location.	
On-Site Edits:				
Setting up at drilling location	Biological hazards causing bites, stings or other injury	H	Examine ground surface for biological hazards prior to setting up equipment. If biological hazards exist, move equipment to a different area for set up if possible. Machetes, or other fixed open blade tools, are not permitted for clearing vegetation. Use insect repellent and check clothing for ticks periodically when applicable.	L
	Struck by traffic causing serious bodily injury		Be alert to other vehicles or pedestrians if work area is in an area with public access. Communicate with any heavy equipment operators in the area to ensure they know where you and the equipment are located. Don high visibility vest.	
	Unstable Rig platform causing tip/fall with crushing injuries		Verify with contractor that rig is set up level and properly chocked and blocked.	
On-Site Edits:				

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Oversight of rig inspection	Mechanical failure of equipment	H	Verify that drilling contractor inspects equipment daily using S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection or equivalent.	L
	Emergency shut off disabled		Verify that kill switch on rig is tested and operational	
On-Site Edits:				
Drilling Oversight	Flying debris, caught by/ struck by injuries	H	Keep a safe distance away during rig operation. Always stand outside of the tip/fall radius of the mast, recommended safe distance is to be no less than 30 feet away from the rig, or the mast height plus 5 feet. Do not talk on cell phone or be distracted by paperwork when in immediate proximity to rig. Stay a safe distance (minimum 5') from outriggers. Do not place or store any equipment on the rig. Verify that all personnel follow S3NA_321_PR1 Drilling, Boring, Direct Push Probing. Wear PPE including hard hats, steel-toe safety boots, safety glasses, and hearing protection.	M
	Caught in/by equipment		Keep hands, feet and other body parts shall be kept a minimum of 5' away from moving parts. When augers are rotating, stay clear of the rotating auger and other rotating/moving components of the drill rig, i.e. outriggers. Do not approach operator without making eye contact and getting approval. Watch for loose clothing (hooded sweatshirts, baggy clothing, loose shoelaces).	
	Exposure to contaminants causing injury or illness		Position yourself upwind of the borehole whenever possible. Perform air monitoring using a PID as described in the HASP. STOP WORK if the action level is exceeded.	
	Noise-induced hearing loss from loud drilling operations		Setup at least 30' away from noisy operations. Don't be near the rig when hammering. Measure dB levels with a noise meter. Wear hearing protection.	
On-Site Edits:				

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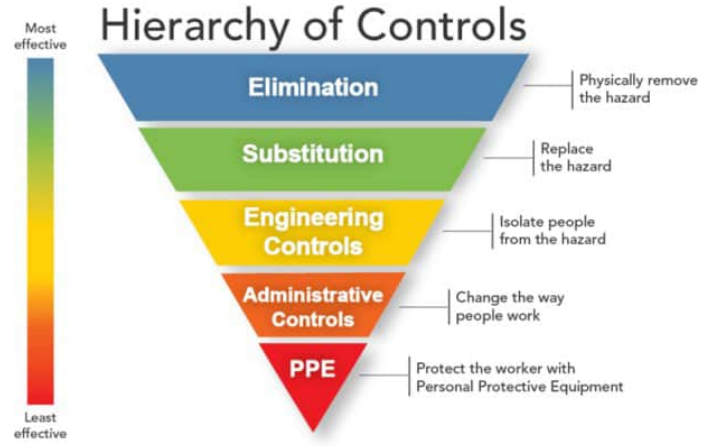
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Task Hazard Assessment

S3AM-209-FM6

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Project Name and Number	91 Leighton Avenue Off-Site, 60788778	**Overall Risk (Highest Post-Mitigation Risk)**	HIGH
Task Name	Drilling - Well Installation / Soil Sampling	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☒ Yes – Specify HHT procedure number(s) and any permits/plans:	See Appendix D.

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	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☐ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated	Choose 1 or 2 as required: ☒ Nitrile ☐ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

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Contact One-Call, private utility contractor, and/or site personnel to locate and mark underground utilities.	*Failure to have underground utilities identified could result in explosion, electrocution, injury, death, property damage.*	M	Call public utility locating service prior to initiating work activities. Use private locating service to mark out areas on private property. Verify location of utility marks; do not perform intrusive work if utility location marks cannot be found or	L
On-Site Edits:				
Set up work zone	Struck by vehicle or equipment traffic	H	Verify that drilling contractor inspects equipment daily using S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection or equivalent. Verify that kill switch on rig is tested and operational. Establish work zone using traffic control devices, signs, cones, etc. in advance of initiating monitoring well abandonment activities. Restrict access to observers and passersby.	L
	Sprain or broken bones due to slip, trip or fall		Maintain required housekeeping in work area, do not carry equipment where visibility of ground is impaired, remove or mark all trip hazards in work area.	
	Contact with overhead utilities.		2d. Keep a minimum of 15 feet from overhead power lines (20 ft. if 230-285 KV, 25 ft. if 285-345 KV, 35 ft. if 345-500 KV) Check HASP to ensure client/site does not have stricter requirements. Mast shall be down when rig is in motion.	
	Hydraulic failure causing release to the environment.		Place secondary containment on ground under rig. Ensure that secondary containment is setup with 'berms/barriers' or containment is securely clipped onto the rig tracks/wheels to protect from any fluid leaking off the plastic.	
On-Site Edits:				

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Commence drilling	Pinch points	H	Never place hands, fingers, feet under the bottom of an auger flight, or other location where these heavy items could be set down or could fall suddenly.	H
	Entanglement		Ensure rotating parts are properly guarded. Remove loose clothing and jewelry that could become entangled in moving parts. Use a long handled shovel to remove cuttings from the auger/rods.	
	Noise		Wear hearing protection while equipment is in use.	
	Back strain/ overexertion when unloading equipment		Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds.	
	Flying/shattering objects		Have bystanders maintain a 5 foot distance from the operation at all times. Wear all required	
	Hand positioning/pinch points		Wear leather or thick puncture-resistant gloves, communication between driller, helpers, and logger. All pinch point hazards should be labeled on rig with warnings.	
On-Site Edits:				
Pulling out core barrel/sampler and extruding core/sample into bag	Injury due to struck by or crush injuries	H	Keep all limbs out of line of fire. Ensure all guards are in place any time the drill rig is in operation. Only the authorized personal are to be in the immediate vicinity of the Drill Rig. Wear cut/impact resistant gloves.	M
	Cut/laceration on sharp edges or core barrel/sampler		5b. Inspect core barrel/sampler for sharp edges and remove. Wear cut/impact resistant gloves.	
	Pinch points using hammer to hammer side of core barrel/sampler.		Never place hands, fingers, feet under the bottom of an auger flight, or other location where these heavy items could be set down or could fall suddenly. Ensure rotating parts are properly guarded. Remove loose clothing and jewelry that could become entangled in moving parts. Use a long handled shovel to remove cuttings from the auger/rods.	
On-Site Edits:				

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Well Casing Assembly and Installation	Muscle strain.	M	Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds.	L
	Slip, trip, and fall (STF) hazards from uneven		Check walking/movement path for STF obstructions. Conduct pre-site walk with crew prior to work and remove or isolate STF hazards.	
	Injury from improper tool use.		Do not use tools for unintended purposes (such as a saw to open bags of bentonite instead of an approved cutting tool).	
	Dust inhalation.		Wear a dust mask and minimize dust when pouring powdered bentonite, concrete, or cement.	
	Cutting PVC, cuts, lacerations		Use PVC cutter for cutting PVC. Wear cut-resistant gloves (Level 2), keep fingers and other body parts away from cutting tool blade.	
	Exposure to airborne chemicals or explosive atmosphere		Conduct air monitoring with PID and 4-gas in background areas and breathing zone of all workers, Stop work if PID or LEL indicates action level, Wear respirator with organic vapor cartridge if VOCs cannot be controlled.	
	Crushed by, pinch point on drill rig		Keep body parts away from moving parts on drill rig.	
On-Site Edits:				

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Installation of sand filter pack/bentonite	Injury from cutting bags open	M	Use a safety knife. No fixed-blade knifes allowed on site. Cut away from the body. Wear minimum Level 2 cut-resistant gloves	L
	Eye and respiratory injury due to dust and other airborne particles		Refer to the SDS for use information. Pour from the upwind side of the well construction activity. Wear long sleeved shirt, long pants, gloves, and safety glasses.	
	Back or muscle strain due to improper load or lifting techniques		Do not lift anything over 50 lbs. without assistance (partner or appropriate mechanical device). Use proper lifting techniques, lift with legs, keep back straight, and carry object close to body.	
On-Site Edits:				
Grouting	Exposure to cement dust and mixed cement, skin, eye, and inhalation	H	Exposure to cement dust and mixed cement, skin, eye, and inhalation	L
	Injury from entanglement in drive shaft or mixing paddles		Do not reach into the mixing tank during operation. Do not wear loose clothing or use tools that could become entangled in drive shaft or mixing paddles. Turn the unit off before attempting to service the mixer or clear debris.	
	Splashes and spills		Wear face shield to guard against splashes. Add water or other liquid additives in a controlled manner to avoid splashes. Do not exceed the capacity of the mixing tank	
	Muscle strain		Stage bags of dry materials as close to mixer as possible. Use a buddy to help move heavy bags. If possible, lower the height of mixer to minimize lifting.	
On-Site Edits:				

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** ***(initial)***	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Excavating Well Pad Area	Underground Utility Strike	H	Ensure area of well pad was cleared during underground utility clearance procedure for well.	M
	Back or muscle strain		Keep shovel loads and twisting motions to a minimum. Do not lift anything over 50 lbs. without assistance (partner or appropriate mechanical device). Use proper lifting techniques, lift with legs, keep back straight, and carry object close to body.	
	Struck by shovel		When shoveling, know area of shovel movement is clear from people or objects. Do not use shovel in the direction of people and objects. If in area of shoveling, do not approach shoveled area unless they acknowledge you and stop working.	
On-Site Edits:				
Installing Well Pad Frame	Cutting Wood Frame	M	Wear cut-resistant gloves (Level 2), keep fingers and other body parts away from blades, watch for jumping of saw, work in area where other employees will not enter	L
	Injury from assembling well frame		Wear cut resistant gloves at all times and watch hand placement to avoid sharp edges and pinch points. Keep face, hands, fingers, and feet out of the line of fire of moving parts and tools	
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** ***(initial)***	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Pouring and Troweling Concrete Pad	Exposure to cement dust and mixed cement, skin, eye, and inhalation irritation.	M	Refer to the SDS for use information. Wear long sleeved shirt, long pants, gloves, and safety glasses. Wear a P, N, or R-95 dust respirator when dealing with dry cement (moving bags, pouring, mixing, and putting bags in trash).	L
	Back or muscle strain		Keep shovel loads and twisting motions to a minimum. Do not lift anything over 50 lbs. without assistance (partner or appropriate mechanical device). Use proper lifting techniques, lift with legs, keep back straight, and carry object close to body.	
On-Site Edits:				

Additional Notes

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All Employees

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

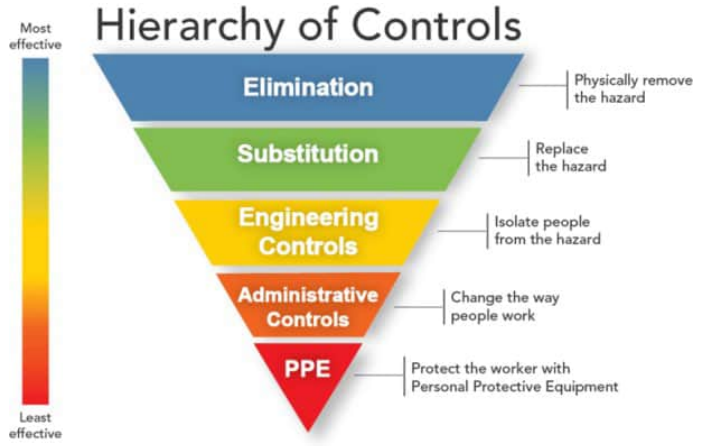
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Probability	Severity				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	25	20	15	10	5
4 – Probable	20	16	12	8	4
3 – Occasional	15	12	9	6	3
2 – Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Supervisor or equivalent
10 to 25 (High)	Risk requires the approval of the Project Manager & SH&E Director

Send THA improvement suggestions to
DCSA.THA.Library@AECOM.com
Include a copy of the new THA or a photo of the THA modifications as appropriate.

Severity – Potential Consequences				
	People	Property Damage	Environmental Impact	Public Image/Reputation
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

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Americas

Task Hazard Assessment

S3AM-209-FM6

Instructions

1. **This form or other applicable region- or business line-specific form is to be completed in accordance with SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.**
2. **Task Hazard Assessments (THA)s are required for any field work involving AECOM activities outside of the office and must be used onsite to review site hazards and confirm necessary controls are in place.**
3. **The THA must be reviewed in its entirety and modified at the work site (as needed) immediately prior to commencement of work to account for actual conditions and any changes (weather, scope of work, simultaneous operations, etc.). All necessary revisions must be written on the THA.**
4. **Acknowledgement of THAs must be recorded via electronic or physical signature as part of the Daily Safety Meeting – refer to Daily Safety Meeting – Americas.**
5. **The completed form must be retained in the project files.**

Project Name and Number	91 Leighton Avenue Off-Site, 60788778	**Overall Risk (Highest Post-Mitigation Risk)**	MEDIUM
Task Name	Monitoring Well Construction/Abandonment and development	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☒ Yes – Specify HHT procedure number(s) and any permits/plans:	Click or tap here to enter text.

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☒ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☒ Work boots ☐ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated ☐ Other - Specify: ….	Choose 1 or 2 as required: ☒ Nitrile ☐ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical ☐ Other - Specify: ….	Choose 1 or both as required: ☐ Ear plugs ☒ Earmuffs
	Other:	Click or tap here to enter text.				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Hand tools, Bentonite chips, pump, First Aid Kit, Gas meter, Spill Kit, Decon Supplies, Fire Extinguisher, Traffic cones or other suitable barrier, manhole lifting device, tubing, decibel-meter, surge block, jackhammer, wheel chocks.

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Position equipment over proposed monitoring well location	Back strain or striking other individuals when moving gas powered auger.	**H**	Communicate path of movement to all project personnel. Establish and use agreed upon hand signals during spotting activities. Use proper lifting and turning techniques.	**L**
	Slip, trip, and fall (STF) hazards from uneven or slippery ground		Check walking/movement path for STF obstructions. Conduct pre-site walk with crew prior to drilling and remove or isolate STF hazards.	
	Struck-by, crushed-by, caught-by drill rig.		Communicate path of movement to all project personnel. Establish and use agreed upon hand signals during spotting activities. Always use a spotter(s) to direct movement of drill rig and watch for vehicle and pedestrian traffic. Additional spotter(s) will be used in high traffic areas and in areas with blind spots where traffic is difficult to observe.	
	Contact with overhead utilities.		Keep a minimum of 15 feet from overhead power lines (20 ft. if 230-285 KV, 25 ft. if 285-345 KV, 35 ft. if 345-500 KV) Check HASP to ensure client/site does not have stricter requirements.	
	Hydraulic failure causing release to the environment.		Place secondary containment on ground under rig. Ensure that secondary containment is setup with 'berms/barriers' or containment is securely clipped onto the rig tracks/wheels to protect from any fluid leaking off the plastic.	
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Contact One-Call, private utility contractor, and/or site personnel to locate and mark underground utilities.	Striking unidentified underground utilities could result in explosion, electrocution, injury, death, property damage.	H	Call public utility locating service prior to initiating work activities. Use private locating service to mark out areas on private property. Verify location of utility marks; do not perform intrusive work if utility location marks cannot be found or if marks are destroyed. Preserve utility marks as much as possible. Call to have utilities remarked if unsure as to their location.	L
	Entanglement in rotating parts causing severe injury or death.		Ensure rotating parts are properly guarded. Remove loose clothing and jewelry that could become entangled in moving parts. Use a long handled shovel to remove cuttings from the auger.	
	Noise induced hearing loss from engine.		Measure noise levels with decibel meter or app. Stand 20' away if not involved in the auger operation. Wear hearing protection while equipment is in use.	
	Back strain/ overexertion when unloading equipment		Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds.	
On-Site Edits:				
Commence drilling/augering	Pinch points with auger causing pinch or crush injuries	M	Perform documented review of the manufacturer's safe operating manual. Never place hands, fingers, feet under the bottom of an auger flight, or other location where these heavy items could be set down or could fall suddenly.	L
	Entanglement in rotating parts causing severe injury or death.		Ensure rotating parts are properly guarded. Remove loose clothing and jewelry that could become entangled in moving parts. Use a long handled shovel to remove cuttings from the auger.	
	Noise induced hearing loss from engine.		Measure noise levels with decibel meter or app. Stand 20' away if not involved in the auger operation. Wear hearing protection while equipment is in use.	
	Back strain/ overexertion when unloading equipment		Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds.	
On-Site Edits:				

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Monitoring well assembly and installation	Muscle strain from improper lifting of heavy materials	**M**	Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds.	**L**
	Slip, trip, and fall (STF) hazards from uneven or slippery ground		Check walking/movement path for STF obstructions. Conduct pre-site walk with crew prior to work and remove or isolate STF hazards.	
	Cut/laceration njury from improper tool use.		Do not use tools for unintended purposes (such as a saw to open bags of bentonite instead of an approved cutting tool).	
	Dust inhalation.		Stay upwind whilst pouring materials. Wear a dust mask and minimize dust when pouring powdered bentonite, concrete, or cement.	
	Cutting PVC, cuts, lacerations		Use PVC cutter for cutting PVC, keep fingers and other body parts away from cutting tool blade. Observe blade line of fire. Wear cut-resistant gloves (Level 2)	
On-Site Edits:				
Installation of sand filter pack/bentonite	Injury from cutting bags open	M	Use a safety knife. No fixed-blade knifes allowed on site.. Cut away from the body. Wear minimum Level 2 cut-resistant gloves	L
	Eye and respiratory injury due to dust and other airborne particles		Refer to the SDS for use information. Pour from the upwind side of the well construction activity. Wear long sleeved shirt, long pants, gloves, and safety glasses.	
	Back or muscle strain due to improper load or lifting techniques		Do not lift anything over 50 lbs. without assistance (partner or appropriate mechanical device). Use proper lifting techniques, lift with legs, keep back straight, and carry object close to body.	
On-Site Edits:				

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Inspect Wells (Open and close)	Pinch Points between cover and ground, abrasion while opening lid with ratchet.	L	Use tools to remove the covers. Remove/replace manhole covers so that they do not pinch fingers. Wear leather gloves for this task.	L
	Back Strain		Utilize proper lifting procedure when removing covers – Bend at the knees and lift with your legs rather than bending/lifting with your back. If heavy, use the help of a coworker.	
On-Site Edits:				
Attach pump/surge to tubing and lower in well.	Pinch points between pump and well casing	M	Note and avoid pinch points between pump and well casing. Wear coated nitrile gloves, or leather gloves when handling tubing.	L
	Overhead hazards causing injury to body/hands		Note and avoid overhead hazards. STOP WORK if any utility lines could be contacted.	
	Back strain from lowering pump/surge block into well		If well is at deeper depth to be performed comfortably by one person it may be necessary to use two people to lower the pump. Use a rope attached to the pump to lower, not the tubing.	
	Repetitive Motion injury from moving surging up and down.		Take frequent breaks as needed to prevent fatigue to shoulder/arm/back muscles caused by surging well. Be aware of the signs/symptoms of repetitive stress injuries (tingling, sharp pains, numbness) and report all symptoms immediately.	
On-Site Edits:				

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Bail or pump water from well (incl. removing pump/tubing from well)	Repetitive motion bailing/pumping well.	M	Take frequent breaks as needed to prevent fatigue to shoulder/arm/back muscles caused by surging well. Be aware of the signs/symptoms of repetitive stress injuries and report all symptoms immediately.	L
	Exposure from splashes during bailing/pumping activities.		Wear additional PPE (Tyvek) if deemed necessary, pace bailing actions. Wear eye protection, long pants, nitrile gloves, and steel-toed boots.	
	Spill or release of impacted water.		Have spill pillows/socks available to contain any release or impacted water spill.	
	Slip, trip, fall.		Wear appropriate PPE (eye protection, long pants, leather gloves, long sleeves, steel-toed boots.	
	Back strain.		Use proper lifting technique (lift with the knees) while handling purge water containers/buckets. Secure bucket lids to prevent splashes/spills.	
	Exposure to contaminants.		When removing tubing use nitrile gloves and paper towels (if necessary to wipe down tubing) as removed. Wipe tubing in downward motion.	
	Overhead/Horizontal hazards.		Remove and coil tubing as removed or lay-out on ground surface. Ensure that tubing on ground surface does not hinder any nearby operations.	
	Back strain.		Depending on depth of well, two people may be needed to hold/guide tubing out of the well. Dispose of tubing within a contractor trash bag.	
On-Site Edits:				
Decontamination - Soak/spray durable equipment to prevent cross-contamination between multiple well locations; properly store disposable equipment	Exposure to decontamination chemicals	L	Wear appropriate PPE (eye protection, long sleeves and pants, nitrile gloves, steel-toed boots). Avoid contact with all decontaminated chemicals (Liquinox, Alconox, Simple Green, methanol, and any other solvents used on development equipment). Store decontaminated equipment in clean dry area.	L
On-Site Edits:				

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Well Abandonment - Unload equipment	Cuts or hand injuries from share edges of cutting tools	M	Inspect equipment for damage and sharp edges, replace all broken or damaged equipment. Keep face, hands, fingers, and feet out of the line of fire of moving parts and tools. Wear cut resistant gloves at all times and watch hand placement to avoid sharp edges and pinch points	L
	Back strain/ overexertion when unloading equipment		Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds. If removing from the back of a truck, slide the case to the tailgate and lift from tailgate and not from the side of the truck bed.	
On-Site Edits:				
Well Abandonment - Set up work zone	Broken bones due to contact with vehicle or equipment traffic	M	Establish work zone using traffic control devices, signs, cones, etc. in advance of initiating monitoring well abandonment activities. Restrict access to observers and passersby. Don hi-visible vest.	L
	Sprains, strains or broken ankles or legs due to slip, trip or fall		Maintain housekeeping in work area, do not carry equipment where visibility of ground is impaired, remove or mark all trip hazards in work area. Plan travel path to avoid changes in surface.	
On-Site Edits:				

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Well Abandonment - Mix grout	Injury to back or strain from lifting and mixing and moving equipment	M	Lift with legs and not back. Do not reach or twist when lifting. Make sure you have a clear path to where you are going before you carry heavy objects over distance	L
	Inhalation of airborne particulates		Stay upwind and wear dust mask while mixing grout. Pour grout slowly.	
	Hand injury from tools used to open bags		Use scissors or safety cutters to open grout bags. Fixed open blade knives are not allowed to be used. Cut away from yourself and others. Inspect tools prior to use. Use cut-resistant gloves.	
	Eye or skin irritation from contact with grout		Use tools to mix grout. Add water slowly to avoid splashing. Wear safety glasses and chemical-resistant gloves.	
On-Site Edits:				
Well Abandonment - Fill well annulus or perforated well with grout	Eye or skin irritation from contact with grout	L	Avoid contact with grout. Wear safety glasses and chemical-resistant gloves.	L
	Contact injury from pressurized hose or tremie pipe failure		Inspect hose connections for wear and damage prior to pressurization and pumping grout. Inspect tremie pipe at connections and verify that there are no obstructions in tremie pipe prior to pumping grout. Wear safety glasses and chemical resistant gloves.	
	Slips, trips, and falls due to obstructions and slippery work area conditions		Maintain clean work area free from trip hazards, such as hoses intersecting walking paths. Clean up any splashed or spilled grout immediately.	
On-Site Edits:				

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Well Abandonment - Debris handling and disposal	Cuts and abrasions and pinch points during debris handling	M	Note pinch points and sharp edges on concrete, well vaults, protective casings, metal skirts, and bollard debris and avoid. Don leather gloves	L
	Ergonomic Injury from lifting heavy objects		Stretch before working. Bend at knees and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds	
On-Site Edits:				
Well Abandonment - Position drill rig over pre-cleared borehole in position to tower up mast	Struck-by, crushed-by, caught-by drill rig.	H	Communicate path of movement to all project personnel. Establish and use agreed upon hand signals during spotting activities. Always use a spotter(s) to direct movement of drill rig and watch for vehicle and pedestrian traffic. Additional spotter(s) will be used in high traffic areas and in areas with blind spots where traffic is difficult to observe.	L
	Contact with overhead utilities.		Keep a minimum of 15 feet from overhead power lines (20 ft. if 230-285 KV, 25 ft. if 285-345 KV, 35 ft. if 345-500 KV) Check HASP to ensure client/site does not have stricter requirements.	
	Slip, trip, and fall (STF) hazards from uneven terrain, slick surfaces		Check walking/movement path for STF obstructions. Conduct pre-site walk with crew prior to drilling and remove or isolate STF hazards.	
	Hydraulic failure causing injection injury or release to the environment.		Place secondary containment on ground under rig. Ensure that secondary containment is setup with 'berms/barriers' or containment is securely clipped onto the rig tracks/wheels to protect from any fluid leaking off the plastic. Inspect hydraulic lines. Look for leaks with piece of wood or cardboard – never a body part.	
On-Site Edits:				

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Well Abandonment - Over drill well	Pinch points	H	Never place hands, fingers, feet under the bottom of an auger flight, or other location where these heavy items could be set down or could fall suddenly.	L
	Entanglement causing severe injury/amputation		Ensure rotating parts are properly guarded. Remove loose clothing and jewelry that could become entangled in moving parts. Use a long handled shovel to remove cuttings from the auger.	
	Hearing loss from noise		Wear hearing protection while equipment is in use.	
	Back strain/ overexertion when unloading equipment		Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds. If removing from the back of a truck, slide the case to the tailgate and lift from tailgate and not from the side of the truck bed.	
	Cuts or contusions to hands, fingers or other body parts due to contact with drill rig hammering		Keep fingers and other body parts away from hammer, watch for jumping/shifting of the rig, work in area where other employees will not enter. Wear cut-resistant gloves.	
	Hand injury manipulating rods for perforation process		Watch hand placement to avoid sharp edges and pinch points. Keep face, hands, fingers, and feet out of the line of fire of moving parts and tools. Wear impact resistant gloves at all times	
On-Site Edits:				

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Well Abandonment - Remove well pad & manway	Injury from tool use	M	Look around and behind you before starting. Inspect tools prior to use. Broken or worn tools should be repaired or replaced. Use tools for their intended purpose to avoid unexpected failure. Do not swing or apply tools (sledge hammer, shovel, digging bar) until the area is free of bystanders. Do not use extreme force. Use controlled motions and avoid having prying tools "break free. Don all required PPE.	L
	Slips, trips, and fall injuries		Practice good housekeeping and frequently clear concrete debris. Keep unused tools off the ground. Do not carry debris long distances for disposal; if possible, park support vehicles in close proximity to well.	
	Eye or body injury from flying debris		Observers should maintain 25' distance when breaking up concrete pad. Wear safety glasses	
	Injury to body due to underground Utility Strike		Ensure area of well pad was cleared during underground utility clearance procedure as well as overhead hazards with the drill rig. Verify utilities and the need for any LOTO requirements.	
	Sprains or strains to back or shoulders during jack hammer use		Take breaks from utilizing jackhammer or other hand tools to break out manway. Do not lift anything over 50 lbs. without assistance (partner or appropriate mechanical device). Use proper lifting techniques, lift with legs, keep back straight, and carry object close to body. Don leather gloves, safety glasses, hard hat and hearing protection.	
	Cuts or contusions to face due to contact with debris		When jackhammering, ensure area of debris throw is clear from people or objects. If in area of shoveling, do not approach technician using jackhammer unless they acknowledge you and stop working. Don leather gloves, safety glasses, hard hat and hearing protection.	
On-Site Edits:				

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Backfilling & surface restoration	Exposure to cement dust and mixed cement and asphalt (eye, and inhalation irritation)	M	Refer to the SDS for use information. Mix upwind. Wear long sleeved shirt, long pants, gloves, and safety glasses. Wear a P, N, or R-95 dust respirator when dealing with dry cement (moving bags, pouring, mixing, and putting bags in trash).	L
	Back or muscle strain due to over exertion		Keep shovel loads and twisting motions to a minimum. Do not lift anything over 50 lbs. without assistance (partner or appropriate mechanical device). Use required lifting techniques, lift with legs, keep back straight, and carry object close to body. Don leather gloves.	
	Ergonomic Injury from lifting heavy bagged materials		Inspect bags prior to lifting and carrying heavy bags of topsoil, concrete, or asphalt patch material. Stretch before working. Bend at knees and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds.	
	Injury or property damage from stepping or driving into open holes or fresh fill areas.		Restore areas as soon as practical to avoid leaving open holes. Use traffic control devices, as needed, to prevent vehicles or pedestrians from contact with open holes or newly restored areas.	
	Contact with patch materials and dust.		Avoid creating and breathing dust. Pour from upwind side of hole. Open bag and pour slowly in well ventilated area. Wear goggles/spoggles and leather gloves when handling materials.	
On-Site Edits:				
Fill well with bentonite chips or granules	Respiratory or skin/eye illness from contact with bentonite	M	Avoid creating and breathing dust. Pour from upwind side of well. Open bag and pour bentonite chips slowly in well ventilated area. Wear goggles/spoggles and leather gloves when adding bentonite to well	L
	Slips, trips, and falls due to hydrated bentonite		Maintain clean work area by minimizing bentonite spillage to ground. Immediately clean up any spilled material.	
	Cuts and abrasions and pinch points during debris handling		Note pinch points and sharp edges on concrete, well vaults, protective casings, metal skirts, and bollard debris and avoid. Don leather gloves.	
	Ergonomic Injury from lifting heavy objects		Stretch before working. Bend at knees and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds.	
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Well Pad Construction or replacement - Set up air compressor and equipment	Overturn the air compressor	H	Check to see that ground is stable and level enough to support the air compressor.	M
	Vehicle collision, Unexpected vehicle or equipment movement		Stand clear of moving vehicles, use spotter to direct driver. Communicate with others working in area when moving air compressor to prevent striking others. Properly hitch air compressor to vehicle before relocating. Once air compressor is in position, **place wheel chocks behind wheels to prevent unexpected movement**.	
On-Site Edits:				

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Remove concrete pad with jack hammer and hand tools	Injury from moving heavy loads	M	Use a buddy to move jack hammer.	L
	Slips, trips, and falls		Practice good housekeeping; keep air compressor hoses out of walking paths and frequently clearing concrete debris.	
	Struck by airborne debris		Jack hammer operator must use face shield to protect face from debris while operating equipment. Observers must stand outside established work zone. Wear safety glasses and hard hats to protect against airborne debris from jack hammer or hand tool use.	
	Struck by hand tools		Look around and behind you before swinging sledge hammer to avoid striking others.	
	Release of stored energy in digging bar resulting in fall or struck by injury (bar or concrete pad)		Avoid placing excessive pressure on digging bar when prying out concrete pad (bending the bar) as this could suddenly release stored energy.	
	Dust inhalation		Maintain upwind positioning while operating jack hammer. If excessive dust, wear particulate dust mask to avoid breathing dust.	
	Exposure to noise		Operator and observers must wear hearing protection during jack hammer operations.	
	Burns		Beware of hot surfaces inside compressor housing. Wear leather gloves when touching compressor components.	
On-Site Edits:				

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Mix concrete	Injury to back or strain from lifting and mixing, moving equipment (wheel barrel), cuts/lacerations	M	Use buddy system when lifting materials >50 pounds. Use proper lifting techniques (lift with your legs and arms, not back). Do not reach or twist when lifting. Make sure you have a clear path to where you are going before you carry heavy objects over distance.	L
	Exposure to cement dust and mixed cement, skin, eye, and inhalation irritation.		Stay upwind and wear dust mask while mixing concrete. Refer to the SDS for use information. Wear long sleeved shirt, long pants, gloves, and safety glasses. Wear a P, N, or R-95 dust respirator when dealing with dry cement (moving bags, pouring, mixing, and putting bags in trash).	
	Hand injury		Use proper tools to open concrete bags and mix concrete. Inspect tools prior to use. Wear leather gloves.	
On-Site Edits:				
Pour concrete pad	Muscle strain	M	Use two people to move heavy well materials to avoid muscle strain or back injury. Keep shovel loads and twisting motions to a minimum. Do not lift anything over 50 lbs. without assistance (partner or appropriate mechanical device). Use proper lifting techniques, lift with legs, keep back straight, and carry object close to body.	L
	Slips, trips, and falls		Maintain a clear path when moving well materials from the support vehicle to the drill rig.	
	Injury from improper tool use		Do not use tools for unintended purposes (such as a saw to open bags of concrete instead of an approved cutting tool).	
	Dust inhalation		Wear a dust mask and minimize dust movement when pouring powdered concrete.	
On-Site Edits:				
Mark position of completed well pad and isolate from traffic	Exposure to vehicles	M	Mark wet concrete well pads with cones or other barricades to alert passersby and vehicles to avoid striking newly completed well pad.	L
On-Site Edits:				

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Debris handling and disposal	Cuts and abrasions and pinch points during debris handling	M	Wear leather gloves when handling debris. Be aware of pinch points and rough and sharp edges on concrete.	L
	Injury from lifting heavy objects		Use more than one person to lift/move heavy (>50 lbs.) debris.	
	Injury from improper tool use		Do not use tools for unintended purposes (such as a saw to open bags of concrete instead of an approved cutting tool).	
	Dust inhalation		Wear a dust mask and minimize dust movement when pouring powdered concrete.	
On-Site Edits:				
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Additional Notes

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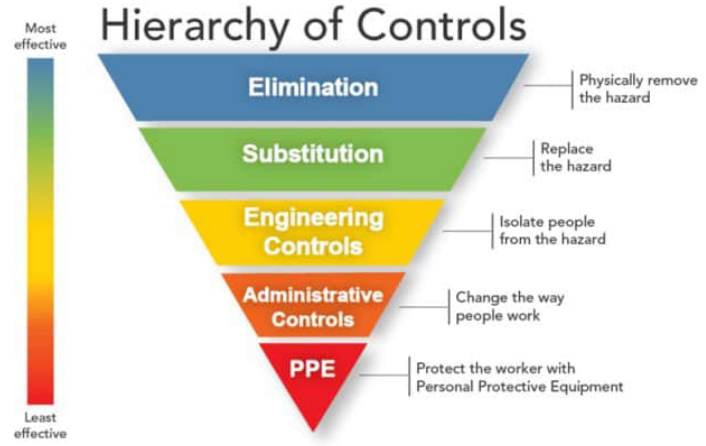
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Probability	Severity				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
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Risk Rating (Probability x Severity)	Risk Acceptance Authority
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Severity – Potential Consequences				
	People	Property Damage	Environmental Impact	Public Image/Reputation
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

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Americas

Task Hazard Assessment

S3AM-209-FM6

Instructions

1. **This form or other applicable region- or business line-specific form is to be completed in accordance with SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.**
2. **Task Hazard Assessments (THA)s are required for any field work involving AECOM activities outside of the office and must be used onsite to review site hazards and confirm necessary controls are in place.**
3. **The THA must be reviewed in its entirety and modified at the work site (as needed) immediately prior to commencement of work to account for actual conditions and any changes (weather, scope of work, simultaneous operations, etc.). All necessary revisions must be written on the THA.**
4. **Acknowledgement of THAs must be recorded via electronic or physical signature as part of the Daily Safety Meeting – refer to Daily Safety Meeting – Americas.**
5. **The completed form must be retained in the project files.**

Project Name and Number	91 Leighton Avenue Off-Site, 60788778	**Overall Risk (Highest Post-Mitigation Risk)**	LOW
Task Name	Monitoring Well Sampling	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☒ Yes – Specify HHT procedure number(s) and any permits/plans:	See Appendix D

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☒ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☒ Steel toe ☐ Composite toe ☐ Metatarsal guard ☐ Electric rated ☐ Other - Specify: ….	Choose 1 or 2 as required: ☒ Nitrile ☒ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical ☒ Other - Specify: Leather	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Knee Pads				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Click or tap here to enter text.

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!			
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Visually clear proposed sampling locations	Exposure to biologic hazards: insects, poisonous plants and animals. Injuries could include anaphylactic shock, allergic reaction, rabies	H	Identify and avoid hazardous plants and animals on site. Look for signs (spider webs, droppings, etc.). Wear cut resistant gloves, insect repellant; use a broom or a rake to move vegetation, not your hand or foot; move slowly	L
	Damage to equipment or vehicles due to surface / subsurface obstructions		Investigate travel path. Look for surface obstructions such as rubble, debris, old foundations or rebar. Use spotter is available or park in such a manner as to not have to back-up.	
On-Site Edits:				
Opening and closing well casings / flush-mount covers and well plug lock	Cuts / lacerations / crushing, bruises	M	Avoid touching sharp materials/ edges. Wear cut resistant ANSI 2 gloves. Keep face, hands, fingers, and feet clear when opening and closing well cover. Inspect ground before kneeling, don knee pads.	L
	Back strain		Stretch before working. DO NOT use awkward positioning. Keep back straight. Take regular rest/stretch breaks. Change position regularly.	
	Vapor exposure resulting in inhalation hazards or illness		Stand upwind from the well opening to avoid vapor exposure. Loosen well cap slowly, keeping control if pressure is released due to vapors. Keep face out of line-of-fire.	
On-Site Edits:				

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Gauge water level of well	Aches and strains from repetitive motion	**L**	Do not use awkward positioning. Keep back straight, take regular rest/stretch breaks. Change position regularly.	**L**
	Exposure to chemical hazards in groundwater resulting in skin irritation or illness		Use smooth movements to avoid splashes. Don nitrile gloves over cut resistant gloves and safety glasses with side shields. Check gloves for damages/ rips.	
	Cross contamination of equipment		Clean the tape and probe using non-phosphate soap and distilled water. Wipe with clean paper towel. Collect decontamination materials for waste disposal. Wear disposable nitrile gloves.	
	Trips / falls from entanglement in measuring tape		Check for location of measuring tape before walking or moving around.	
On-Site Edits:				
Insert sampling device (bailer, tubing, hydrosleeve) into well	Cuts/lacerations/crushing, bruises	M	Avoid touching sharp material/edges. Keep face, hands, fingers feet clear when cutting tubing and setting up equipment. Wear cut resistant ANSI 2 gloves with disposable nitrile over gloves.	L
	Pressurized systems		Bleed pressure off when making connections and disconnections from pump regulator assembly. Check pressures – operate within proper range. Cylinder should be transported upright, secured, with regulator removed.	
On-Site Edits:				

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Sample well	Exposure to chemical hazards in groundwater resulting in splash or inhalation hazard or illness	L	Stay upwind to avoid vapor exposure. Retrieve sampling device at a steady controlled rate to avoid splashing. Wear safety glasses and nitrile gloves.	L
	Cuts/lacerations/bruises to knee (flush mount)		Don knee pads and inspect ground before kneeling down and take frequent breaks to stand and stretch	
On-Site Edits:				
Gather sampling equipment and tools, place in work vehicle	Cuts/lacerations/crushing/bruises from gathering or dropping equipment	L	Maintain a secure grip on equipment and only carry manageable amount of equipment when demobilizing.	L
	Aches and strains from improper lifting		Bend and lift with legs. Keep back straight. Take regular rest/stretch breaks. Change position regularly. Team lift is required for items over 50 lbs (or awkward items)	
On-Site Edits:				
Additional Notes				

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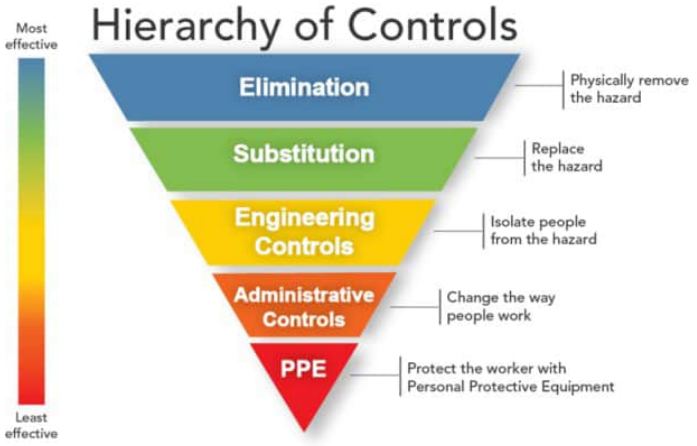
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Americas

Task Hazard Assessment

S3AM-209-FM6

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4. **Acknowledgement of THAs must be recorded via electronic or physical signature as part of the Daily Safety Meeting – refer to Daily Safety Meeting – Americas S3AM-209-FM5.**
5. **The completed form must be retained in the project files.**

Project Name and Number	91 Leighton Avenue Off-Site, 60788778 ….	**Overall Risk (Highest Post-Mitigation Risk)**	MEDIUM
Task Name	Residential Entry/ Work	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-209-PR2.)	☐ No	☐ Yes – Specify HHT procedure number(s) and any permits/plans:	Click or tap here to enter text.

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☐ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☐ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated ☐ Other - Specify: ….	Choose 1 or 2 as required: ☒ Nitrile ☐ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical ☐ Other - Specify: ….	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

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Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Click or tap here to enter text.

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Entering Private Residence	Occupant unaware of upcoming activity	9	Conduct outreach activities consisting of emails to property owner followed up by phone calls to confirm appointment; and track these activities in a log. Confirm owner has received and signed off on acknowledge/ consent form for property access. Have at least two (2) people from AECOM and/or Subcontractor/ NYSDEC enter the residence during activities	4
	Slips/ trips/ falls	10	Inspect and clear walking path prior to entering. Keep one hand free for balance.	4
On-Site Edits:				
Working in Private Residence	Injury from pet (e.g., bite, etc.)	12	Have owner/ occupant restrain pet via leash, cage, etc.	3
	Injury to occupant (e.g., fall, equipment strike, etc.).	12	Make sure occupant(s) are at safe distance from activities.	3
	Injury from improperly stored items/ containers (e.g., spill, etc.)	9	Have owner/ occupant secure items/ containers prior to entering room/ space.	3
On-Site Edits:				

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Leaving Private Residence	Slips/trips/falls	**10**	Inspect and clear walking path prior to leaving. Keep one hand free for balance.	4
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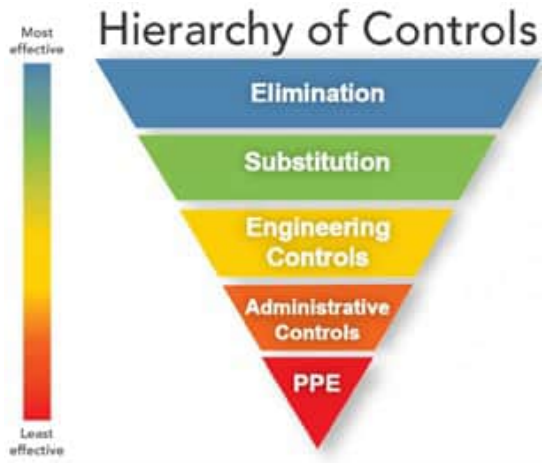
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Send THA improvement suggestions to DCSA.THA.Library@AECOM.com
Include a copy of the new THA or a photo of the THA modifications as appropriate.

Severity – Potential Consequences				
	People	**Property Damage**	**Environmental Impact**	**Public Image/Reputation**
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

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DCSA Environment

Residential Investigations Blanket Delegation Checklist

The Environment Region has a blanket approval to streamline the process when the criteria below are met with respect to the AECOM Approval Matrix triggers for residential investigations. These criteria indicate that a project will be low risk. ORM representative, the Regional Risk Manager, will review the checklist and confirm the opportunity meets the blanket delegation criteria and approve via email. This blanket delegation cannot be used in conjunction for any disaster recovery and responses services (AECOM Approval Matrix 1.1.c). An RFPA will not be needed for this approval.

All boxes must be checked to meet the blanket authorization. Please add comments as needed for clarity.

☐ The scope of work is NOT in support of any disaster recovery or emergency responses services. If the work is in support of any AECOM Approval Matrix 1.1.c trigger scopes, then this delegation does not apply.

Comments: XXXXX

☐ Determine if litigation associated with impacted residential site(s) is imminent and the degree to which the AECOM contract with client indemnifies client for 3rd Party claims.

Comments: XXXXX.

☐ A request for Indemnification will be made of the client (if such protective language is not already part of the contract or MSA). (See Attachment - Liability and Release Agreement).

Comments: AECOM Legal/Risk original request for this (and similar) work was addressed by us including the following in the SoW: "In this Work Assignment, NYSDEC has provided written authorization for AECOM to perform certain vapor intrusion assessment activities, including, but not limited to, subslab vapor sampling and indoor air monitoring. NYSDEC and NYSDOH make the determination of which properties require the assessments."

This public client will not sign the liability and release agreement.

☐ A Site Access Agreement (SAA) will be obtained for each property where work will be performed. The SAA will need to be signed and dated by each party to be considered valid. The strong preference is for the SAA to be between the client and the property owner, rather than between AECOM and the property owner. If the client obtains site access, AECOM should request that the SAA include AECOM and any subcontractors. Should the client be unwilling to secure SSA directly from residential property owner AECOM will request property owner to sign a Preferred SSA that includes a liability release from the impacted resident (See Attachment - Site Access Agreement) before going onto the property. If no Site Access Agreement is in place, AECOM staff will only enter the property under the written authorization of the State or Federal Agency providing oversight.

Comments: XXXXX.

☐ All work will be performed per the provisions of the operative Work Plan or Test Plan.

Comments: XXXXX.

☐ For exterior sample point installation/drilling, appropriate steps will be taken to identify subterranean utilities (e.g., engage Miss Utility or an equivalent service).

Comments: XXXXX.

☐ For interior sample point installation/drilling, appropriate steps will be taken to identify and locate in-slab or sub-slab utilities (e.g., identify exterior points of entry of utility lines to the building, survey slab for floor drains and

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other markers of subsurface utilities). Photographs will be taken of the before and after condition of the floor or slab when installing or removing sampling probes.

Comments: XXXXX.

☐ Field work will follow standard industry practices, as set forth in the standard methods and SOPs.

Comments: XXXXX

☐ Field work will be documented, including date, time, location, conditions, samplers, sampling locations, observations, etc.

Comments: XXXXX.

☐ Site work inside buildings will always involve at least two witnesses: typically, two AECOM staff members. AECOM staff will not work solo or be alone with building occupants.

Comments: XXXXX.

☐ Project team to discuss public engagement and security measures with Global Security and Resilience. Contact GSR@aecom.com to start the conversation in advance of the proposal being submitted.

Comments: XXXXX

☐ If subcontractors are employed, only qualified subcontractors will be used. Our standard subcontract agreement with full flow down provisions will be used.

Comments: Subcontractors are not needed.

☐ AECOM staff will be present and supervise subcontractors if they are performing work within a building at AECOM's request.

Comments: XXXXX

☐ Staff assigned to perform this work will have the requisite experience. The project team will meet prior to starting work to identify actions.

Comments: XXXXX

☐ The health and safety plan will address pandemic procedures, for field teams and any residents encountered, based on the latest guidance and recommendations. The plan must be approved by the appropriate member of the safety team.

Comments: XXXXX

If an opportunity does not meet the above requirements, the opportunity will not meet the blanket authorization. The formal approval process should be followed according to the current AECOM Approval Matrix.

Review and approved by Regional Risk Manager: _____ **Date:** _____

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Americas

Task Hazard Assessment

S3AM-209-FM6

Instructions

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5. **The completed form must be retained in the project files.**

Project Name and Number	91 Leighton Avenue Off-Site, 60788778	**Overall Risk (Highest Post-Mitigation Risk)**	MEDIUM
Task Name	Vapor Sampling	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☐ Yes – Specify HHT procedure number(s) and any permits/plans:	Click or tap here to enter text.

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☐ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☒ Steel toe ☐ Composite toe ☐ Metatarsal guard ☐ Electric rated ☐ Other - Specify: ….	Choose 1 or 2 as required: ☒ Nitrile ☒ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical ☐ Other - Specify: ….	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Click or tap here to enter text.

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt?* *What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Pre-mobilization, Equipment Inspection	Injury from equipment malfunction	M	If using rental equipment, ensure that PM or person responsible for scheduling rental equipment requests that the vendor inspects the equipment prior to site delivery to ensure all appliances are in working order and fit for use	L
On-Site Edits:				

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Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Setup and Use of Hammer Drill	Injury from improper operation	M	Prior to acceptance of equipment from the vendor (if rented equipment), review the operating procedures and maintenance logs with the vendor representative (if applicable).	L
	Contact with cutting tools		Wear appropriate PPE (i.e., eye protection, long pants, nitrile sampling gloves (inner), leather gloves (outer), hard hat, hearing protection, shirt with sleeves, steel-toed boots.) No loose sleeves – may get caught in rotating drill.	
	Noise-related hearing loss		Minimize duration of exposure by taking breaks or alternating operators. Wear hearing protection.	
	Electric shock causing injury or electrocution		Utilize protective equipment as follows: • Plug into GFCI-protected outlet or GFCI-protected extension cord. • Use appropriate gauge extension cord. Amperage issues from electric motor could trip breaker • Make sure cord is in good shape • Ensure water used in coring doesn't affect electric cords or equipment	
	Rotating machinery		Review and understand the following: • Make sure bit is sharp and bit is securely in place. • Place the drill bit on a debris-free level surface before starting. • Make sure drill is straight to ensure a vertical hole is drilled. • Ensure that area is clear of power/extension cords. Position power cords behind body.	
	Flying/shattering objects		Have bystanders maintain a 5 foot distance from the operation at all times. Wear all required	
	Back strain from moving drill		Bend knees to lift out drill out of case to prevent back strain. Stretch before working. Do not use awkward positioning.	
	Strain or sprain from hammer drill binding in hole		Gently and slowly apply force to penetrate the slab surface. **DO NOT FORCE.** Let the drill bit do the work. This is not good for drill bit and may cause machine to bind up. Potential to spin and strain wrists. Let go of drill assembly immediately. If too much force is required then switch out dull bit with new.	
	Hand positioning/pinch points		Use leather gloves to install drill bits and lock in place. While moving drill, keep hands away from the top of the drill bit.	

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On-Site Edits:				
Sub-Slab Vapor Implant Install	Flying debris, caught by/ struck by injuries	M	Eye protection. Utilize Shop-Vac as described in 3a. Clear away anything that has a chance of interfering with the operation. Remove debris that could cause you to slip or lose your balance or accidentally contact the drill bit. Keep hands away from the rotating drill bit.	L
	Wedged drill bit, wrist/back strain		If bit gets stuck in borehole, bend at the knees and apply gentle upwards pressure while turning and moving the drill back and forth gently, keep finger from trigger or unplug. Upon removal, re-drill hole if required	
	Dust from mixing cement		Small amount of cement required for cementing implant in place. Minimize dust while handling and mixing cement. Don nitrile gloves when mixing and handling cement.	
	Noise related hearing loss		Shop-Vac use while vacuuming out any cuttings from hole. Minimize duration of exposure by taking breaks or alternating operators. Wear hearing protection.	
On-Site Edits:				

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Set up sampling equipment	Muscle strain	M	Use proper precautions (lift with legs, not back) when lifting equipment into/out of vehicle. If lifting >50 lbs, use the buddy system. Avoid twisting, stooping, and/or extended reaching positions when handling or moving equipment.	L
	Equipment damage		Use a solid work surface when assembling summa canisters to avoid dropping or damaging equipment. Work from the ground surface, floor, or the tailgate of the truck when applicable. Adhere to laboratory assembly instructions. Use correct size wrenches to connect fittings. Ensure wrenches are properly seated on fittings prior to loosening or tightening fittings.	
	Pinch points, lacerations		Wear leather gloves to prevent hand injury in case the wrench slips off a fitting or while cutting tubing.	
	Tool/equipment failure caused by use		Conduct physical inspection of all equipment. Worn or broken tools should be repaired or replaced.	
On-Site Edits:				
Collect Sample	Injury from poor ergonomics	M	Maintain proper body positioning/good ergonomic form. Avoid stooping and twisting.	L
	Chemical exposure		Stay upwind to avoid vapor exposure. Wear safety glasses and nitrile gloves.	
On-Site Edits:				

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Work area clean-up	Back strain	M	Bend knees to lift equipment and supplies case to prevent back strain. Continue to stretch before lifting. Do not use awkward positioning. Get help for anything >50 lbs.	L
	Pinch points, slips, trips, falls		Wear leather gloves. Practice good housekeeping, have a clear path established.	
On-Site Edits:				
On-Site Edits:				
Additional Notes				

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All Employees

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

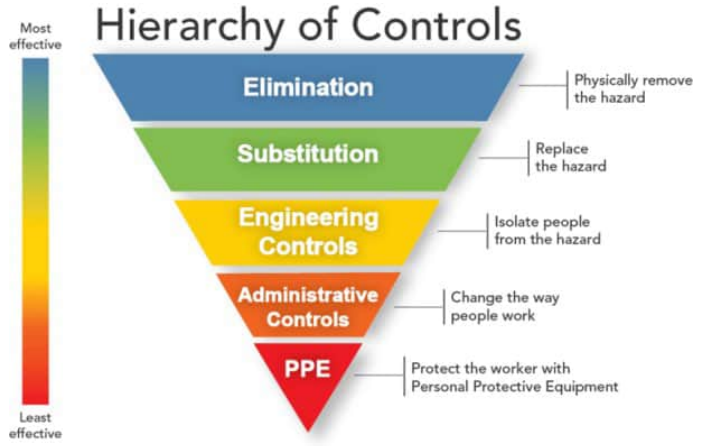
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Probability	Severity				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	25	20	15	10	5
4 – Probable	20	16	12	8	4
3 – Occasional	15	12	9	6	3
2 – Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Supervisor or equivalent
10 to 25 (High)	Risk requires the approval of the Project Manager & SH&E Director

Send THA improvement suggestions to
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Include a copy of the new THA or a photo of the THA modifications as appropriate.

Severity – Potential Consequences				
	People	Property Damage	Environmental Impact	Public Image/Reputation
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

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Americas

Task Hazard Assessment

S3AM-209-FM6

Instructions

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Project Name and Number	91 Leighton Avenue Off-Site, 60788778	**Overall Risk (Highest Post-Mitigation Risk)**	MEDIUM
Task Name	Hand and Power Tools	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☒ Yes – Specify HHT procedure number(s) and any permits/plans:	See Appendix D

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☐ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☐ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated	Choose 1 or 2 as required: ☒ Nitrile ☒ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Click or tap here to enter text.

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt?* *What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Use of tools	Broken bones or cuts due to improper tools for task	**H**	Inspect tools prior to use. Broken or worn tools should be repaired or replaced. Use tools for their intended purpose to avoid unexpected failure. Don leather gloves and safety glasses when inspecting tools.	**M**
	Cuts, contusions or sprains to various body parts due to tool use		Look around and behind you before starting. • Inspect tools prior to use. Broken or worn tools should be repaired or replaced. Use tools for their intended purpose to avoid unexpected failure. • Ensure work area is free of clutter or other workers which may interfere with ability to handle tools safely. • Do not swing or apply tool (sledge hammer, shovel, digging bar) until area is free of bystanders. • Do not use extreme force. Use controlled motions and avoid having prying tool "break free". • Ensure limbs such as hands, and digits such as fingers and toes, are out of the "line of fire" prior to undertaking the task. • Review and understand manufacturer's instructions and ensure they are followed. • Use tools only for tasks they were designed/intended, not as stand-in for tools unavailable. • Don safety glasses, leather gloves	
	Eye or body injury from flying debris		Observers should maintain a 2' distance from the area of work, have donned protective PPE, and are outside of the "line of fire". Remain vigilant as a support to the worker handling the tools, and do not distract or interfere abruptly with that worker.	
On-Site Edits:				

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Additional Notes

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All Employees

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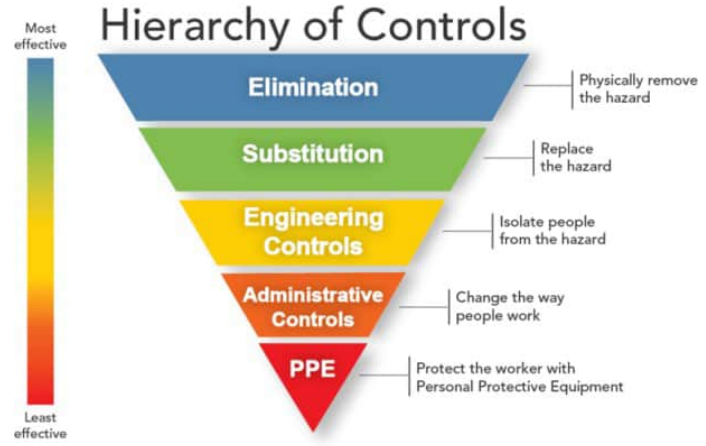
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Americas

Task Hazard Assessment

S3AM-209-FM6

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Project Name and Number	91 Leighton Avenue Off-Site, 60788778	**Overall Risk (Highest Post-Mitigation Risk)**	HIGH
Task Name	Investigation Derived Waste Management	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-216-PR2.)	☐ No	☒ Yes – Specify HHT procedure number(s) and any permits/plans: See Appendix D

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☐ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☐ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated	Choose 1 or 2 as required: ☒ Nitrile ☒ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Click or tap here to enter text.

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Prepare work area	Trips & falls	M	Clear any trip/fall hazards from work area. Scan ground prior to moving or walking	L
	Tools and emergency equipment not present		Obtain tools and emergency equipment and stage adjacent to work area	
On-Site Edits:				
Remove drum lid	Pinch points at drum ring	M	Use socket set to loosen drum ring, avoid placing fingers in to pinch points. Make sure cut-resistant gloves fit properly (not too big so fingertips get caught)	L
	Sharp edges on drum ring or rim		Evaluate rim and ring for sharp edges, avoid handling as much as possible. Wear cut resistant gloves	
On-Site Edits:				

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REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
Load soil into drums	Exertion/sprains/strains	M	Exertion/sprains/strains • Use proper lifting techniques; this consists of bending your knees and lifting with your back straight. • Shovel loads heavier than 50 lbs or awkward to handle use a mechanical loading device or ask for help. • Grasp shovel handle properly: Position one hand at base of shovel handle and your other hand near the top of the handle. • Rotate task with others if needed and take breaks.	L
	Exposure to contaminants		Exposure • Set up upwind of drum. • Wear PPE (e.g., eye protection-goggles, long pants, Nitrile exam gloves, Nitrile over-gloves (11-mil), long wrist) Tyvek coveralls, shirt with sleeves, steel-toed shoes with boot covers, half-face air purifying respirator fitted with an organic vapor, acid, HEPA filter combination cartridge). • Perform air monitoring as per HASP. **STOP WORK** if action level is exceeded.	
	Slips/trips/falls		Be alert for uneven and slippery terrain. Keep tools and equipment away from walking paths.	
	Sharp edges on drum rim		Inspect rim for sharp and rough edges, avoid leaning into drum or placing hands onto rim edge Wear cut-resistant gloves	
On-Site Edits:				

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Replacing drum ring	Pinch Points	M	Use socket set to tighten drum ring, avoid placing fingers in to pinch points. Make sure gloves fit properly (not too big so fingertips get caught)	L
On-Site Edits:				
Moving/relocating drums	Exertion	M	Exertion • If drums must be moved utilize a drum dolly. • DO NOT ATTEMPT TO "WALK" or "ROCK" DRUMS TO MOVE THEM. • Drums can become unstable and easily tip-over causing possible damage and personal injury as well as releasing the material contained.	L
	Trips and Falls		Clear any trip/fall hazards from work area. Scan ground prior to moving or walking	
On-Site Edits:				

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On-Site Edits:					
On-Site Edits:					
Additional Notes					

….

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All Employees

STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

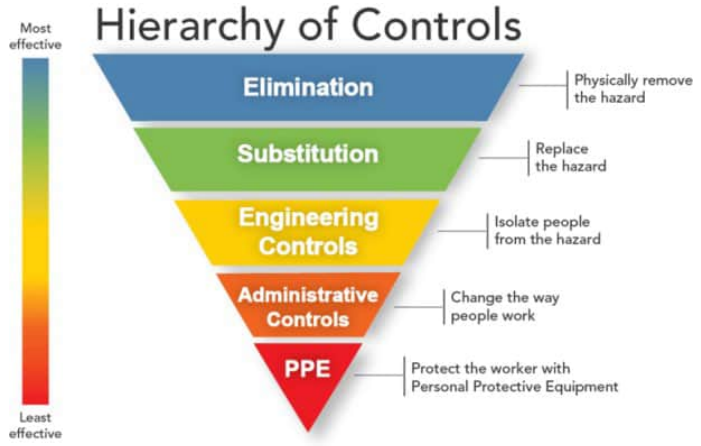
Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories





- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Probability	Severity				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	25	20	15	10	5
4 – Probable	20	16	12	8	4
3 – Occasional	15	12	9	6	3
2 – Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Supervisor or equivalent
10 to 25 (High)	Risk requires the approval of the Project Manager & SH&E Director

Send THA improvement suggestions to
DCSA.THA.Library@AECOM.com
Include a copy of the new THA or a photo of the THA modifications as appropriate.

Severity – Potential Consequences				
	People	Property Damage	Environmental Impact	Public Image/Reputation
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

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Americas

Task Hazard Assessment

S3AM-209-FM6

Instructions

1. **This form or other applicable region- or business line-specific form is to be completed in accordance with SH&E Risk Assessment and Planning – Americas S3AM-209-PR2.**
2. **Task hazard assessments (THAs) are required for any field work involving AECOM activities outside of the office and must be used onsite to review site hazards and confirm necessary controls are in place.**
3. **The THA must be reviewed in its entirety and modified at the work site (as needed) immediately prior to commencement of work to account for actual conditions and any changes (weather, scope of work, simultaneous operations, etc.). All necessary revisions must be written on the THA.**
4. **Acknowledgement of THAs must be recorded via electronic or physical signature as part of the Daily Safety Meeting – refer to Daily Safety Meeting – Americas S3AM-209-FM5.**
5. **The completed form must be retained in the project files.**

Project Name and Number	91 Leighton Avenue Off-Site, 60788778 ….	**Overall Risk (Highest Post-Mitigation Risk)**	Choose an item.
Task Name	Click or tap here to enter text.	**Date**	7/31/2026
Work Location	91 Leighton Avenue, Rochester, NY 14609	**Client**	NYSDEC

Does this include High Hazard Tasks (HHTs)? (Refer to Table 1 of SH&E Risk Assessment and Planning – Americas S3AM-209-PR2.)	☐ No	☐ Yes – Specify HHT procedure number(s) and any permits/plans:	Click or tap here to enter text.

Required PPE	☒ Hard Hat	☒ Eyewear (with side shields)	☒ High-Visibility Vest	☒ Ankle Height Footwear	☒ Gloves	☒ Hearing Protection
	Specify type: ☒ Type I (standard) ☐ Type II (climbing style)	Choose 1 or 2 as required: ☒ Safety glasses ☐ Spoggles ☐ Safety goggles ☐ Face shield	Choose type: ☒ Class 2 ☐ Class 3	Choose 1 or more as required: ☐ Work boots ☐ Steel toe ☒ Composite toe ☐ Metatarsal guard ☐ Electric rated ☐ Other - Specify: ….	Choose 1 or 2 as required: ☒ Nitrile ☐ Cut- resistant ☐ Thermal ☐ Vibration ☐ Electrical ☐ Other - Specify: ….	Choose 1 or both as required: ☐ Ear plugs ☐ Earmuffs
	Other:	Click or tap here to enter text.				

Note: Employees must have gloves readily available, even if the task does not require their use.
Note: All employees must wear shirts with sleeves that cover their shoulders and long pants at a minimum.

Tools and Equipment (Examples: air/noise monitoring equipment, tools, generators, traffic control devices, fire prevention equipment, etc.)	Click or tap here to enter text.

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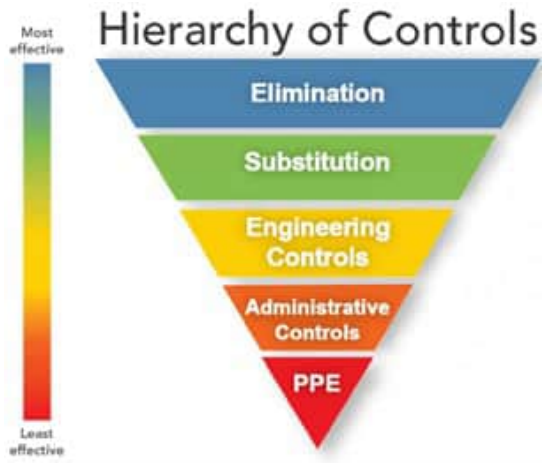
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Daily Safety Meeting

S3AM-209-FM5

Instructions

1. **Complete this form or equivalent in accordance with SH&E Risk Assessment and Planning – Americas S3AM-209-PR2.**
2. **Conduct the Daily Safety Meeting at the start of each shift. Require attendance of all AECOM employees and subcontractors. Invite personnel from simultaneous operations for coordination purposes. Retain the completed form in the project files.**

AECOM Project Manager	Mike Gutmann		**Phone #**	(716) 345-4649	
AECOM SH&E Contact	Caroline Lee (Env East)		**Phone #**	(445) 345-3568	
Meeting Leader	….	**Project Name/Location**	NYSDEC 91 Leighton Avenue, Rochester, NY 14609	**Project #**	60788778
Date	…..	**Today's Scope of Work**	….		
Simultaneous Ops	☐ No ☐ Yes - **Specify impacts:** ….				
☐	**List Task Hazard Assessments (THAs; e.g., FLRAs) completed and reviewed for today's tasks**	….			

Muster Point Location:	**First Aid Kit Location:**	**Fire Extinguisher Location:**	**Spill Kit Location:**
….	….	….	….

1. Required Topics - Employees & Managed Subcontractors (Check if completed)

☐	Fitness for Duty requirements (all sign in/sign out)	☐	Personal Protective Equipment (PPE) (Required items per THAs are in good condition / in use by all.) **Specify Specialized PPE Needs:** ….
☐	Required training (including task specific) completed and current		
☐	SH&E Plan onsite (understood, reviewed, signed by all)	☐	Work area set up and demarcation/ barricades in place to protect workers, site staff, and the public
☐	STOP WORK Right & Responsibility (all task changes/changed conditions must be reassessed with THA)	☐	Short Service Employees (SSE) (mentor/ oversight assignment for employees with less than 6 months experience working in the industry of the work to be performed)
☐	Requirement to report to supervisor any incidents (e.g., injury, illness, damage, near miss, unsafe act / condition)	☐	Required checklists/records available and understood **Describe:** ….
☐	Emergency Response Plan (including muster point, first aid kit, fire extinguisher, and clinic/hospital location)		

2. Discuss if Applicable to Today's Work (Check 'Yes' if reviewed, or 'NA' if Not Applicable. Work marked with [*] is considered high hazard work.)

Yes	NA		Yes	NA		Yes	NA	
☐	☐	Ergonomics (lifting, body position)	☐	☐	Hazardous Substances and Communication	☐	☐	Weather Hazards / Heat Stress / Cold Stress
☐	☐	Biological Hazards	☐	☐	* Railroads	☐	☐	* Hazardous Energy Control
☐	☐	*Ground Disturbance	☐	☐	* Underground Work	☐	☐	* Hand and Power Tools
☐	☐	*Work at Height	☐	☐	*Confined Spaces	☐	☐	* Working On, In or Near Water
☐	☐	*Highway & Road Work	☐	☐	*Heavy Equipment & Machines	☐	☐	Subcontractor Management (Review subcontractor plans and THAs)
☐	☐	* Required Work Permits/Plans are in place and understood. **Identify/ attach:** ….	☐	☐	Other Topics **Describe/ attach:** ….	☐	☐	Client Specific Requirements **Describe/ attach:** ….

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3. Daily Check-Out by Site Supervisor

Describe incidents, near misses, observations, or Stop Work interventions from today	....	**Describe lessons learned / improvement areas from today**	....

The site is being left in a safe condition and work crew checked out as fit unless otherwise specified as above.

....		....
Site Supervisor Name	**Signature**	**Date/Time**

4. Worker Acknowledgement and Sign In/Sign Out

SITE WORKERS (including AECOM Employees and Managed Contractors/Subcontractors): Your signature below indicates you understand the requirement to:

- Participate in creating, reviewing, & updating task hazard assessments (THAs) for all your tasks.
- Understand and continuously reassess tasks, hazards and mitigations, amending THAs as needed.
- Follow permit to work requirements if applicable to the work you are about to perform.
- Communicate any changes in personnel or conditions at the worksite to the supervisor.
- Exercise your authority and obligation to "Stop Work", intervene, and speak up / listen up if you are concerned or uncertain about safety or hazards, or if additional precautions are not recorded on the THA.

  Note: If you identify an imminent danger related to a contractor for which AECOM does not have contractual oversight, remove yourself and communicate your concerns to the contractor, site representative, and AECOM management immediately.

Your initials below certify you arrived and departed fit for duty, and have reported all incidents/near misses, meaning:

- You are physically and mentally fit for duty and have inspected your required PPE to ensure it is in satisfactory condition.
- You are not under the influence of any medication, drugs, or alcohol that could affect your ability to work safely.
- You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred); or impairment/fatigue issue to the AECOM Supervisor.
- You signed out as fit and uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
....		In & Fit	Out & Fit ....
....		In & Fit	Out & Fit ....
....		In & Fit	Out & Fit ....
....		In & Fit	Out & Fit ....
....		In & Fit	Out & Fit ....
....		In & Fit	Out & Fit ....
....		In & Fit	Out & Fit ....
....		In & Fit	Out & Fit ....

Attach additional Site Worker sign-in/out sheets if needed. Identify the number of attached sheets: ....

5. Site Visitor / Site Representative Sign In/Sign Out

Print Name & Company	Signature	Arrival Time	Departure Time
....		....	....
....		....	....
....		....	....
....		....	....

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Appendix D Applicable SH&E Procedures

Safety Health and Environment

1. Purpose and Scope

The purpose of this procedure is to define methods for project execution in accordance with the AECOM Global Corporate SH&E policies and programs. It has been developed to enable EC employees, to fully understand, and commit to this corporate responsibility.

All EC Employees are required to comply with and ensure adherence to fundamental office safety, health, and environmental requirements. When EC staff are seconded to a Lead Team office, they will work under the Lead Team office SH&E Management System.

This procedure applies to all projects undertaken by EC and all EC offices, and is based on five areas of emphasis:

a. Management Leadership: As one of the 9 AECOM life preserving principles, the importance of our leadership team to exhibit safety as a core value is paramount. There are specific responsibilities for management outlined herein.

b. Safety for Life: AECOM's "culture of caring" sets the vision and expectation for each employee, contractor, and business partner to take personal responsibility for keeping ourselves, colleagues, and others associated with our work safe and personally adopt safety as a core value. "Safety for Life" defines our commitment to achieving zero work-related injuries and/or illnesses, preventing damage to property and the environment, and maintaining an environment friendly and sustainable workplace.

c. Planning: A comprehensive action plan supporting SH&E Policy – AECOM Global objectives is provided.

d. Implementation and Operation: Systematic controls for implementing the SH&E Management System are provided. Training for effective SH&E implementation will be provided.

e. Monitoring and Continuous Improvement: SH&E performance is continuously monitored and evaluated. Corrective action is taken as appropriate.

f. Management Review: SH&E performance is reviewed on an on-going basis by EC senior management to assure continuous improvement and application of best practices.

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2. Procedure

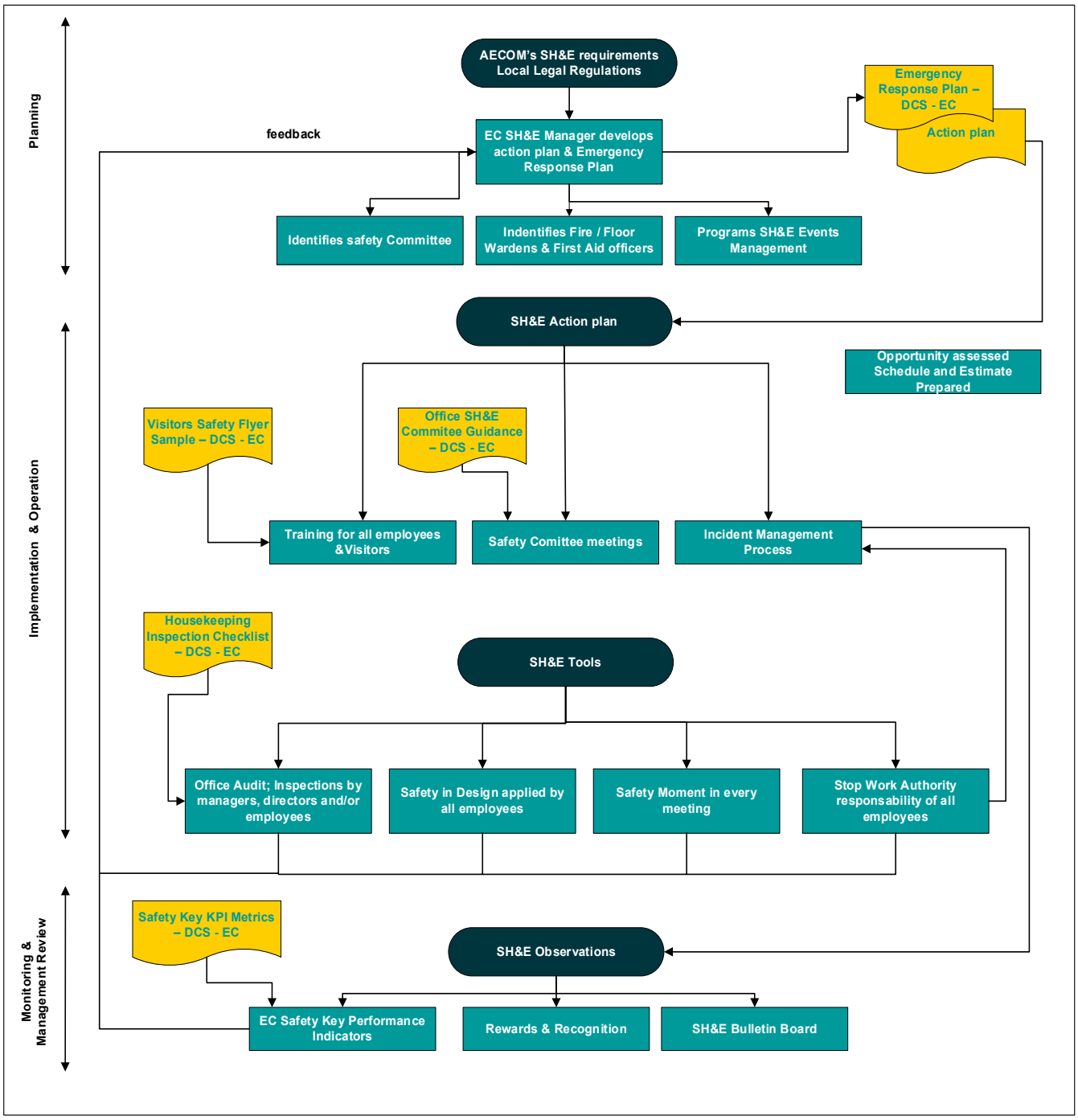


Figure 1 SH&E Processes and Tools

All employees are expected to promote safety, perform, and document safety inspections, and implement appropriate corrective actions to minimize risk and enhance SH&E performance. Each office shall assess the potential for violation and establish appropriate security procedures consistent with building manager's protocol.

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3. Terms and Definitions

a.	Emergency Response Plan	A Specific Emergency Response Plan shall be developed at each EC office for an emergency evacuation of the office. All employees shall be familiar with the Emergency Evacuation Plan as part of their Induction Training. They shall know what to do in an emergency and how to obtain assistance, and follow the directions provided by the floor wardens and proceed to the designated assembly area. In the event of: – natural disasters, fire, medical incident, hazardous chemical spill, elevator malfunction, security incident, power failure, or any other situation which you judge as an emergency – notify your Supervisor and SH&E Manager as soon as practicable. SH&E Manager shall ensure that the appropriate resources are allocated and that the Emergency Response Plan is implemented. EC Leadership will decide the need for periodical testing across each office. Refer to Emergency Response Plan Template – DCS – EC.
b.	Fire / Floor Wardens and First Aid Officers / Providers	In the event of a medical, fire, or natural disaster emergency, fully trained and competent First Aid Officers and Floor wardens are to be in their designated location to provide assistance. In some localities, the property management provides appropriately trained Floor Wardens. A legible copy of the list of floor wardens (Fire Marshals & First Aiders) shall be maintained at respective EC office location by facilities discipline. Floor wardens shall be easily identified by a high visibility vest or other similar highly visible identification. A legible copy of list, inventory, and distribution record of First aid kit shall be maintained at respective EC office location by facilities discipline. Purchase of First Aid Kit shall be from an approved source.
c.	Safety Key Performance Indicator Metrics	Metrics established by EC Management for implementation, monitoring, and continual improvement of SH&E at EC offices. Refer to Safety KPI Metrics– DCS – EC. The leading metrics target is set by the local safety team in conjunction with EC management. However, the lagging metrics is governed by the regional AECOM SH&E guidelines.
d.	Safety Committee	The Safety Committee is a group of employees chosen to represent SH&E principles at each EC. They shall meet periodically to help assure that our "Safety for Life" commitment is visible to all employees, to collect and make decisions to ensure offices are safe places to work and uphold and proactively manage SH&E concerns with the collaborative participation of all employees. Refer to Office SH&E Committee Guidance – DCS - EC.
e.	Safety in Design (SiD)	Safety in design shall be incorporated in the design and building aspects of facilities, structures, and processes to minimize risk to people, and capitalize on intrinsic efficiencies of an enhanced design process from concept to completion, including proposals and marketing, engagement of sub-consultants, and subsequent operation.
f.	ESG/Safety Moment	Every meeting of five or more attendees (employees and non-employees) shall start with a Safety or Wellbeing Moment intended to share a Safety topic with all attendees. Meeting organizers are responsible for identifying an attendee to present or facilitate the Safety Moment (preferably other than an SH&E professional). Meeting agendas shall identify Safety Moments as a meeting item and meeting minutes shall include the Safety Moment topic.

g.	SH&E Bulletin Board	Bulletin board dedicated to SH&E showing updated, relevant materials regarding Life-Preserving Principles as well as any other local legislative or geography-specific information. All postings shall be in the appropriate local language and in English.
h.	Management Sponsored SH&E Events	EC provides an environment where employees are encouraged to voice their concerns on any SH&E issues within the business through participation in SH&E campaigns and awareness programs. Safety communication and advisory shall be shared with employees to keep them informed of SH&E matters that may contribute to maintaining a safe and healthy working environment. From time-to-time management will sponsor various communication and participation events to highlight various SH&E topics and help improve the overall core value of safety. Employees with suggestions about such events should use the employee observation box or speak directly to their supervisor.
i.	Stop Work Authority	All employees have the responsibility and authority to stop work by using the Safety Time-Out card if they believe a danger exists for any persons, property, or the environment in any kind of work. Prior to commencing a formal Stop Work, the affected employees shall immediately discuss the concern and attempt to remove, mitigate, or isolate the hazard in coordination with the supervisor and SH&E manager. Work associated with the affected area or operation shall not resume unless all corrective actions identified have been resolved to an acceptable level. Employees shall never be penalized for exercising their responsibility to Stop Work.
j.	Observation and Incident Management Process	Observations and Incidents shall be reported by employees. AECOM makes available to all employees a reporting system which encourages the raising of observations related to safe/unsafe behavior/condition or other SH&E incident. Employees may raise an observation related to SH&E in several ways, including online (Lifeguard tool on Ecosystem), Safety Observation Cards, or even verbally with their supervisor or local office management. Employees may report an incident through IndustrySafe. Refer to the SH&E Management System Manual – AECOM Global for incident management.
k.	Visitors Safety	Visitors shall be made aware of the Emergency Response Plan. Offices shall have identifiable means of designating office visitor(s). The badge is used to identify visitors and shall be worn for the duration of the visit. Refer to 208-02, Visitor Safety Flyer Sample.
l.	Office Audits	Periodic office inspections shall be performed, preferably on a twice monthly basis as well as prior to the occupation of any new facility, when new tasks that were not previously performed at this location are now performed, when new hazards are introduced to the office environment, or when office conditions or local regulations require an inspection. Actions to eliminate or reduce hazards and risks are to be implemented immediately or referred to the Safety Committee and/or Senior Management dependent upon severity. All inspections and walkthrough shall be documented and retained as required. Refer to Housekeeping Inspection Checklist – DCS - EC.
m.	Senior Management Safety “Walk Downs”	A periodic “walk down” of the work areas shall be made by senior management. Best practice is to have an employee accompany the senior manager during the safety “walk down.” Please utilize LifeGuard for Senior Management Assessment.

n.	Rewards & Recognition	All levels of supervision are encouraged to recognize the SH&E initiatives, milestones, and efforts made by those who work with them on an ongoing basis. This recognition could be publicly thanking an employee. This recognition may also include team, project, and office recognition of achievements in SH&E

4. References

a. SHE Policy – AECOM Global S1-001-PL1

b. Safety, Health and Environment Management System Manual – AECOM Global S2-001-SM1

c. Life Preserving Principles – AECOM Global S2-001-WI1

d. Safety for Life Program - Ecosystem.

e. Project Document and Records Control - DCS Q2[DCS]-222-PR1

f. Office SH&E Committee Guidance – DCS – EC S4[DCS](EC)-001-WI1

g. Visitor Safety Flyer Sample – DCS – EC S4[DCS](EC)-013-WI1

5. Records

Copies of all SH&E Management System documents and data shall be managed and retained in accordance with Safety Key Performance Indicators Metrics – DCS – EC.

a. Housekeeping Inspection Checklist – DCS – EC S4[DCS](EC)-013-FM1

b. Emergency Response Plan – DCS – EC S4[DCS](EC)-209-FM1

c. Visitor Safety Flyers

6. Issue Authorization and Maintenance for Use

The applicable EC Functional Leader is responsible for the maintenance of this procedure and will review the procedure annually to determine any necessary updates. Should an individual employee have a suggestion for improvement or modification to this procedure, they may mark-up a copy of the document and send to the applicable EC Functional Leader for review. Changes to the procedure will be distributed to other functional leads for their input prior to finalizing changes to this procedure.

7. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	05-Dec-2022	Initial release as S4[DCS](EC)-001-PR1	All
1	14-Oct-2024	2024 Review; updated references by removing the “GEP” number from titles and linking to “DCS” level Quality Management procedures and forms as part of the EC/DCS Integration project; minor edits and updated links.	Section 3, 4, 5

AECOM

AECOM Global

Minimum Global Safety, Health & Environment Requirements

S2-001-WI3

Table of Contents

0. SH&E Essentials 1

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Global

Minimum Global Safety, Health & Environment Requirements

S2-001-WI3

Global Safety, Health and Environment (SH&E) requirements have been developed and shall be implemented as the minimum requirements to be met by AECOM operations. Global SH&E documents are identified with document numbers beginning with S2. Supplementary SH&E procedures to the Global SH&E Requirements shall be developed and implemented when additional detail is necessary based on differences in services offered by Business Lines, and in laws and statutes across geographies and regions. These supplementary SH&E procedures are identified with document numbers beginning with S3 for documents applying to the super-geographies, (Americas [AM], Asia-Pacific [APAC], Europe, Middle East & Africa [EMEA]), and with S4 for Region, Business Line, or country-specific documents.

The Global SH&E Requirements are as follows:

0. SH&E Essentials

0.1 Stop Work

a. All employees have the authority and responsibility to stop work if SH&E is being compromised without fear of reprisal or retribution. Nothing is ever so urgent or important that we cannot take the time to do it safely.

b. Work associated with the affected area or operation will not resume unless the corrective actions identified have been resolved to an acceptable level and management approval obtained to restart.

c. AECOM's Safety Red Card is a tangible reminder of stop work authority for AECOM employees and subcontractors. The cards are designed to be paired with Company and / or customer ID badges; every employee shall have or have access to their own Red Card. An equivalent tool shall be established where the red card cannot be used (e.g., cultural significance of red, conflicts with client badging, etc.).

0.2 Induction / Orientation and Training

a. Each employee shall be trained and competent to perform tasks that may impact on SH&E in the workplace and as required by legislation, company procedures and client expectations.

   i. Assessment of competence and training will consider responsibility, ability, literacy and exposure to risk.

   ii. Comprehension of training shall be appropriately verified (e.g., demonstration of skills, quiz, etc.).

b. Potential employees are required to bring evidence of their qualifications to job interviews. Project Managers or supervisors, in coordination with Human Resources (HR), use employee training records and resumes to confirm potential employees have the required skills, knowledge, training and experience for the proposed tasks. Where appropriate, resumes are included in job tenders for client perusal.

c. Within one week of starting at AECOM, project managers or supervisors are responsible for ensuring each new employee receives induction / orientation training to set the expectations of the AECOM Safety for Life program including incident reporting, stop work authority, accessing SH&E resources and tools, and a clear expectation of zero injuries.

d. Employees shall also complete any applicable site-specific field or office orientations.

e. Supervisors shall confirm visitors complete an orientation appropriate to the location or site they are to visit, supplemented by appropriate visual material (e.g., handout, iPad, etc.) and subsequently abide by AECOM SH&E policies and procedures when visiting our premises or sites.

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f. Visitors to AECOM premises or sites shall be escorted by an AECOM employee who shall confirm local security arrangements are applied, appropriate Personal Protective Equipment (PPE) is provided, and the visitor is aware of SH&E management requirements, including those for emergency response and incident reporting.

g. Project Managers and Supervisors shall complete appropriate training to support AECOM's Culture of Caring and to enable effective execution of our Safety for Life program.

h. The responsibility for ensuring that employees receive adequate SH&E training rests with the operation leaders based on the requirements of these minimum requirements and the jurisdiction's applicable SH&E procedures.

    i. Supervisors are responsible for confirming that each employee within their direct control is competent to undertake their job as specified.

    ii. AECOM Regional and Business Line leadership shall develop a training matrix for employees of their area of responsibility. Managers are required to arrange the appropriate training as identified in the training matrix and on a timely basis (e.g., upon hire, or upon commencement of a new task).

    iii. On-going employee competence and training needs are assessed as part of our annual performance and review process.

    iv. SH&E training needs may also be identified through individual risk assessments, incident investigations, observed non-compliance, or when procedures change. As required, appropriate training will be arranged, and may be provided through AECOM University courses, safety meetings, and / or classes delivered by internal or external providers. Employees identifying a particular training requirement are expected to discuss this with their managers if the requirement cannot wait until their next appraisal.

    v. Employees are encouraged to take part in continuing professional development activities to enable retention, competency, and remaining abreast of emerging techniques and processes.

i. Supervisors shall confirm employee training is adequately documented and records are maintained.

0.3 Newly Hired or Transferred Employee

Employees who have been newly hired or transferred to a different position in the company shall be:

a. Trained to AECOM procedures and client requirements prior to performing work.

b. Supervised by a competent person.

c. Visually identifiable and their presence in field locations recorded.

0.4 Fit for Duty

a. Employees shall come to work in a fit state that does not place themselves or others at risk due to physical, mental, and emotional factors.

b. Employees who come to work in an unfit state shall inform their supervisor so that adjustments to their activities can be made accordingly. This may include but is not limited to:

    i. Temporary conditions (e.g., fatigue, stress)

    ii. Physical limitations (e.g., eyesight, hearing, flexibility, lifting restrictions)

    iii. Cognitive limitations (e.g., brain damage)

    iv. Psycho-social factors (e.g., depression, anxiety, fears)

c. Employees who observe another employee that may be working in an impeded manner or unfit state are expected to inform a supervisor immediately.

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d. Employees who have experienced an off-the-job injury should consult their supervisor, Human Resources (HR) business partner and/or AECOM's Occupational Health Team for assistance in assessing their scope of work to determine any potential for risk of further complications. Adjustments to activities may be appropriate to facilitate a return to full health.

e. Specific work environments and/or activities may warrant a fitness for duty assessment program to assess employees' / candidates' fitness for duty prior to assignment to identify potential physical, mental, and emotional risk to the individual, and to take appropriate action given the identified risk.

   When risks indicate a fitness for duty assessment program is necessary, an appropriate program shall be developed specific to that identified risk through consultation with Regional HR, Legal (labor and employment counsel) and SH&E (including the Occupational Health Team) and approved by the applicable Regional Executive and AECOM's Corporate labor and employment counsel. Programs shall identify:

   i. Assessment requirements (including methods to restrict results to those needed to assess the risk).

   ii. Involved parties and associated responsibilities.

   iii. Methods to maintain confidentiality in accordance with Global Privacy Notice – AECOM Global.

   iv. Actions appropriate to the assessment results and the risk prior to assignment (e.g., who is consulted when a risk to the individual is identified).

   v. Fitness for duty assessment prior to assignment shall involve informing the employee / candidate of the work environment and/or activity's exposures and expectations.

f. Where an incident has occurred and there is reason to believe the individual may not have been fit for duty the local SH&E team and HR business partner shall be contacted immediately.

0.5 Fatigue Management

a. The responsible manager or supervisor shall assess the activity and task specific risks, duration and exertion level as appropriate, and mitigate them to an appropriate level to enable the employee to effectively manage fatigue hazards.

b. Employees shall work within prescribed guidelines, including a maximum of 14 hours a day, 60 hours a week, unless additional risk management strategies are implemented, such as increased supervision or additional rest breaks, to combat the effects of fatigue.

c. The SH&E Plan shall address fatigue issues as part of the risk assessment.

0.6 Drugs & Alcohol (Including Prescription Medication)

a. AECOM prohibits employee use, possession, presence in the body, distribution, manufacture, concealment, transportation, promotion or sale of the following items or substances when providing services on behalf of AECOM or when on or in AECOM / client property:

   i. Illegal drugs (or their metabolites), designer and synthetic drugs, mood- or mind-altering substances and drug use related paraphernalia unless authorized for administering currently prescribed medication.

   ii. Controlled substances that are not used in accordance with physician instructions or non-prescribed controlled substances.

   iii. Alcoholic beverages while at work or while on any customer or AECOM controlled property. This prohibition on alcohol applies whenever an employee is on-duty, including during meal or break periods, while on Company premises, or while representing AECOM. AECOM may make exceptions and permit the consumption of alcohol beverages at work-related events, such as Company-sponsored or approved business meals, conferences, or holiday events. Employees who choose to consume alcohol on approved occasions are expected to exercise good judgment and to refrain from becoming intoxicated or impaired. If an employee has consumed alcohol and needs transportation home, the Company will reimburse the cost of a taxicab or other reasonable costs of transportation so that the employee may avoid driving.

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b. AECOM does not prohibit lawful use and possession of current medication prescribed in the employee's name or over-the-counter medications. Employees are expected to consult with their health care provider about any prescribed medication's effect on their ability to perform work safely and/or any associated work restrictions.

c. An employee whose ability to perform work safety may be impaired due to consumption of a prescribed or over-the counter medication shall disclose to their supervisor, HR business partner, or Occupational Health Team, only those effects or restrictions applicable to safe performance of work.

0.7 Emergency Planning

a. Each AECOM office and worksite SH&E Plan shall include a site-specific Emergency Response Plan (ERP) suitable to the location and local requirements. The author of the ERP shall check with applicable stakeholders (e.g., client, site owner, building manager, landlord, etc.) regarding the various parties' current emergency procedures and will incorporate these, as appropriate, into the AECOM Emergency Response Plan.

b. Project Managers are responsible for emergency planning regarding SH&E risks on project work and for recording their arrangements within the project documentation. Plans shall include confirming appropriately trained personnel are on site as required, and emergency equipment and supplies are available and in operable condition. Inspection, testing and maintenance of emergency and first aid equipment shall be identified, scheduled and undertaken in accordance with local legislative and manufacturer requirements. Affected personnel shall be briefed on the arrangements, trained in their roles and responsibilities, and be knowledgeable about alarm and communication requirements. Testing and evaluation of the plan is achieved through review of actual incidents and mock drills.

c. SH&E Plans shall comply with client requirements and specifications, shall be appropriately posted, and will typically contain the following:

   i. Reporting Procedures for Fires, Environmental Incidents and Other Emergencies.
   ii. Alarm System and Security Measures.
   iii. Evacuation Routes, Assembly Points, Shelter In Place Procedures.
   iv. Extreme / Severe Weather Planning.
   v. Natural Disaster Planning (e.g., earthquake, flood, etc.).
   vi. Critical Equipment / Operations Procedures.
   vii. Assisting Disabled or Medically Restricted Personnel.
   viii. Personnel Accounting Procedures.
   ix. Rescue and Medical Duties.

d. Emergency response personnel (e.g., evacuation coordinators, first aid responders, fire wardens, etc.) shall be identified in accordance with potential emergencies, legislation, and requirements of the site-specific SH&E Plan.

e. The number of first aid persons / appointed persons and standard of qualifications will differ due to the varying risk level associated with different environments and activities. First aid or appointed persons shall be identified to meet first aid requirements in accordance with legislation and the requirements of the site-specific SH&E Plan.

0.8 Incident Reporting, Notifications, Investigation, and Injury Management

a. All work-related injuries, illnesses and incidents, including those of employees and subcontractors under direct AECOM control, shall be reported to an AECOM supervisor immediately. Any associated regulatory notification requirements of the applicable jurisdiction shall be met.

b. Injuries, illness and incidents shall be entered into IndustrySafe using the initial incident form within one business day of the event.

c. For company-wide SH&E statistics, OSHA recordkeeping requirements shall be used in all Regions / Business Lines. To comply with local regulations, additional SH&E reporting and statistics may be required to be maintained.

d. Where required, injury logs shall be signed by senior management of Operations.

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e. A formal investigation process (e.g., Why Tree, 5-Why) shall be utilized to determine root causes and contributing factors for all recordable and high potential incidents ([HiPos] assessed at a risk rating of 10 or above using the AECOM Risk Matrix). Refer to section 'Hazard Identification & Risk Management' for an explanation of the AECOM Risk Matrix.

f. All records applicable to an incident shall be retained as defined in the AECOM Records Retention Procedure and as necessary to manage any future action associated with the incident.

g. Executive Incident Reviews shall be performed for all high potential or high actual consequence (HiPo) incidents.

h. The Executive Incident Review (EIR) shall be presented by the respective Project Manager to the appropriate executive / leadership (Geography, Business Line, Region, Legal, Human Resources, etc.) and Regional SH&E Director. The following table provides direction concerning EIR content:

Required EIR Content
Cover slide
Project Description / Scope
Incident Summary - Overview and Actual Risk
Investigation - Investigation Team / Interviewees
Investigation - Applicable Photos / Sketches
Investigation - Timeline / Details
Immediate Incident Response and Care Management
Ongoing Care Management
Why Tree or other Root Cause Analysis
Results - Corrective and Preventative Actions
Results - Lessons Learned Summary
Discussion / Questions / Comments

Optional EIR Content
Agenda
Invitee Guidance
Incident Summary - Potential Risk
Incident Summary - Involved Employee Background
Investigation - Hazard Assessment (Photo of document)
Investigation - Project Planning & Execution Efficacy
Results - Cost
Invited / Attended

i. Injuries shall be managed in accordance with the procedure(s) applicable to the jurisdiction.

j. When possible and unless restricted by local regulation or law, labor agreement or client provided treatment, a supervisor (or designee) should escort an injured employee to the initial physician visit. The Supervisor shall confirm that the Company's return to work policy is followed and assist in communication between the injured employee and management.

0.9 Ground Transportation / Motor Vehicles

a. When traveling for business purposes (excluding commute to and from work), two-wheeled modes of transportation (e.g., bicycles, motorbikes, etc.) are prohibited unless specified and approved in the applicable SH&E Plan.

b. The below requirements apply to employees who operate motor vehicles that are owned, rented, or leased by AECOM and to employees who use personal, client or government-supplied vehicles while conducting AECOM business.

   i. Motor vehicles shall be selected, equipped, operated, and maintained in a way that protects personnel from harm.

   ii. At-risk driving behavior by AECOM employees shall be identified and managed appropriately (e.g., retraining, driving restrictions, disciplinary action, etc.).

iii. Motor vehicle operators shall adhere to all local laws including, signs, postings, regulations, ordinances, and codes applicable for the jurisdiction in which the motor vehicle is being operated.

iv. Commercial motor vehicles and operators are required to meet the jurisdiction's applicable commercial motor vehicle regulatory requirements.

v. Only licensed and appropriately insured drivers, who are fit for duty, shall operate a motor vehicle.

vi. Travel shall be assessed to allow for safe management of the journey.

1. Drivers who are to undertake trips in excess of 250 miles (400 km) each way, drive in remote or hazardous areas, or when otherwise deemed necessary, shall develop and document a Journey Management Plan.

2. Plans typically include the route, location of route hazards, timing, rest periods and locations, communications, emergency response and security arrangements.

3. Appropriate planning shall include, but not be limited to, personal protective equipment, competence in vehicle recovery, positive communications, and ensuring adequate drinking water and supplies are available in the event personnel become stranded.

vii. The use of electronic devices that may distract the driver while driving is prohibited. This includes cell phones, two-way radios and other items whether hand-held or hands-free.

1. GPS units and devices (e.g., smart phones, tablets) used for navigation may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their eyes off the road.

2. Electronic devices shall be setup for operation prior to commencing driving activities and shall not be changed by the driver while driving.

viii. Motor vehicle occupants are required to wear seatbelts at all times when the vehicle is in operation.

ix. When driving in off-road conditions employees shall confirm they have a fit for purpose vehicle and have experience or training for the conditions.

0.10 Consultation & Communication

a. AECOM shall provide appropriate resources, time, training, and methods to facilitate SH&E communication and consultation between management and employees. Any identified barriers to effective communication and consultation, such as language barriers, or fear of reprimand, shall be appropriately addressed and removed to allow for employee participation.

b. AECOM leadership shall promote awareness of SH&E issues in AECOM offices, facilities, and worksites through such approaches as the use of banners, SH&E notice boards, AECOM's intranet, newsletters, alerts (including those issued by clients), key performance indicators and other SH&E-related material.

c. Communication and coordination amongst key stakeholders (e.g., AECOM personnel, subcontractors, clients, teaming partners, regulatory bodies, etc.) shall be conducted as appropriate throughout the lifecycle of a project to safeguard our employees, subcontractors, the public and the environment.

d. Values moments should be shared in every meeting via webcast, telephone, video conference, or live. When the Values moment is not safety-related, safety should be included in the agenda.

e. As appropriate, employees shall be consulted during SH&E activities. Associated SH&E documentation shall be completed and provided to affected personnel as a method of SH&E communication (e.g., SH&E hazard assessments, plans, permits, inspections, investigations, lessons learned, etc.).

f. All personnel are encouraged to discuss any SH&E concerns, good practices or ideas with their Supervisor, and to enter SH&E observations within LifeGuard or IndustrySafe. Content shall be monitored by the SH&E Team and appropriate response or close–out action taken.

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g. Regular SH&E meetings shall be conducted between management and employees. Frequency as established in the applicable SH&E Plan shall be met.

h. AECOM encourages the establishment of SH&E committees, including Safety Leadership Teams (SLTs), with the aim of allowing a direct interface between management, SH&E team, and other employees.

i. Where established, the requirements of these committees or SLTs should be developed; basic agenda, membership composition, frequency of meetings (at least quarterly), with meeting minutes published and posted for employees to access.

j. Requests for information from external interested parties shall be reviewed and dealt with on a case-by-case basis and in accordance with legal, AECOM and client requirements. Project related requests shall be managed by the associated Project Manager, with necessary assistance provided by the SH&E Team.

0.11 Recognition and Rewards

a. Rewards and recognition programs shall be developed and implemented to recognize individuals, teams, projects, and offices that meet established criteria in SH&E performance. Project rewards and recognition programs shall be included in the project's SH&E Plan.

b. All levels of supervision are encouraged to recognize the SH&E initiatives, milestones and efforts made by those who work with them on an ongoing basis. This recognition may be as simple as publicly thanking an employee for reporting hazards, taking the time to do a job safely, participating in SH&E Committees, or refusing unsafe work. This recognition will also include team, project, and office recognition of achievements in SH&E.

1 Exposure Management

1.1 Toxic and Hazardous Substances

a. Where there is a risk of exposure to toxic and hazardous substances, the activity and task shall be assessed for employee exposure and, as applicable, appropriate hazard controls developed, implemented, communicated, and maintained.

    i. While hazardous substances commonly encountered on worksites include asbestos, silica, benzene, cadmium, chromium (VI), hydrogen sulfide, and lead, any other toxic or hazardous substances that may be encountered by AECOM employees (e.g., ammonia, arsenic, coal dust, isocyanates, mercury, etc.) shall also be assessed.

b. When the assessment identifies the potential hazard of toxic or hazardous substance exposure, medical screening and surveillance requirements shall be defined if applicable to the substance and jurisdiction.

c. Employees shall be informed of the hazards of the chemicals to which they may be exposed in the course of their work (e.g., container labeling, training, etc.). The Global Harmonization System shall be applied in alignment with the applicable jurisdictional requirements.

d. Appropriate training and guidance shall be provided to employees to eliminate or control occupational exposures to toxic or hazardous substances (gas, vapor, aerosol [dust], mist, fume, fog, fiber, smoke) to the lowest level practicable.

1.2 Industrial Hygiene & Medical Screening

a. Industrial hygiene hazards shall be identified, including as applicable, toxic and hazards substances, physical agents (acoustic, thermal, etc.) and biological airborne contaminants. To the extent possible, the associated risks shall be reduced to as low as reasonably practicable, given the available technology and known toxicological or adverse human health effects.

b. Only competent and trained personnel shall perform work where employees and subcontractors are exposed to industrial hygiene hazards.

c. Current exposure limits identified by the *American Conference of Governmental Industrial Hygienists* (ACGIH) shall be used as the maximum exposure limit. Exposure limits established by local regulatory standards or consensus standards that are more conservative than those identified by ACGIH shall be applied in the applicable jurisdiction.

d. Medical screening and surveillance shall be conducted as necessary based on potential exposures and regulatory requirements.

e. Appropriate hazard control measures shall be in place where exposures will be above established occupational exposure levels.

f. Project SH&E Plans shall specify exposure limits and action levels.

2 Planning & Oversight

2.1 Safety in Design

- Safety in design shall be incorporated into the design and constructability aspects of temporary and permanent facilities, structures, and processes from concept to completion, including proposals and marketing, engagement of subcontractors, construction operations and subsequent operation, maintenance, and demolition of the product.
- Where the principles of safety in design are not required by law, the practices of safety in design shall be incorporated in the design and building aspects of temporary and permanent facilities, structures and processes to minimize risk to people, and capitalize on intrinsic efficiencies of an enhanced design process.

2.2 Hazard Identification and Risk Management

a. The Project Manager shall confirm risk assessment processes are conducted to identify hazards and manage the associated risks applicable to the location. Risk assessment processes shall be utilized throughout the lifecycle of the project:

   i. SH&E risk assessment during the pre-bid stage of a project is conducted to inform the go / no go decision as well as identify potential SH&E planning, budgetary and staffing requirements. Please refer to *S2-001-ATT4 Catastrophic and Critical Consequences Guidance* for a listing of potential events or outcomes to be considered in relation to a project's work scope.

   ii. Project start-up activities require appropriate SH&E planning prior to work commencing, including identification of hazards, associated risk, and appropriate controls for each task and operation found in the work scope. Completed risk registers / hazard assessments shall be incorporated into the Project's SH&E Plan.

   iii. Project execution activities shall confirm the Project SH&E Plan is reviewed and hazards are further assessed given current conditions. To capture nuances or site-specific conditions immediately present that are otherwise unacknowledged, task hazard assessments (THAs, also known as Safe Work Method Statements, Field Level Risk Assessments, Risk Assessment Method Statements, etc.) must be completed and reviewed immediately prior to initiating the task at the work location by those conducting the task.

   iv. SH&E performance reviews at close-out of a project shall be conducted to identify successes and any potential improvement opportunities. As appropriate, preventive actions shall be developed with the goal of continual improvement to industry-, client-, or location-specific SH&E activities, as well as the AECOM SH&E Management System.

b. The manager shall plan required SH&E activities and incorporate SH&E procedures into the location or project SH&E Plan. The SH&E documentation for any project lasting twelve (12) months or longer will be reviewed at periodic intervals, but at least annually.

c. Where necessary, the Project Manager shall seek input from the relevant SH&E team and affected workers into the planning process.

d. Risk assessment processes shall identify the hazards and mitigations or controls required to eliminate or reduce the associated risk to as low as reasonably practical for each hazard.

e. Those involved in a documented risk assessment shall include trained and competent personnel in hazard identification and use of risk management tools and processes.

f. Results shall be communicated to affected personnel (e.g., SH&E Plans, Tailgate meetings, daily safety huddles, review of documented assessments, etc.).

g. Risk mitigations or controls shall be monitored on an ongoing basis for effectiveness.

h. A risk ranking shall be performed for pre- and post-mitigation efforts. The risk ranking shall be completed using the following AECOM Risk Matrix:

	Severity				
Probability	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	**25**	**20**	**15**	**10**	**5**
4 – Probable	**20**	**16**	**12**	**8**	**4**
3 – Occasional	**15**	**12**	**9**	**6**	**3**
2 – Remote	**10**	**8**	**6**	**4**	**2**
1 - Improbable	**5**	**4**	**3**	**2**	**1**

i. If the final risk rating is a 5-9 (medium risk) or 10-25 (high risk), additional hazard controls shall be identified and applied until the final risk rating is reduced to 4 or below. If the final risk rating cannot be reduced to 4 or lower, additional approvals, as shown below, are required before the activity can begin.

Risk Rating (Probability x Severity)	**Risk Acceptance Authority**
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Supervisor or equivalent
10 to 25 (High)	Risk requires the approval of the Project Manager & SH&E Director

Severity – Potential Consequences				
	People	**Property Damage**	**Environmental Impact**	**Public Image/Reputation**
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Almost certain to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur, though possible during task/activity	1/1,000
Improbable	Highly unlikely to occur during task/activity	1/10,000

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j. The Project Manager shall review the risk assessments incorporated in the SH&E Plan on site and modify them if circumstances are different or change during the work. Site personnel shall sign the SH&E Plan initially and after any changes to show they have read and understood it.

k. Situations may arise that were not foreseen or accounted for when the operating procedures or plans were developed. The purpose of Management of Change is to protect personnel from hazards caused by major changes in the scope of work. Stop work shall be initiated and appropriate changes in the way the operations are conducted shall be identified so the work can recommence and be performed safely. The changes may be temporary or permanent. A record of the Management of Change shall be documented and employee training on the change completed before work restarts.

l. Mitigation of Hazards

i. Supervisors shall refer to the SH&E Plan to confirm task-based risks are managed in accordance with the hierarchy of controls.



ii. Advance planning enables Safety in Design to be applied to systems, equipment and work areas in order to eliminate, substitute, or apply engineering controls to the hazard.

iii. When determining appropriate controls to mitigate the risk presented by each hazard, the most effective controls (ordered from the most effective at the top of the image above to the least effective at the bottom) shall be assessed and applied as is practicable, with PPE considered the last line of defense.

iv. Layers of control or redundancy shall be established whenever possible (utilizing multiple means e.g., engineered control further supplemented by safe work practices and PPE).

v. When PPE is required, specific basic and/or specialized PPE shall be identified in the SH&E Plan. Supervisors will verify workers and visitors have access to the appropriate PPE and that workers and visitors are properly trained and competent in the use and requirements related to the given PPE. Advice on the use, care, storage and maintenance of PPE is available on the company intranet, or from the SH&E Team.

vi. Managers shall assess the workplace for potential violence scenarios and incorporate findings into the emergency preparedness and response planning where applicable.

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2.3 Personal Protective Equipment (PPE)

a. The following basic PPE is required to be worn at all times on industrial sites:

   i. Hard hat/ bump cap (selected based on applicable hazards), safety glasses with side-shields, work boots, full length trousers, shirt with sleeves, gloves.

   ii. All personnel shall have gloves in their immediate possession 100% of the time when in a shop or on a work site. Appropriate gloves shall be worn when employees work with or near any materials or equipment that present the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc.

   iii. PPE shall be worn at all times on industrial sites unless the employee is in an area clearly marked and the differing PPE requirements defined, in which case the area's requirements shall be met.

b. All personal protective equipment required for the identified hazards shall meet applicable standards (e.g., approved safety glasses worn in environments presenting eye hazards [meaning prescriptive eyewear shall also meet applicable safety standards when eye hazards are present], appropriate class / type of hard hat in a high voltage electrical environment, etc.).

c. All personal protective equipment shall be in good working condition and maintained to manufacturer's specifications. Defective or damaged equipment shall be discarded and replaced.

2.4 Permit Required Activities

a. All work activities shall be evaluated to determine if work permits or specific plans are required.

b. Activities requiring a completed permit or specific plans before work begins (e.g., confined space, lockout / tagout, electrical, hot work, fall protection, radiation, blasting and explosives, temporary protection, critical lifts, excavation, underground work) to safely perform work shall be planned, managed, and executed by competent personnel.

c. Additional tasks (e.g., core drilling, perimeter work, elevator shaft work, stair installation, etc.) shall be assessed based on risk, regulatory requirements and client requirements to determine whether Permit to Work processes are required.

d. The responsibilities, accountabilities, training and competency requirements for the permit issuer, individual permit holders and persons performing permitted tasks shall be clearly defined.

e. All personnel undertaking work requiring a permit shall be made aware of the hazards, how the hazards are being controlled, and the permit conditions that are required to be met.

2.5 Oversight of AECOM Subcontractors / Subconsultants

a. Subcontractors / subconsultants that work for or on behalf of AECOM will be selected/ prequalified in accordance with AECOM's subcontractor management procedure / process.

b. Subcontractor / subconsultant SH&E plans and applicable procedures shall be reviewed prior to initiation of work.

c. Subcontractors / subconsultant SH&E plans and applicable procedures shall comply with the client and AECOM site specific SH&E plan.

d. AECOM shall monitor performance and conduct and report on routine inspections of work activities of subcontractors / subconsultants. Feedback shall be provided as appropriate.

e. Subcontractors / subconsultants shall immediately report all incidents to AECOM and investigate as appropriate.

f. Subcontractors / subconsultants shall follow equivalent due diligence processes for any lower-tiered subcontractors.

2.6 Environmental Procedures

a. AECOM project and office SH&E Plans shall document the identification and assessment of the various environmental aspects and impacts resulting from our business activities. These can be positive or adverse, direct (under AECOM direct control) or indirect (e.g., those created by the activities of our partners and contractors / suppliers).

b. Full account is taken at each stage of office and project activities including under normal / abnormal operating conditions and contingencies (incidents, emergency situations), past / present / foreseeable activities, partner / supplier activities and so on.

c. As applicable to the activities and tasks, the environmental impacts and aspects shall each be assessed for significance to develop, document, and implement suitable and sufficient controls, emergency arrangements, and procedures for identifying, assessing, and managing environmental sustainability for the following considerations:

- Air Quality and Pollution.
- Contaminated Land.
- Ecology, Archaeology and Cultural Heritage.
- Noise.
- Resource Consumption.
- Statutory Nuisance.
- Traffic Management.
- Waste Management.
- Water Quality and Pollution.
- Dust Control Measures.
- Storm Water Management.
- Spill Response.
- Delivery, Storage and Refueling of Fuel, Oil and Chemicals.
- Energy and Water Use, Recycling.

d. In addition, when planning new processes, the environmental risks and impacts are re-assessed in light of any specific, new, or changed factors posed by the proposed new activity and location in accordance with the procedures for risk management and management of change.

   i. The results of these assessments are collated into a country-specific Register of Environmental Aspects and Impacts (as applicable) which is reviewed upon major activity change and / or at least annually and updated accordingly.

2.7 Regulatory Agency Visits

a. Visits or inspections by regulatory agencies for the purpose of these requirements include:

   i. Any non-routine announced or unannounced visit or inspection of an AECOM office or project site by a regulatory agency involved with Occupational Health and Safety and Environmental laws and regulations.

   ii. Periodic visits from service or local agencies to project sites to approve certain activities such as utility hook-up, utility clearance, etc. are not considered regulatory visits or inspections.

b. The Project Manager shall:

   i. Confirm a senior AECOM employee meets with the agency representative to obtain copies of credentials, determine the purpose of the visit or inspection and to request applicable documentation.

   ii. Confirm the visit or inspection is reported in IndustrySafe as an incident within one business day.

   iii. Confirm notification of the relevant Regional SH&E Director and SH&E Manager of the visit or inspection.

   iv. Notify the client a regulatory visit or inspection is occurring on their project site so the client may have representation during the visit or inspection, at their discretion.

   v. Confirm an appropriate AECOM escort is identified and accompanies the agency representative at all times to address questions, observe activities and monitor evidence gathering (this may include obtaining duplication of evidence, such as dual photos and split samples).

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vi. Confirm copies of the visit record and other documents or postings that the agency representative may issue are obtained.

vii. Request a debrief session.

viii. Where a citation, violation, or penalty was issued:

1. Confirm direction is given to the local employees to stop the performance of the cited activity until the appropriate corrective actions are implemented.

2. Confirm any required posting is completed in accordance with the directions outlined by the agency.

3. Confirm a formal response is submitted to the issuing agency and facilitate payment of any associated monetary fine after approval from Counsel.

4. As applicable, serve, or designate an appropriate individual to serve, as AECOM's informal and formal agency negotiation meeting representative to discuss the citation, violation, or penalty.

2.8 Office Safety

a. Each AECOM office will develop an Office SH&E Plan in accordance with the template provided on the company intranet.

b. Managers shall confirm that employees understand any specific risks, are briefed in the correct emergency response procedures, and have access to emergency equipment.

c. All visitors to the office shall sign in and be given an SH&E orientation / induction.

d. All offices shall have an SH&E noticeboard in place with current relevant materials posted to include but are not limited to the AECOM SH&E Policy, Life Preserving Principles as well as any other local regulatory or geography specific information.

e. Offices shall be inspected to identify and address any specific hazards. Hazards shall be controlled or have actions in place to mitigate the risk.

f. Safety committees shall be established in accordance with jurisdictional requirements and as a minimum, in AECOM offices of more than 50 employees.

g. All office equipment and workstation design and installation shall take ergonomic performance into account. Equipment and workstations shall be, as far as practicable, designed and installed to suit the individual(s) interacting with them.

h. Workplace ergonomic hazard assessments shall be performed when necessary and required controls implemented as far as practicable.

3 Field

3.1 Confined Space Entry

a. All confined spaces shall be evaluated and classified by a competent person as permit or non-permit.

b. Efforts shall be made to eliminate the need to enter a confined space where practicable.

c. Confined space entries shall be planned and managed by competent personnel.

d. Only trained, authorized, and fit for duty personnel shall enter, or attend the entry of, a confined space.

e. No entry shall occur without an assessment that includes hazard identification and appropriate hazard control measures (e.g., suitable atmospheric testing requirements defined, inspection requirements to confirm equipment is fit for purpose, etc.).

f. A rescue plan shall be prepared and communicated to the entry and rescue teams.

g. Confined space entry shall never be conducted alone.

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h. Atmospheric testing is required for all permit-required confined spaces, and if necessary to confirm absence of atmospheric hazards in non-permit confined spaces.

3.2 Working at Heights / Fall Protection

a. An assessment shall be completed prior to the start of working at heights.

b. Where practicable eliminate the need to work at heights. Alternatively, a safe working platform shall be a priority (e.g., elevated lift or scaffolds). Fall prevention shall take preference over fall arrest systems.

c. As a minimum standard, fall protection is required and will be provided for any work/job/task to be performed above the normal walking/working surface at heights of 6 feet (2 meters) or greater in the construction, mining, and demolition industry, and 4 feet (1.2 meters) or greater in all other industries. Local regulatory standards or consensus standards that are more conservative than this minimum standard shall be applied in the applicable jurisdiction.

d. Only competent / qualified / trained personnel shall select and use personal fall prevention/arrest systems or access equipment that provides appropriate protection from falls (e.g., aerial lift, scaffold).

e. Edges shall be considered when evaluating proper fall protection.

f. Only competent / A rescue plan for personal fall arrest systems shall be in place for work at heights.

g. Material and tools used at heights shall be adequately secured or prevented from falling and an appropriate exclusion zone shall be established when working at heights.

h. Three points of contact (two hands and one foot, one hand and two feet) shall be maintained when accessing ladders or other structures. Ladders shall not be used as a working platform.

3.3 Demolition

a. Demolition operations shall be planned and managed by competent personnel. Where appropriate to accurately identify applicable hazards, an engineering survey of the structure shall be incorporated into the work planning (e.g., planning for mechanical equipment, debris containment, etc.).

b. Applicable permit to work processes shall be followed prior to demolition work commencing.

c. An assessment shall be completed that identifies and documents the hazards and controls associated with the planned demolition activities.

d. The demolition structure shall be assessed for the presence of harmful materials. Methods for monitoring, testing and management of potential exposures to atmospheric contaminants will be established and evaluated by a qualified person.

e. All activities involving demolition equipment, explosives and blasting shall be managed by competent and authorized personnel.

f. All sources of energy including, but not limited to, electric, gas, water, steam, sewer, and other service lines shall be isolated.

3.4 Energy Isolation

a. Where the release of energy during major replacement, repair, renovation, or modification of machinery, equipment, or systems or during installation of new machines, equipment or systems may cause injury to personnel, an assessment shall be conducted.

b. Lockout tagout (LOTO) activities are required when:

   i. An unexpected energization or start-up of machines and/or equipment would result in the release of stored energy which could cause injury to an employee.

   ii. Any employee (or contractor) is required to remove or bypass a guard or other safety device.

iii. Any employee (or contractor) is required to place any part of their body into the mechanism of a piece of equipment or path of hazardous energy.

c. No work shall be initiated (including LOTO procedures) prior to obtaining any required work permits.

d. Only qualified and licensed personnel shall be allowed to work on energized systems including testing and tagging of equipment.

e. Competent personnel shall verify systems are de-energized prior to conducting work activities.

f. Locks shall not be removed without proper authorization.

g. Identify and communicate to all affected personnel and to all employees whose work operations may be in an area where LOTO procedures may be utilized.

h. LOTO procedures shall include requirements applicable to:

i. Shut-down of equipment or request for de-energization of an energy source(s).

ii. Lockout of energy source(s) and tagging to identify the lockout controls and parties involved.

iii. Inspection and verification of de-energization, and application of locks and tags.

iv. Methods to coordinate multiple locks and the continuation of LOTO protection through shift or personnel changes.

v. Control and accountability of locks and tags, including processes for emergency lock removal.

vi. Equipment-specific LOTO procedures.

3.5 Electrical Safety

a. All applicable electrical codes, SH&E procedures and manufacturer's specifications shall be followed to eliminate the need to directly work on live electrical systems where practicable.

b. Electrical work, (meaning work associated with equipment or systems of 50 volts or greater, or a current of 20 amps or greater) shall be assessed, planned, and managed by competent personnel.

c. Only competent and authorized personnel shall perform work on live electrical system components.

d. Written and approved justification is required to work on energized systems and is only authorized when de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations (life supporting interruptions, deactivation of emergency alarms, shutdown of ventilation equipment in hazardous location).

e. A permit to work process shall be established and implemented for live electrical work.

3.6 Excavation & Trenching

a. Excavation and trenching operations shall be planned, managed, and executed by competent personnel.

b. Applicable permit to work processes shall be followed prior to excavation or trenching activities commencing.

c. Before any excavation work is undertaken, an assessment shall be conducted to identify, assess, and manage the hazards present.

d. Overhead obstructions and underground utilities / installations shall be clearly identified.

e. Appropriate control measures to prevent contact with overhead obstructions and underground utilities / installations, including establishing suitable clearances, shall be in place prior to work commencing.

f. Fit-for-purpose equipment, protective systems (e.g., barriers, lighting, signage, etc.), and means of access/egress shall be selected, installed, operated, and maintained in a way that minimizes the risk of injury to personnel and the public, and damage to property.

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g. Inspection of excavations (as a minimum, any excavation greater than 1.5 meters [5 feet]) and any protective systems shall be undertaken by a competent person as appropriate to the conditions and in compliance with regulatory requirements.

3.7 Underground Work / Tunneling

a. Tunneling operations shall be planned, managed, and executed by competent personnel.

b. Project managers or supervisors are responsible for confirming employees involved in underground work possess any required training, registrations, or certifications.

c. Applicable permit to work processes shall be followed prior to underground work / tunneling activities commencing.

d. Before any underground work is undertaken, an assessment shall be conducted to identify, assess and manage the hazards present.

e. A safe means of access to and egress from all work locations shall be provided and access to all openings controlled to prevent unauthorized entry.

3.8 Heavy Equipment

Heavy equipment (also referred to as mobile equipment) includes, but is not limited to, equipment such as backhoes, excavators, skid steers, graders, loaders, dozers, tractors, cranes, drills, and draglines.

a. Verify that employees comply with applicable regulatory, client and supplier requirements relevant to operating heavy equipment.

b. Tower cranes and personnel hoists shall be inspected by an independent third party both at the third party's facility and at the site prior to mobilization.

c. Heavy equipment shall be selected, equipped, operated, inspected, and maintained in a way that enables safe operation, protects personnel from harm, and conforms with regulatory and manufacturer requirements.

d. Ground guides / spotters shall be used to facilitate safe movement of heavy equipment near personnel, equipment and utilities, and when obstructions or congestion present hazards to safe operation.

e. Back up alarms or equivalent means to allow for safe reverse movement, are required on all heavy equipment.

f. Daily documented inspections shall be completed on all heavy equipment prior to operation.

g. Only authorized operators who are fit for duty and meet jurisdictional requirements shall operate heavy equipment.

h. All local laws including signs, postings, regulations, and codes applicable for the jurisdiction in which the equipment is being operated shall be observed.

i. Heavy equipment operations shall be adequately separated from light vehicles, workers and pedestrians. If separation is not possible, appropriate procedures shall be implemented to maintain the safety and health of personnel involved.

j. Positive communication shall be implemented between ground personnel and heavy equipment operators.

3.9 Lifting Operations

a. Lifting operations shall be planned, managed, and executed by competent personnel.

b. Operators, riggers, banks-man, and inspectors shall be certified according to jurisdictional requirements to carry out their work as it relates to lifting operations.

c. Fit-for-purpose lifting equipment shall be selected, positioned, installed, operated, and maintained in a way that minimizes the risk of injury to personnel or property damage. This is to include equipment used for incidental lifts.

d. Inspection and testing of lift equipment shall be undertaken by a qualified person.

e. No lifts shall commence without a lift plan in place and approval by a qualified person.

f. Critical lifts require a formal, written plan. A critical lift is a non-routine crane lift (e.g., more than one crane or hoisting device, lifts over structures or equipment, load may be out of the operator's view, hoisting personnel, etc.) requiring detailed planning and additional or unusual safety precautions.

g. Lift plans shall specify wind restrictions in accordance with jurisdictional requirements, manufacturer requirements. As a minimum 30 mph (48 km/h) shall be the maximum wind speed for material hoisting, and 20 mph (32 km/h) for hoisting of personnel.

h. Audible alarms or equivalent communications means shall be utilized to alert personnel in the area immediately prior to the imminent lifting operation.

i. Appropriate exclusion zones shall be defined and in place prior to lifting operations commencing so as to prevent the risk of injury from the equipment or the load falling or striking personnel, and may be comprised of physical barriers, warning signs, signage and/or spotters.

j. Taglines shall be used to control load movement. If tagline usage poses a safety hazard this shall be reflected in the planned procedure and the task hazard assessment, and a short line of suitable length shall be attached to allow the worker to catch the load.

3.10 Working Alone

a. An employee is considered a lone worker if he / she is performing work with no line of sight or direct voice communication with another person who is aware of their assignment and capable of initiating emergency response.

b. When traveling alone, staff shall take appropriate precautions, including notifying their manager of the travel plans, check in times, as well as carrying a communication device and appropriate safety equipment.

c. Managers shall plan work to restrict personnel from working alone on any site without an appropriate risk assessment, controls, and approvals. If an employee will be out of contact with other personnel, the manager shall establish a buddy system or check-in procedure with another employee or responsible person.

d. Employees shall not conduct permit required or high residual risk tasks (e.g., confined space entry, work on an energized system) while working alone.

e. Where employees are undertaking office / computer-based work alone outside of normal working hours, they shall confirm security measures are in place (e.g., lock doors), support can be contacted and provided in the event of an emergency, and where appropriate, check-in procedures are established.

3.11 Temporary Works

Temporary works are the structures and installations enabling permanent construction to take place (e.g., formwork, false work, precast, shoring, scaffolding, back propping, temporary structures, etc.).

a. Temporary works shall be identified, designed and independently verified by appropriately qualified persons, and shall be installed in accordance with the design. Installation shall be verified by an appropriately qualified and competent person prior to initial use and loading.

b. Temporary works shall be regularly inspected by competent persons.

c. No changes to installed temporary works shall be made without prior acceptance of the designer, and if necessary, further design certification and independent verification of the changes.

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d. Temporary works shall be physically protected and secured where there is a risk of collision, or damage through adverse weather conditions or adjacent work practices.

3.12 Unmanned Aircraft Systems (UAS)

All AECOM operations using UAS shall be properly planned, managed, and executed to enable compliance to applicable requirements and prevent harm. AECOM has established the UAS Working Group; a team comprised of SH&E, Insurance, Operations, and UAS expertise. The UAS Working Group provides oversight of UAS operations to:

a. Provide expertise and support for commercial UAS operations within AECOM to enable compliant, professional, and responsible operations.

b. Review proposed UAS activities in AECOM for adherence to established procedures and operating guidelines, approval of personnel, performance in accordance with project work plans, and approval by UAS subject matter experts.

c. Approve UAS operations as appropriate and coordinate approved UAS activities with the Insurance function for appropriate insurance coverage.

d. Confirm field-level risk mitigation strategies are developed and integrated with the project work plans, and that flight safety briefings with all project personnel are conducted prior to the flights.

3.13 Working on or Near Water

a. Work activities that entail operations on, above, under or near water shall be assessed for hazards and the hazards appropriately mitigated.

b. If applicable to the identified hazards, a rescue plan and communication arrangements shall be established.

c. The hiring or leasing of watercraft shall take into consideration the seaworthiness of the vessel and that only licensed personnel can operate the craft.

d. Diving activities are prohibited unless specifically approved by the applicable Regional SH&E Director or designee (e.g., Diving Board).

3.14 Marine Safety & Vessel Operations

a. Project managers shall confirm boats / vessels selected are appropriate to the planned work activities and vessel operators are licensed to operate in the applicable jurisdiction.

b. All boats and vessels shall be properly equipped and operated by a qualified vessel operator (e.g., Marine Operations Superintendent, Master Mariner, Barge Captain, or similar authority and title) in accordance with the applicable jurisdiction’s Marine Safety Laws.

c. A site-specific SH&E Plan, Float Plan and any other SH&E planning documents shall be developed and in place prior to vessel operation.

3.15 Rail Corridors

a. AECOM employees shall not enter a railroad right of way without appropriate coordination and approval by a local railway employee (or representative of the railway owner) with knowledge of the operation and means and authority to enable on track safety.

b. Prior to performing work in a railroad right of way or railyard, AECOM employees will be provided with clear instructions applicable to the specific railroad operations, associated hazards, procedures, and requirements to enable employee safety associated with occupying the railroad right-of-way / fouling of tracks and the means of communication.

c. AECOM employees and equipment shall not foul the track (be in such proximity to a track that the individual or equipment could be struck by a moving train or on-track equipment) without securing appropriate approvals.

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d. An on-site safety briefing shall be conducted at the start of the shift, after work breaks, and any time there is a change in the nature of the work, a change in method of on-track safety being provided, or a change in the work area environment. Additional parties shall be engaged and included as required and appropriate (e.g., host railroad employee with the means and authority to provide on track safety protection).

e. Written documentation of the on-site safety briefing shall be provided by the AECOM employee-in-charge (EIC) of the work being performed on railway property.

3.16 Munitions & Explosives of Concern / Unexploded Ordnance (MEC/UXO)

a. Prior to beginning any activities on a site suspected of MEC / UXO, every effort shall be made to determine whether munitions-related activities ever occurred on the specific work area or within waters on which AECOM operations/activities will take place.

b. All MEC / UXO encountered or suspected on AECOM jobsites shall be treated as extremely dangerous. Employees shall not touch the suspected material and shall retreat. Employees shall identify the location, notify other team members, keep all employees out of the area, and report the finding to their supervisor.

c. MEC support activities, including surface and subsurface removal activities, shall be handled by UXO-qualified personnel only.

4 Change Log

Rev #	Change Date	Description of Change	Location of Change
1	15-Jun-2015	Complete rewrite – integration of URS & AECOM programs	Various locations
2	01-Aug-2016	Refer to SH&E Management System Manual Edit Summary – August 2016	Various locations
3	01-Aug-2017	Refer to SH&E Management System Manual Edit Summary – August 2017	Various locations
4	14-Jan-2019	Rewrite and restructure into 1 manual and 3 attachments (this document as ATT3). Refer to SH&E Management System Manual Edit Summary – January 2019	Various locations
5	03-May-2019	Added reference to S2-001-ATT4 SH&E High Risk Events Guidance	Section 2.2
6	14-Jun-2023	Revisions throughout to align with current organizational terminology. Renumber from ATT3 to WI3.	Various locations
7	13-Dec-2023	Remove EIR Template reference and revise required / optional EIR content.	Section 0.8 h
8	21-Mar-2024	Added new bullet (e) and sub-bullets to section 0.4 Fit for Duty	Section 0.4 e
9	22-July-2025	Updated core value reference. Updated hazard assessment content and probability table.	Section 0.10 and Section 2.2
10	13-Nov-2025	Revised Risk Acceptance Authority for Medium Risk to “Risk requires approval by Supervisor or equivalent”	Section 2.2 (h.i.)

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SH&E Training

S3AM-003-PR2

1. Purpose and Scope

a. This procedure establishes the minimum Safety, Health, and Environment (SH&E)-related orientation and training requirements for employees to identify and control SH&E risks in their work, dictated by the work each employee performs (or is expected to perform), and the geographic area(s) where the Employee performs these activities.

b. This procedure outlines the process and minimum requirements for classifying an AECOM employee as a "Competent Person" to oversee and/or self-perform work activities. Local law may contain alternate definitions for Competent Person, and it is the responsibility of the Project Manager, in conjunction with an SH&E Manager/Director to determine and resolve conflicts, if any, existing between AECOM and applicable regulatory definitions.

c. This procedure defines recordkeeping requirements, aims to maintain consistency in SH&E training content, and provides a framework to assess participant competency and understanding.

d. This procedure applies to all AECOM Americas-based employees and operations, as well as contracted personnel required to comply with this document's content.

2. Procedure

2.1 New Employee SH&E Orientation

a. Employees must complete the required SH&E training assigned through Learning Management System (LMS) – AECOM University (AECOM U) or other approved platform.

b. Employees must complete a "new hire" SH&E orientation on the AECOM SH&E systems including hazard reporting, risk management, and accessing procedures/resources.

c. Employees must also be provided with a local office-specific orientation to include information on safety reporting, emergency response plans, and other office-specific SH&E topics.

d. Orientation should be completed within 1 week, but no longer than 1 month, from the employee's hire date and must be completed prior to undertaking any field work.

e. New Employee SH&E Orientation – Americas form or equivalent may be used to document new employee SH&E orientation progress.

2.2 Project- / Site-Specific SH&E Orientation

a. Employees must complete a relevant project- and/or site-specific orientation provided by AECOM, the controlling contractor, and the client, where applicable, within the specified timeframes of the project and before initiating site work.

b. Staff and AECOM-managed subcontractors must not enter a site unless they have received the relevant orientation.

c. The Project Manager is responsible for confirming that the on-site orientation for AECOM employees and AECOM-managed subcontractors has been completed prior to the commencement of work.

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d. Orientation requirements can be outlined in the project-specific SH&E Plan / Safe Work Plan (SWP) / Task Hazard Assessment (THA ; e.g., Field Level Risk Assessment [FLRA] in Canada) and should, at a minimum, cover the following items:

   i. Scope of work / project overview;

   ii. Key personnel;

   iii. Local law, client, and any other requirements;

   iv. Incident reporting and management process including the importance of near miss and observation reporting to enhance safety awareness and culture - refer to SH&E Incident Response and Investigation – Americas;

   v. Communication and consultation arrangements, including the safety escalation and resolution process - refer to SH&E Communication and Consultation – Americas;

   vi. Site-specific safety procedures and rules (as applicable) regarding minimum personal protective equipment (PPE) requirements, alcohol and drugs policy, smoking areas, parking, deliveries, visitors, exclusion zones, permits, hours of work and fatigue policy, etc. - refer to SH&E Risk Assessment and Planning – Americas and Safety Gear – Americas;

   vii. Risk management processes, such as critical risks and critical controls, SH&E plans/SWPs/THAs (e.g., FLRAs in Canada), and 4-Sight - refer to SH&E Risk Assessment and Planning – Americas;

   viii. Red Card – Stop Work Authority - refer to Safety Tenets and Stopping Work – Americas;

   ix. Key workplace hazards/risks and control requirements;

   x. Emergency management;

   xi. Environment, community, and stakeholder requirements; and

   xii. Safety observations.

e. The Project Manager must maintain a record (e.g., acknowledgement page of the SH&E Plan, orientation sign-off page) of all site orientations conducted (including AECOM-managed subcontractors) in the project folder.

2.3 Risk-Based Approach to SH&E Training

a. Assessment of SH&E Training Requirements – Americas should be used as a guideline for providing SH&E training to employees per the requirements of their role, in relation to the specific risks posed by their work activity, and in accordance with legal, client, and industry requirements. Other applicable region-, business line-, or project-specific training assessments should also be consulted.

b. In Canada, project-specific training is identified and listed in the Project-Specific SH&E Plan – DCS – Americas – Canada.

c. All employees who will perform work outside of the office setting must discuss and develop their training needs with their direct supervisor within 1 week of hire and annually thereafter. Employees should review their SH&E training requirements in conjunction with their annual performance review.

d. SH&E training needs may be identified through individual risk assessments, incident investigations, observed non-compliance, when procedures change, or through the annual staff appraisals process. As required, appropriate training must be arranged and may be provided through LMS – AECOM U courses, safety meetings, and/or classes delivered by internal or external providers.

e. All personnel who are required to fulfill a designated emergency response role must be trained in their responsibilities and be well-versed in the specific Emergency Response Plan for the workplace. Minimum training requirements are detailed in Assessment of SH&E Training Requirements – Americas.

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f. All workers and visitors at AECOM-controlled workplaces must be trained (workers) or briefed (visitors) on emergency evacuation and response protocols during the orientation process and must be required to participate in any emergency-related training as required (e.g., evacuation drills and simulated response exercises).

g. For larger scale projects, a site-specific training matrix can be developed to identify specific training requirements, including competency, licensing, and qualifications, for specific project personnel including contractors if applicable. It is the responsibility of the Project Manager to confirm that this document is maintained.

h. Project managers must review the relevant training and certification records of all employees on their projects prior to mobilization into the field to confirm that they have current and appropriate training.

2.4 Visitors and Delivery Drivers

a. Where visitors to project sites are required to enter operational work areas, it is recommended that they receive a brief site-specific orientation and always be supervised by fully orientated and safety trained site personnel while on site.

b. Where delivery drivers are required to enter an operational project zone, it is recommended they participate in a brief delivery driver orientation to familiarize themselves with the site specifics.

c. Where regular deliveries are expected on the project, the Project Manager should make early contact with the transport companies involved to arrange for orientation to be programmed well in advance of deliveries commencing.

2.5 Short Service Employees (SSE)

a. An employee is designated as an SSE if they are undertaking work in the field and have less than 6 months of experience working in the industry of the work to be performed.

b. An employee is not considered an SSE if they have more than 6 months of fieldwork experience in a similar industry and can demonstrate competency in AECOM's safety management system and processes.

c. Former employees who return to AECOM within 12 months and are placed into the same job assignment may not be designated as SSEs.

d. Specific circumstances may warrant the extension of the SSE designation, reduction of the required time identified in the schedule, or an exemption. Project managers must consult the Regional SH&E Manager with any SSE schedule variance or exemption requests, if applicable. Refer to SH&E Management System Variance Request – Americas.

e. SSEs must receive all required training and certification prior to being mobilized into a field environment. Until training has been provided, SSEs may only attend work sites under the direct supervision of a trained employee who is competent to perform the work activity. This supervision must continue until the SSE has received training and is deemed competent to undertake the task.

f. Where specific training is not immediately required, a training plan must be established. The training plan should outline the schedule for the required training to be achieved prior to the SSE being mobilized into a field environment.

g. SSEs must not be assigned to field projects unless they are supervised on site by safety oriented and trained personnel. It is the responsibility of the Project Manager to ensure that all new employees are suitably supervised by a Competent Person in all situations where they may be exposed to harm and while performing high risk work, until such time as they have had sufficient training and/or have demonstrated competence.

h. SSEs are not permitted to work alone or away from their field team at any time.

i. As required, project managers must notify the client and/or host facility when an SSE will be working at their site.

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j. An identification system (e.g., green hard hats) to readily differentiate SSEs from other employees must be implemented when required by the client and/or local law.

2.6 Competency

a. A designation of Competency may be required for certain tasks. The competencies required for a particular employee must be established by the Employee's Supervisor at the time of orientation and whenever new equipment or tasks are introduced to the workplace.

b. The Competent Person Designation – Americas form or equivalent must be used for documenting Competent Person designations. Documentation must be filled out completely and updated as necessary. Project-specific competency designation requirements may be defined in the SH&E Plan, SWP, and/or THA (e.g., FLRA in Canada).

c. Employees are not allowed to carry out high-risk work unless they have the required certificates/licenses for the type of work being conducted (refer to the SH&E Manager for further information). High-risk work license/training records must be available for review.

d. Where competency is not yet established, the Supervisor or Project Manager must confirm that gaps are documented on the training plan. The Employee must be provided with sufficient instruction and an opportunity to undertake the task under supervision by a Competent Person until their competency is established.

e. All training records, work licenses, and certificates must be maintained by each Supervisor or Project Manager in the project files.

2.7 Safety Training – General Requirements

a. Training Competency Levels

   i. Awareness Level: The primary goal of awareness-level training is to transfer basic knowledge to enable employees to recognize and avoid hazards. Additionally, employees must learn what precautions are necessary when they are exposed to hazards, and the precautions may necessitate additional training. Training typically takes the form of instructor-led discussions, presentation of related video content, and/or self-directed e-learning modules. Comprehension may be assessed through discussion of the training topic with the participants and/or a simple quiz.

   ii. Performance Level: Performance-level training must build upon the awareness-level training for certain high-risk tasks. The goal of performance-level training is to have employees successfully demonstrate they can apply the knowledge discussed during training and perform the desired skills necessary to perform higher-risk tasks. Training materials are provided and discussed and must incorporate a demonstration of the skills to be completed. The instructor must gauge the level of understanding through interactive discussion with participants and a pass/fail designation of demonstrated skills by the employees. A test or quiz of moderate difficulty must be provided followed by the successful demonstration of the desired skill to receive certification.

b. Training Delivery

   i. Internal Training: Internal training is performed by AECOM's internal resources and may include online webinar and classroom-based training. Peer-reviewed AECOM training materials must be used for training whenever they are available to facilitate consistency in content and duration of training. AECOM-based training materials can be supplemented as appropriate with content specific to the program, project, customer, office, or geographic unit. Trainers should be approved by an SH&E Manager. Training format and material must be appropriate to the topic and audience. Course content must be periodically reviewed and updated as appropriate, or multiple versions of training may be developed for rotating use to provide participants with new learning materials and avoid stagnation or to meet specific regulatory requirements.

   ii. External Training: External vendors must be pre-approved by an SH&E Manager to conduct training not available through internal training sources. This training may be classroom, web seminar, or online training.

c. Training Evaluation

   i. At the conclusion of a training event, participants should be provided with the opportunity to anonymously evaluate the training session. Instructors must review evaluations at the conclusion of training, and information from the evaluations must be considered when revising training content.

d. Ongoing Training Maintenance

   i. Training should be tracked electronically using LMS – AECOM U or Workday whenever possible.

   ii. Training may expire in accordance with requirements specified in applicable local law or policy.

   iii. If training required by AECOM or local law expires, employees must be disqualified from performing associated tasks until training has been renewed.

   iv. Refresher training may be provided in the following circumstances if:

      1. an employee is observed working or operating equipment in an unsafe manner
      2. an employee is involved in an incident
      3. an employee is assigned a new task or type equipment; or
      4. a condition in the workplace changes in a manner affecting personal safety or the safe operation of equipment.
      5. As required by local law.

3. Training

Individuals administering LMS – AECOM U SH&E training are required to undertake LMS training from the implementation team.

4. Terms and Definitions

a.	Competent Person	An employee who, through education, training, and experience, has knowledge of applicable regulatory requirements, is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.
b.	LMS – AECOM U	Learning Management System – AECOM University – An electronic training delivery and data management system utilized to implement and document the SH&E training program.
c.	SH&E	Safety, Health, and Environment.
d.	SSE	Short Service Employee – SSEs are those who have been newly hired or transferred to a different position in the company (e.g., one with new and possibly unfamiliar hazards and safe operating procedures).

5. References

a. Safety Tenets and Stopping Work – Americas S3AM-001- PR2

b. SH&E Incident Response and Investigation – Americas S3AM-004-PR2

c. SH&E Communication and Consultation – Americas S3AM-006-PR2

d. Safety Gear – Americas S3AM-208-PR2

e. SH&E Risk Assessment and Planning – Americas S3AM-209-PR2

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6. Records

a. Records include the following:

   i. Assessment of SH&E Training Requirements – Americas S3AM-003-FM1

   ii. New Employee SH&E Orientation – Americas S3AM-003-FM6

   iii. Orientación de seguridad y salud para nuevos empleados - Américas S3AM-003-FM6(ES)

   iv. Competent Person Designation – Americas S3AM-003-FM7

   v. Daily Safety Meeting – Americas S3AM-209-FM5

   vi. Project-Specific SH&E Plan – DCS – Americas – Canada S4[DCS]AM(CA)-209-FM1

   vii. SH&E Management System Variance Request – Americas S3AM-215-FM2

b. Completion of the orientation provided by AECOM must be documented, initialed, or signed by the orientee and stored in the project folder or in a local (office) folder.

c. On or prior to completion of the orientation, copies of the orientee's safety training certificates must be collected as appropriate to their scope of work. Employees are also required to keep copies of certificates and provide these as requested by the SH&E team, their supervisors, or project managers.

d. Companywide training must be captured and recorded through LMS – AECOM U. LMS - AECOM U can also be used to deploy and track local courses as required.

e. External training must be tracked through use of LMS – AECOM U where an applicable course code has been established, or it is acceptable to capture this through business line or other local training registers or in Workday. These must be reviewed periodically for accuracy.

f. Courses denoted in Assessment of SH&E Training Requirements – Americas or commonly required training must be tracked in LMS – AECOM U when completed. Employee training tracked in LMS – AECOM U must be retained for the duration of the Employee's employment.

g. Classroom training must be documented using an attendance record and course agenda.

h. For training provided by customers/vendors, training documentation must be entered into a training database, and documentation must be maintained by the Employee.

i. In some cases, objective evidence of comprehension is required (passing a test), and this information may be tracked in addition to the course information.

j. Attendance sheets, agendas, course evaluations, completed tests, and copies of certificates must be maintained and filed in program or project training files by course.

k. Locations, projects, and programs must maintain records on any project-, program-, location-, or site-specific training requirements.

l. Managers should verify that employees have the required training prior to assigning or authorizing specific roles and responsibilities to each employee.

7. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Dec-2025	Initial release as S3AM-003-PR2; consolidated portions of the contents from the following retired documents: SH&E Training – Americas S3AM-003-PR1, Newly Hired or Transferred Employees – Americas S3AM-015-PR1, and Competent Person Designation – Americas S3AM-202-PR1.	All

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Driving

S3AM-005-PR2

1. Purpose and Scope

a. This procedure establishes requirements for when operating:

   i. AECOM-owned, rented, or leased vehicles, client- or customer-owned vehicles, and personal vehicles used by AECOM employees on AECOM business.

   ii. Off-Highway Vehicles (OHVs), including all-terrain vehicles (ATVs), utility task vehicles (UTVs), and snowmobiles used to transport AECOM site personnel.

b. This procedure applies to all AECOM Americas-based employees and operations, as well as contracted personnel required to comply with this document's content.

c. Additional driving requirements are set forth in the Travel Policy – AECOM Global..

1.1 Critical Controls

The following is a list of the minimum required critical controls to be implemented as applicable by the Project Manager or Designee to prevent high potential/significant incidents:

a. Only Authorized Drivers are to operate a motor vehicle on AECOM business (this applies to rental, personal, client- or customer-owned, and AECOM-owned or leased vehicles). An Authorized Driver is an employee who receives Supervisor/Manager and, as applicable, Fleet Manager approval following evaluation of driver criteria to drive and maintain an AECOM-owned, leased, or rented vehicle, a client- or customer-owned vehicle, or a personal vehicle while conducting AECOM business.

b. Authorized Drivers must maintain a valid and current driver's license with full privileges applicable to the vehicle to be operated and location. AECOM-owned, rented, or leased vehicles are for official business use only and are not to be used for personal activities.

c. Personal vehicles driven by Authorized Drivers on AECOM business must satisfy the registration and insurance legal requirements. Refer to the Travel Policy – AECOM Global, local travel procedures, and local Employee Handbook (refer to the Employee Handbooks Ecosystem page) for any additional requirements or approvals for personal vehicle use.

d. The Manager/Supervisor must work with the Safety, Health, and Environment (SH&E) Manager to determine driver training and qualifications specific to the project and vehicle. Refer to Section 3 - Training for additional information.

e. Prior to use of electric or hybrid electric vehicles, employees must review manufacturer charging instructions.

f. The use of fully autonomous, self-driving features is prohibited.

g. Employees with conditional licenses are prohibited from operating vehicles on AECOM business.

h. Drivers must follow all traffic laws and are prohibited from being under the influence of alcohol or drugs or improperly using medication in a way that could diminish an employee's ability to drive. Refer to Substance Abuse Prevention – Americas.

i. Authorized Drivers must immediately report the following:

   i. A change or limitation(s) to their operating license to the appropriate AECOM Human Resources Representative or Manager/Supervisor.

   ii. Receipt of a legal summons associated with a moving violation related to the use of a company vehicle to the appropriate Manager/Supervisor and SH&E Manager.

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j. All Authorized Drivers must perform a walk-around inspection of the vehicle prior to operation on company business and confirm the vehicle is in good working condition before operating. Pre-operation vehicle inspections can be documented by Authorized Drivers utilizing Vehicle Inspection Checklist – Americas or similar.

k. A roadside assistance service should be identified prior to operation of a vehicle on AECOM business. Employees must never change tires or make repairs to vehicles in the field unless this activity is covered in an approved project-specific SH&E plan, with justification provided.

l. The use of portable electronic devices, consumption of food, smoking, or other activities that may distract the driver while driving is prohibited. Electronic devices include, but are not limited to, all mobile phones, laptops, radios, GPS units, DVD players, tablets, and other portable electronic devices that can cause driver distraction whether hand-held or hands-free.

   Note: GPS units and devices (e.g., smart phones, tablets) used for navigation may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their eyes off the road. Consult jurisdictional requirements and with the SH&E Manager.

m. The vehicle may not move until the driver:

   i. and all passengers have fastened their restraints in the proper manner.

   ii. has adjusted their seat, all mirrors, steering wheel, and any other adjustable driver devices.

   iii. has adequately secured all transported cargo.

n. Authorized Drivers are responsible for monitoring their assigned AECOM-owned/leased/rented vehicle for any service or maintenance requirements and are expected to coordinate repairs and service through their respective Fleet Manager. Vehicles are to be maintained according to manufacturers' specifications, local law, and the applicable environmental and operating factors (e.g., winterized with appropriate fluids, winter tires installed, and appropriate coolant for hot climates).

o. AECOM-owned or leased vehicles are to have a first aid kit, portable fire extinguisher, safety triangle, and two reflective safety vests. If not available, contact the Project Manager/Supervisor or SH&E Manager to determine how to obtain a kit. The kit should be modified based upon the project Task Hazard Assessment (THA; e.g., field level risk assessment [FLRA] in Canada) or client requirements, with additional equipment such as additional means of communication for remote locations.

p. Motorcycles may not be operated on AECOM business unless specific written approval is received from the SH&E Manager.

q. Reverse parking of vehicles while on business is recommended. A spotter must be used when the backing of trucks and heavy equipment presents a risk of collision.

r. AECOM-owned/rented/leased vehicles, personal vehicles, and specialty vehicles must not be modified beyond manufacturer's specifications without relevant approvals from SH&E.

s. When practical, alternatives to road travel including teleconferencing/video conferencing, the use of public transportation, or carpooling should be evaluated.

t. Employees must never operate motor vehicles while excessively fatigued. Refer to Fitness for Duty – Americas.

1.2 Journey Management

a. Drivers who will undertake trips more than 250 miles (400 km) each way, drive in remote or hazardous areas, or when otherwise deemed necessary or specified in project-specific requirements, must develop and document a journey management plan (JMP) using Journey Management Plan - Americas or equivalent.

b. Refer to SH&E Risk Assessment & Planning – Americas for additional requirements.

c. A JMP typically includes the route; location of route hazards; timing; rest periods and locations; and communications, emergency response, and security arrangements.

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1.3 Commercial Motor Vehicles

Prior to operating a Commercial Motor Vehicle (CMV), an SH&E Manager must be engaged to clarify and confirm that CMV operator requirements have been met. This may include the following:

a. Additional training.

b. Driver's logs.

c. Appropriate marking of vehicles.

d. Medical exams.

e. Drug and alcohol testing requirements.

1.4 Off-Highway Vehicles (OHVs)

a. Prior to operation, employees must obtain approval to operate OHVs from the Project Manager and SH&E Manager. Examples of OHVs include ATVs, utility task vehicles (UTVs), and snowmobiles.

b. For OHVs, the following minimum personal protective equipment (PPE) must be worn and equipment available:

   i. Helmet including the appropriate institute label.

   ii. Eye and face protection (conduct THA for appropriate selection).

   iii. Ear protection as needed.

   iv. Gloves.

   v. Clothing: Wear protective over-the-ankle footwear with low heels, sturdy jackets and pants. Dress for cold and wind chill as appropriate (e.g., face guard, helmet liner, etc.). Do not wear scarves or loose clothing that could potentially become entangled with moving parts.

   vi. OHVs with seating for more than one person must be manufacturer-equipped with seat belts and rollover protection systems.

   vii. First aid kit.

   viii. Small fire extinguisher, as required.

c. Refer to Safety Gear – Americas for additional PPE requirements.

d. Prior to starting an OHV, the entire vehicle must be inspected using Off-Highway (OHV) Inspection – Americas or equivalent to confirm that the OHV is in a safe operating condition.

2. Training

a. Authorized Drivers must review this procedure and complete required training. Refer to SH&E Training – Americas and its associated Assessment of SH&E Training Requirements – Americas for training requirements.

b. Vehicles such as ATVs, four-wheel drive vehicles, motorized carts, snowmobiles, box vans, and trailers (towing) require specialized training and supervision.

c. All OHV operators must be trained by an SH&E Manager or approved training vendor. Training must include at a minimum:

   i. The operator's pre-trip inspection,

   ii. Use of personal protective apparel,

   iii. Operating skills according to the OHV manufacturer's specifications,

   iv. Basic mechanical requirements, and

   v. Loading and unloading the vehicle.

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vi. Employees unfamiliar with OHVs will also receive hands-on instruction on site by experienced and trained personnel.

3. Terms and Definitions

a.	AECOM Business	Any activity performed in the name of AECOM. This includes, but is not limited to, vehicle travel between work locations, client sites, and meeting locations as well as driving performed as a part of work-related travel (e.g., driving to and from airports, hotels, train stations), and all other reimbursable travel. AECOM business does not include driving part of a daily routine commute from home to an AECOM location.
b.	AECOM Owned/Leased Vehicle	A vehicle that is purchased or leased by AECOM for business use.
c.	ATV	All-Terrain Vehicle. An ATV can also be referred to as a quad, quad bike, three wheeler (illegal), or four wheeler. The ATV is defined by the American National Standards Institute (ANSI) as “a vehicle that travels on low pressure tires, with a seat that is straddled by the operator, along with handlebars for steering control.” This type of ATV requires an active rider and includes snowmobiles. For the purpose of this procedure and in alignment with various jurisdictions, the definition of ATV also includes all-terrain vehicles that instead require a passive rider and utility vehicles such as Argos, Gators, etc.
d.	Authorized Driver	An AECOM employee who receives Supervisor/Manager and, as applicable, Fleet Manager approval following evaluation of driver criteria to drive and maintain an AECOM-owned, leased, or rented vehicle, a client or customer-owned vehicle, or a personal vehicle operated while conducting AECOM business. Authorized Drivers must maintain a current driver’s license with full privileges applicable to the vehicle to be operated.
e.	Client- or Customer-Owned Vehicle	A vehicle that is owned by a client or customer—not AECOM—but is used for AECOM business.
f.	CMV	Commercial motor vehicle. Any self-propelled or towed motor vehicle used for AECOM business (e.g., to transport passengers or property) when the vehicle is one of the following: i. Has a gross vehicle weight rating (GVWR) or gross combination weight rating equal to or greater than the weight specified by the applicable jurisdiction; or ii. Is designed or used to transport more than the number of passengers specified by the applicable jurisdiction, including the driver, for compensation; or iii. Is designed or used to transport more than the number of passengers specified by the applicable jurisdiction, including the driver, and is not used to transport passengers for compensation; or iv. Is used in transporting hazardous material in quantities specified by the applicable jurisdiction at any time.
g.	Collision	Any incident in which a motor vehicle (whether in motion, temporarily stopped, or parked) makes contact with another vehicle or pedestrian, or results in property damage and/or bodily injury, regardless of who was injured, what property was damaged, or who was responsible.
h.	Distracted Driving	An activity that takes the driver’s attention away from the primary task of driving.
i.	Local Laws	Signs, postings, laws, regulations, ordinances, and codes applicable to the jurisdiction in which the motor vehicle is being operated.
j.	Personal Vehicle	A motorized vehicle owned or leased by an employee.
k.	PPE	Personal protective equipment.

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l.	Portable Electronic Device	A mobile electronic device that is used to receive or communicate voice, email, internet, and/or public media. The device requires user interaction (typing, dialing, reading, keying, etc.) that distracts the motor vehicle operator. Example devices include, but are not limited to, Mobile Communication Devices (MCDs); Personal Data Assistants (PDAs); iPads, iPods, or other tablet models; computers; and Global Positioning System (GPS) receivers.
m.	Rental Vehicle	A vehicle that is rented from AECOM's preferred suppliers and reserved through a Company-approved travel management company or Company-approved online booking tool.
n.	Spotters	Trained personnel may provide guidance when maneuvering in close and/or complex situations in order to avoid the occurrence of an incident.

4. References

a. SH&E Training – Americas S3AM-003-PR2

b. Fitness for Duty – Americas S3AM-008-PR2

c. Substance Abuse Prevention – Americas S3AM-019-PR1

d. Safety Gear – Americas S3AM-208-PR2

e. SH&E Risk Assessment and Planning – Americas S3AM-209-PR2

f. Travel Policy – AECOM Global TR1-001-PL1

g. Employee Handbooks – Ecosystem page

5. Records

a. Journey Management Plan – Americas S3AM-005-FM1

b. Vehicle Inspection Checklist – Americas S3AM-005-FM2

c. Off-Highway Vehicle (OHV) Inspection – Americas S3AM-005-FM3

d. Assessment of SH&E Training Requirements – Americas S3AM-003-FM1

6. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Dec-2025	Initial release as S3AM-005-PR2; consolidated portions of the contents from the following retired documents: Driving – Americas S3AM-005-PR1, Authorized Driver Safety – Americas S3AM-005-ATT1, All-Terrain Vehicles – Americas S3AM-319-PR1, ATV Safety – Americas S3AM-319-ATT1, and Commercial Motor Vehicles – Americas S3AM-320-PR1.	All

Americas

Vehicle Inspection Checklist

S3AM-005-FM2

Instruction

1. **This form or equivalent is to be completed in accordance with Driving – Americas S3AM-005-PR2.**
2. **This Vehicle Inspection Checklist is intended to be completed by the vehicle's driver prior to departing on a trip.**
3. **Checking boxes in the "Yes" column means that item is present and functioning.**
4. **Deficiencies that affect or could potentially affect the safe operation of the vehicle must be repaired or corrected before departure.**
5. **This checklist is not intended to replace a regular, comprehensive vehicle maintenance program.**
6. **The completed form must be retained in the project files.**

Vehicle Tag No	Mileage	Date	Time	Driver Name	Location
….	….	…..	….	….	….

	Item	Yes	No	N/A
1.	**General**			
a.	Proof of insurance and registration available and current?	☐	☐	☐
b.	Is the date of the last regular maintenance known, or is the mileage/date of next scheduled maintenance known?	☐	☐	☐
c.	Is the overall condition of the vehicle good (no body damage, unusual sounds, leaks, odors, etc.)?	☐	☐	☐
2.	**Tires**			
a.	Do all tires have sufficient tread for driving conditions? Legal limit: 2/32" (for rain/snow: > 4/32")	☐	☐	☐
b.	Are tires sufficiently inflated for driving conditions?	☐	☐	☐
c.	Are the lug nuts and stem caps present and tight for each tire?	☐	☐	☐
d.	Is the spare tire and jack present and in good condition?	☐	☐	☐
3.	**Vehicle Interior**			
a.	Are the brake and accelerator pedal pads in good condition?	☐	☐	☐
b.	Are the floor mats in good condition and not interfering with the brake or accelerator pedals?	☐	☐	☐
c.	Is the seat properly adjusted (including the headrest)?	☐	☐	☐
d.	Is the seatbelt in good condition?	☐	☐	☐
e.	Are the mirrors in good condition (not broken, dirty)?	☐	☐	☐
f.	Are the dashboard/instrument lights working?	☐	☐	☐
g.	Is the dashboard free of warning lights and do the gauges appear to work when the car is started?	☐	☐	☐
h.	Does the horn work?	☐	☐	☐
i.	Are distractions such as cell phones and GPS units secured so they do not encourage use?	☐	☐	☐
4.	**Lights and Signals**			
a.	Do the headlights and high beams work?	☐	☐	☐
b.	Do the tail lights function properly?	☐	☐	☐
c.	Do the turn signals work (front and rear)?	☐	☐	☐

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	Item	Yes	No	N/A
d.	Do the brake lights work (including high light in the rear window if applicable)?	☐	☐	☐
e.	Do the hazard lights (emergency flashers) work?	☐	☐	☐
f.	Do back up / reverse lights work?	☐	☐	☐
g.	If equipped with a back-up alarm, can it be heard clearly?	☐	☐	☐
5.	**Mechanical**			
a.	Do the brakes work and feel solid (not soft)?	☐	☐	☐
b.	Does the parking/emergency brake work?	☐	☐	☐
c.	Is the steering in good working condition (not loose)?	☐	☐	☐
d.	Is the engine oil level full or in the operating zone?	☐	☐	☐
e.	Excessive vehicle bounce going over bumps reported (possible sign of worn shock absorbers)?	☐	☐	☐
f.	Is the fuel level full or at an adequate level for the proposed usage?	☐	☐	☐
6.	**Windows and Windshield**			
a.	Is the windshield clean and unbroken?	☐	☐	☐
b.	Are the wiper blades in good condition (front and rear)?	☐	☐	☐
c.	Are all the windows clean and unbroken and windshield fluid available and operational?	☐	☐	☐
7.	**Emergency Equipment (as needed per conditions/project requirements)**			
a.	Is there a “Safety Kit” (fire extinguisher, first aid, safety triangle and 2 reflective vests)?	☐	☐	☐
b.	Is survival gear and equipment available (blanket, water, heat source, flashlight, etc.)?	☐	☐	☐
c.	Is a means for emergency communication available?	☐	☐	☐
8.	**Other Equipment (as needed per conditions/project requirements)**			
a.	Is there a means to secured loads (cargo next, container)?	☐	☐	☐
b.	Are cones or other warning devices available?	☐	☐	☐
c.	Is weather specific equipment (snow chains, tired etc.)?	☐	☐	☐
d.	Does the vehicle have a snow brush/ice scraper?	☐	☐	☐
9.	**Comments**			
….				

….		…..
Inspector Name	**Signature**	**Date**

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Heat and Cold Stress

S3-AM-112-PR2

1. Purpose and Scope

a. Provide guidance to employees on the effects of heat and cold stress and controlling exposure to hot and cold working conditions.

b. This procedure applies to all AECOM Americas-based employees and operations, as well as contracted personnel required to comply with this document's content.

2. Procedure

2.1 Critical Controls

a. The Project Manager must monitor weather forecasts and current conditions and identify potentially hazardous heat or cold exposures. If potential for hazardous heat or cold exposure exists, the Project Manager must develop a heat/cold stress exposure control plan, incorporate the plan in the project-specific Safety, Health, and Environment (SH&E) plan, and confirm implementation in the field. Refer to SH&E Risk Assessment and Planning – Americas.

b. During a task hazard assessment (THA; e.g., field level risk assessment [FLRA] in Canada), potential heat and cold stress hazards must be evaluated, and appropriate control measures must be implemented to mitigate associated risks. Refer to SH&E Risk Assessment and Planning – Americas.

c. Employees must not be exposed to levels exceeding those specified for the given work level and work-rest regimen.

d. Employees must immediately report any signs or symptoms of heat or cold stress they may experience or observe in fellow employees. Refer to SH&E Incident Response and Investigation – Americas. Project managers should use such information to adjust the work-rest schedule.

e. Initiate emergency response procedures when necessary, including contacting emergency medical services as appropriate and in accordance with the project-specific SH&E plan. If an employee shows signs or reports symptoms of heat or cold stress, they must be removed from the hot or cold environment and treated by a first aid-trained person or by a physician, as needed.

f. The Project Manager should include costs in project budgets for specialized equipment and supplies needed to complete the field activities.

2.2 Heat Stress Planning and Prevention

a. Requirements for working in extreme heat may be triggered by regulatory criteria (e.g., state law in California, Washington, Oregon, Nevada, and Maryland) or as a result of a hazard analysis assessing various contributing factors.

b. Monitor ambient temperatures and conduct heat stress monitoring, as required, in accordance with the project-specific SH&E plan. Revise the heat stress monitoring and controls if there are any reports of discomfort due to heat stress.

c. Monitor temperatures in each unique environment in which employees perform work. Follow manufacturer's specifications on proper use of the thermometer.

d. Assess and apply as is practicable the hierarchy of controls (ordered by level of effectiveness) to reduce employees' exposure.

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2.2.1 Engineering Controls

a. Wherever possible, a designated break area should be established in an air-conditioned space, or in shaded areas where air conditioning is impractical.

b. The break area should be equipped to allow employees to loosen or remove protective clothing, and sufficient seating should be available for all employees.

c. If shade is not available, shaded areas must be constructed. This same type of canopy can be set up to shade personnel performing various types of work in hot weather.

d. Cooling measures other than shade (e.g., misting, air-conditioned break areas, and air-conditioned vehicles) can be used in lieu of shade provided it can be demonstrated they are at least as effective in cooling employees.

e. Employees should have access to these rest areas at break times and at any other time when suffering from heat illness or believing a preventive recovery period is needed.

2.2.2 Administrative Controls

a. Employees must:

   i. Review the heat stress exposure control plan within the SH&E plan and/or THAs.

   ii. Confirm a reliable method of communication is in place to allow for contact with supervision.

   iii. Take frequent short breaks in areas sheltered from direct sunlight, frequently eat and drink small amounts, and avoid performing manual labor during breaks (other than paperwork or similar light tasks).

   iv. Avoid strenuous physical activity outdoors during the hottest part of the day.

   v. Avoid sudden changes of temperature.

   vi. Avoid working alone in extreme heat and instead use the buddy system.

   vii. Air out a hot vehicle before getting into it.

   viii. Obtain medical direction if taking diuretics during hot weather (a lower dose may be necessary).

   ix. Perform a self-assessment to evaluate their body's reaction to the heat and work conditions.

b. The Project Manager must:

   i. Develop appropriate work-rest schedules based on recognized technical standards (e.g., those published by National Institute for Occupational Safety and Health [NIOSH], American National Standards Institute [ANSI], and American Conference of Governmental Industrial Hygienists [ACGIH]) or as required by the most stringent applicable local law. Appendix 1– Heat Stress Work-Rest Schedule, adapted from ACGIH guidelines, may be used as a reference where no conflicting local law exists. The frequency and length of work breaks should be based on the ambient temperature, amount of sunshine, humidity, the amount of physical labor being performed, the physical condition of the employees (e.g., acclimated or unacclimated), and protective clothing being used.

   ii. Once a work-rest schedule is established, continually evaluate its effectiveness through observation of employees for signs/symptoms of heat stress such as dizziness, heat cramps, and/or extreme thirst.

   iii. Consider physiological monitoring of each employee's vitals (pulse, blood pressure, and temperature) and engage with SH&E and the Occupational Health Team in support of the assessment and implementation. Physiological monitoring can provide additional information in determining if the schedule is adequate or needs to be adjusted. Physiological monitoring of heat stress may be documented using Heat Stress Monitoring Log – Americas, or equivalent.

      Note: Monitoring of the extent of water loss may be considered. Water loss may be monitored by weighing the Employee at the start and end of each workday. A weight loss exceeding 1.5% of total body weight indicates the need for increased fluid intake.

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iv. Allow for acclimatization when work is performed by new and returning employees (absent 1 week or more) who have not had time to acclimatize, as they may be more susceptible to heat-related illnesses.

1. Minimize workload and gradually increase as tolerance is built up.
2. Allow for more frequent breaks.
3. While acclimatization normally takes approximately 5 to 7 days, heightened monitoring of these employees must be maintained for the first 14 days.
4. When possible, employees should begin hydrating at least 3 days prior to working in high heat conditions.

v. Try scheduling work at night or during the cooler parts of the day.

vi. Have cool (not cold), fresh, potable water available in the break area, and in the work area itself unless hygiene/chemical exposure issues prevent it.

vii. Have dry clothing or towels available to minimize chills when taking breaks.

2.2.3 Personal Protective Equipment (PPE)

a. Auxiliary cooling should be considered when ANY of the following conditions exist:

i. Ambient temperature is over 80°F (26°C).

ii. Employees are wearing impermeable garments (i.e., Tyvek, Saranex, and Chemrel).

iii. It is desirable to have long work shifts with minimum interruption.

b. If cooling devices are worn, only physiological monitoring must be used to determine work activity.

c. Cooling devices should be worn beneath protective garments, but over any underclothing.

d. Heat/flame-resistant gloves or mittens, tested in accordance with legal standards, should be selected when handling extremely hot or cold materials.

2.3 Cold Stress Planning and Prevention

a. Requirements for working in extreme cold may be triggered by regulatory criteria or because of a hazard analysis assessing various contributing factors.

b. Monitor ambient temperatures and implement controls in accordance with the project-specific SH&E plan. Revise the cold stress controls if there are any reports of discomfort due to cold stress.

c. Assess and apply as practicable the hierarchy of controls (ordered by level of effectiveness) to reduce employees' exposure.

2.3.1 Engineering Controls

a. The Project Manager can make shelters or screens available around the work area to provide protection from wind and rain and insulation from the ground. If a shelter is not readily available, consider supplying temporary shelters.

b. Prevent body heat loss by providing appropriate sources of heat (e.g., warm packs and portable heaters) and/or using insulating materials on equipment handles. Adequate protection, such as general ventilation, must be incorporated into any warming shelter design to prevent carbon monoxide poisoning.

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2.3.2 Administrative Controls

a. Employees must:

   i. Review the cold stress exposure control plan within the SH&E plan and/or THAs.

   ii. Confirm a reliable method of communication is in place to allow for contact with supervision.

   iii. Get adequate rest and nutrition. Eat high-calorie snacks to maintain body metabolism and replenish energy stores.

   iv. Drink plenty of warm liquids to avoid dehydration.

   v. Limit time of exposure to the cold. Take advantage of heat from the sun and stay out of the wind as much as possible.

   vi. Take frequent short breaks in warm dry areas to allow the body to warm up.

   vii. For a wind chill below 10°F or -12°C, adopt a “buddy system” of constantly watching the faces of others in the party for white skin tissue, which is evidence of frostbite (frostnip).

   viii. Be informed of the hazards associated with unstable snow or ice build ups.

b. The Project Manager must:

   i. Develop appropriate work-to-warming-break periods based on ambient temperature, wind speed for workers wearing dry clothing, wind chill temperature (refer to Appendix 2– Wind Chill Temperature Index), physical exertion, and acclimatization.

   ii. Confirm appropriate protection measures are in place.

   iii. Confirm walking and working surfaces are cleared of ice and snow to prevent slips and falls.

   iv. Allow for acclimatization when work is performed by new and returning employees (absent 1 week or more) who have not had time to acclimatize, as they may be more susceptible to cold-related illnesses.

   v. Make special provisions to prevent hypothermia and freezing of damaged tissue in addition to providing for first aid treatment.

   vi. Confirm extra blankets or sleeping bags are on site and provide opportunities for employees to change into dry clothing when heavy work is performed.

   vii. Specify, make available, and confirm supplies are regularly inspected/restocked when necessary, including heating/cooling enclosures, de-icing, traction aids, warm or replenishing drinks, and batteries.

2.3.3 Personal Protective Equipment

a. Wear multiple layers of insulating clothing to help prevent cold stress. When applicable, PPE should include:

   i. An outer layer to break the wind and allow some ventilation.

   ii. Head coverings and gloves or mittens for cold, wet, and windy conditions.

   iii. A hat or hard hat liner.

   iv. Insulated footwear with adequate traction to prevent slips and falls. Traction devices may need to be applied to the soles of work boots if the Employee may be walking on icy surfaces. Confirm the addition of ice cleats or other traction devices do not pose additional hazards.

   v. A change of dry clothing available in case work clothes become wet.

   vi. Eye and face protection when working outdoors in a snow and/or ice-covered terrain.

   vii. Sunglasses (with UVA and UVB protection) and sunscreen when there is a persistent combination of snow and direct sun.

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viii. Special safety goggles to protect against potential eye hazards such as blowing ice crystals, snow, ultraviolet light, and glare.

ix. Face guards to protect skin in cold, windy conditions, including riding in an unshielded vehicle.

b. Avoid cotton, especially blue jeans.

c. Confirm these items are approved and do not introduce additional unacceptable hazards (e.g., insufficient visibility and conductivity).

3. Training

a. All employees potentially exposed to heat or cold stress, including their supervisors, will receive the appropriate training prior to work commencing. Refer to SH&E Training – Americas for additional training requirements.

b. Training will include, but is not limited to:

i. Sources of exposure

ii. Use and impact of protective clothing

iii. Importance of acclimatization

iv. Safe work practices

v. Recognition of heat- or cold-related illness symptoms

vi. Preventive/corrective measures

vii. Weather monitoring

viii. Proper eating and drinking practices

ix. Buddy system

x. Proper use of PPE.

xi. First aid and emergency response procedures for symptoms on heat- or cold-related stress

4. Terms and Definitions

a.	Acclimatization	The process of physiologically adjusting or becoming accustomed to a new climate or environment.
b.	ACGIH	American Conference of Governmental Industrial Hygienists.
c.	Auxiliary Cooling	Cooling devices worn beneath protective garments, but over any underclothing.
d.	BEI	Biological Exposure Index.
e.	Cold Stress	The physiological effects due to cold temperatures and/or wind chill.
f.	Heat Cramps	A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.
g.	Heat Rash	A heat-induced condition characterized by a red, bumpy rash with severe itching.
h.	Heat Stress	The combination of environmental and physical work factors that constitute the total heat load imposed on the body. Symptoms include heavy sweating, headache, dizziness, nausea, and fast heart rate.
i.	Hypothermia	Condition of reduced core body temperature to 95°F (35°C) resulting in loss of dexterity, loss of mental alertness, collapse, and possible death.
j.	TLV	Threshold Limit Value.
k.	Wind Chill	The combined effect of air temperature and wind velocity. Wind chill on exposed skin can cause heat loss.

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5. References

a. SH&E Training – Americas S3AM-003-PR2

b. SH&E Incident Response and Investigation – Americas S3AM-004-PR2

c. Safety Gear – Americas S3AM-208-PR2

d. SH&E Risk Assessment and Planning – Americas S3AM-209-PR2

e. Work On, In, Or Near Water – Americas S3AM-315-PR2

6. Records

a. Heat Stress Monitoring Log – Americas S3AM-112-FM1

7. Appendices

a. Appendix 1 – Heat Stress Work-Rest Schedule

b. Appendix 2 – Wind Chill Temperature Index

8. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Dec-2025	Initial release as S3AM-112-PR2; consolidated portions of the contents from the following retired documents: Cold Stress – Americas S3AM-112-PR1, Temperature Thresholds – Americas S3AM-112-ATT1, Heat Stress – Americas S3AM-113-PR1, and Temperature Thresholds – Americas S3AM-113-ATT1.	All

Appendix 1 Heat Stress Work-Rest Schedule

a. ACGIH defines heat stress as the net heat load to which a worker may be exposed from the combined contributions of metabolic heat, air temperature, air movement, humidity, radiant energy, and clothing. The ACGIH gives these limits in units of WBGT (wet bulb globe temperature) degrees Celsius (°C), which considers environmental factors such as air temperature, humidity, and air movement (see Table 1). WBGT values are not the same as humidex values. In some workplace situations, solar load (heat from radiant sources) is also considered in determining the WBGT.

Table 1. ACGIH Screening Criteria for Heat Stress Exposure (WBGT values in °C) for 8-Hour Work Day 5 Days per Week with Conventional Breaks

Allocation of Work in a Work/Rest Cycle	Acclimatized				Action Limit (Unacclimatized)			
	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
75-100%	31.0	28.0	--	--	28.0	25.0	--	--
50-75%	31.0	29.0	27.5	--	28.5	26.0	24.0	--
25-50%	32.0	30.0	29.0	28.0	29.5	27.0	25.5	24.5
0-25%	32.5	31.5	30.5	30.0	30.0	29.0	28.0	27.0

Note: Assumes 8-hour workdays in a 5-day workweek with conventional breaks.
Threshold Limit Values (TLVs) assume that workers exposed to these conditions are adequately hydrated, are not taking medication, are wearing lightweight clothing (long-sleeve shirts and pants), and are in generally good health.

Examples of workloads:

Rest – sitting (quietly or with moderate arm movements)

Light work – sitting or standing to control machines; performing light hand or arm work (e.g., using a table saw); occasional walking; driving

Moderate work – walking about with moderate lifting and pushing or pulling; walking at moderate pace; e.g., scrubbing in a standing position

Heavy work – pick and shovel work, digging, carrying, pushing/pulling heavy loads; walking at fast pace; e.g., carpenter sawing by hand

Very heavy – very intense activity at fast to maximum pace; e.g., shoveling wet sand

Source: Adapted from 2024 TLVs® and BEIs® - Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists (ACGIH), 2024, pp. 236 and 237.

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b. The ACGIH exposure limits are intended to protect most workers from heat-related illnesses. If you are wearing heavier clothing, then the exposure limit should be lowered per ACGIH recommendations suggested in Table 2.

Table 2. Correction of TLV for Clothing (Values cannot be added when wearing multiple layers)

Clothing Type	WBGT Correction (°C)
Work clothes (long-sleeve shirt and pants)	0
Cloth (woven material) coveralls	0
SMS (Spunbonded – Meltdown – Spunbonded) polypropylene coveralls	+ 0.5
Polyolefin coveralls	+ 1
Double-layer woven clothing	+ 3
Limited-use vapor-barrier coveralls	+ 11

Note: These values are not to be used for completely encapsulating suits. Coveralls assume only modest clothing is underneath, not a second layer of clothing.

Source: Adapted from 2024 TLVs® and BEIs®: Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists (ACGIH), 2024, p. 235.

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Appendix 2 Wind Chill Temperature Index

Table 3 gives temperatures for various combinations of wind and air temperature, as well as guidelines on the danger of skin exposure.

Table 3. Wind Chill Temperature Index

Wind Chill Temperature Index
(Frostbite Times Are for Exposed Facial Skin)

Air Temperature (°C)

Wind Speed (km/h)	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47	-53	-58
10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63
15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54	-60	-66
20	1	-5	-12	-18	-24	-30	-37	-43	-49	-56	-62	-68
25	1	-6	-12	-19	-25	-32	-38	-44	-51	-57	-64	-70
30	0	-6	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72
35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60	-66	-73
40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61	-68	-74
45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62	-69	-75
50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63	-69	-76
55	-2	-8	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77
60	-2	-9	-16	-23	-30	-36	-43	-50	-57	-64	-71	-78
65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79
70	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-80
75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80
80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81

FROSTBITE GUIDE

Increasing risk of frostbite for most people in 10 to 30 minutes of exposure
High risk for most people in 5 to 10 minutes of exposure
High risk for most people in 2 to 5 minutes of exposure
High risk for most people in 2 minutes of exposure or less

Source: Adapted from 2024 TLVs® and BEIs®: Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists (ACGIH), 2024, p. 226.

Americas

Heat Stress Monitoring Log

S3AM-112-FM1

Instructions

1. **This form is to be completed in accordance with Heat and Cold Stress – Americas S3AM-112-PR2.**
2. **The purpose of this form is to monitor employees for heat illness when applicable.**
3. **It is the responsibility of the Foreman or Supervisor-in-Charge to confirm that each person completes the required information.**
4. **The completed form shall be retained in the project files.**

Details							
Project Name	….		**Date**	…..	**Foreman/Supervisor Name**	….	
Work/Rest Duration:	….	Work (minutes)	….	Rest (minutes)	**Temperature Measured in**	☐ Celsius	☐ Fahrenheit

Employee Name	Water Provided[1]		Acclimated[2]		Vitals[3]	Period 1		Period 2		Period 3		Period 4	
	Yes	No	Yes	No		In	Out	In	Out	In	Out	In	Out
….	☐	☐	☐	☐	**P**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**BP**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**Temp**	….	….	….	….	….	….	….	….
….	☐	☐	☐	☐	**P**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**BP**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**Temp**	….	….	….	….	….	….	….	….
….	☐	☐	☐	☐	**P**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**BP**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**Temp**	….	….	….	….	….	….	….	….

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Employee Name	Water Provided[1]		Acclimated[2]		Vitals[3]	Period 1		Period 2		Period 3		Period 4	
	Yes	No	Yes	No		In	Out	In	Out	In	Out	In	Out
….	☐	☐	☐	☐	**P**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**BP**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**Temp**	….	….	….	….	….	….	….	….
….	☐	☐	☐	☐	**P**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**BP**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**Temp**	….	….	….	….	….	….	….	….
….	☐	☐	☐	☐	**P**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**BP**	….	….	….	….	….	….	….	….
	☐	☐	☐	☐	**Temp**	….	….	….	….	….	….	….	….

[1] Each employee should be provided a sufficient amount of water or sports drink before entering the hot zone. Drinks such as coffee and cola should be discouraged.

[2] An employee is “acclimated” if he/she has worked in a hot environment for at least 5 - 7 consecutive days. If an employee is acclimated, check “Yes.” If an employee is not acclimated, check “No” and reduce the work duration by 50 percent for that Employee until the 5 – 7 -day period is reached.

[3] P = pulse rate, BP = blood pressure, Temp = body temperature

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Noise

S3AM-118-PR1

1. Purpose and Scope

a. This procedure establishes requirements for the following:

   i. An effective hearing conservation program.

   ii. Confirming that personal noise exposure remains within acceptable limits.

b. This procedure applies to all AECOM Americas-based employees and operations, as well as contracted personnel required to comply with this document's content.

2. Procedure

2.1 Critical Controls

The following is a list of minimum mandatory critical controls to be implemented, as applicable, by the Project Manager or Designee to prevent high potential and/or significant incidents:

a. Safety, Health, and Environment (SH&E) plans and task hazard assessments (THAs; e.g., field level risk assessments [FLRAs] in Canada) must identify:

   i. Applicable hazards related to noise exposure via established exposure limits and action levels specified by local law.

   ii. In the absence of specifications, an 8-hour time-weighted average (TWA) of 85 decibels A (dBA) as the action level.

   Note: Refer to SH&E Risk Assessment and Planning – Americas.

b. When processes or areas present potential or actual noise exposures at or above the action level identified by local law, a trained and competent individual must conduct a noise survey and interpret results to measure the extent of the hazard.

c. Resulting documentation (e.g., noise maps, and results of the sound level survey data) must be communicated to affected employees in writing within 15 days from receipt of results, or less where required by local law, and posted or available at the location.

d. Noise assessments must be repeated when there is any change in processes or equipment affecting the noise level or the exposure duration.

e. Eliminate noise sources or use engineering controls to reduce noise levels when practicable prior to implementing hearing protection personal protective equipment (PPE).

f. Where practicable, a clearly visible warning sign must be posted at every approach to an area in the workplace where the sound level regularly exceeds 85 dBA.

2.2 Hearing Protectors

The Project Manager is responsible for confirming the following:

a. At a minimum, hearing protectors must provide a level of protection bringing actual or anticipated exposure below the established exposure limit in accordance with local law.

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b. Hearing protection is mandatory for all employees who:

   i. Work on or near heavy equipment unless personal dosimetry or other techniques have been used to document actual exposure is below the action level;

   ii. Are exposed to 85 dBA or higher at any time; and/or

   iii. Have experienced a standard threshold shift (STS).

c. Hearing protection must be made available at no cost to all employees exposed to the action level.

   Note: At least two types of hearing protectors must be available to employees free of charge, and the type of hearing protector must be suitable to the task and in accordance with local law.

d. Hearing protectors must be used in accordance with manufacturer's specifications to effectively protect hearing.

e. Refer to Safety Gear – Americas for additional information.

2.3 Audiometric Testing

a. Employees with exposure greater than the action level must be enrolled in the medical surveillance program at no cost to the employees, which includes that the enrolled employees receive:

   i. Baseline audiograms within 6 months of the first exposure (consult local law for more stringent timelines).

   ii. Audiograms annually and compared with the baseline exam to determine if the audiogram is valid, and if there is an STS.

   iii. Audiograms during their exit physicals.

b. For more information on medical surveillance, refer to Fitness for Duty – Americas.

c. Audiometric testing and employee notification of results must be in accordance with local law.

2.4 Employee Monitoring

a. When information indicates employees' exposure may equal or exceed the applicable action level, the Project Manager and SH&E Manager must develop and implement a site-specific monitoring program to identify inclusion in the hearing conservation program and enable the proper selection of hearing protectors.

b. Noise surveys must be conducted in a manner reasonably reflecting the exposure of affected employees. Surveys must be conducted under supervision of a competent person.

3. Training

a. All employees with potential exposure above the applicable action levels, or who otherwise utilize any type of hearing protector, must participate in a hearing conservation training program.

b. Training must occur with 30 days of enrollment into the hearing conservation program and address the use of hearing protectors. Refer to SH&E Training – Americas and its associated Assessment of SH&E Training Requirements – Americas for additional training requirements.

c. Hearing protection training must be conducted annually for all affected employees or more frequently for employees who do not properly use hearing protectors or otherwise fail to comply with this policy.

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4. Terms and Definitions

a.	Action Level	May also be referred to as Monitoring Level. An 8-hour, time-weighted average established by local law, measured on the A-scale, slow response. Depending on local law, this can vary anywhere from 74 dBA to 85 dBA, and may additionally be defined as 50% of the allowable noise dose. In the absence of an action level specified by local law, 85 dBA must be used as the default action level.
b.	dB	Decibel – Logarithmic unit of measurement of sound level.
c.	Established Exposure Limit	The maximum regulatory noise exposure to which an individual may be exposed to for an 8-hour time weighted average (TWA). This limit is referred to by different terminology depending upon local law (e.g., Permissible Exposure Limit [PEL], Contamination Limit, Occupational Exposure Limit [OEL], Threshold Limit Value [TLV], etc.). Acceptable methods of adjusting this limit to correspond to a different exposure period (e.g., 10 hours) vary by local law.
d.	PPE	Personal Protective Equipment.
e.	SH&E	Safety, Health, and Environment.
f.	STS	Standard Threshold Shift – When one's hearing threshold has changed (relative to the baseline audiogram) an average of 10 dB or more at 2000, 3000, or 4000 Hz in either ear.
g.	TWA Sound Level	Time-Weighted Average Sound Level – The average noise level a person is exposed to over a specific period of time, usually an 8-hour workday, taking into account variations in the noise level during that time. It considers both noise levels and how long the employee is exposed at each noise level.

5. References

a. SH&E Training – Americas S3AM-003-PR2

b. Fitness for Duty – Americas S3AM-008-PR2

c. SH&E Risk Assessment and Planning – Americas S3AM-209-PR2

d. Safety Gear – Americas S3AM-208-PR2

6. Records

a. Noise exposure measurement records, surveys, and site-specific hearing conservation plans must be retained at the project or facility for the duration of the project.

b. Audiogram records must be retained in the employee's medical records.

c. Assessment of SH&E Training Requirements – Americas S3AM-003-FM1

7. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Mar-2016	Initially released as S3NA-118-PR1	
1	31-July-2019	Re-released as S3AM-118-PR1	
2	01-Dec-2025	2025 review; comprehensive revision as part of the Americas SH&E IMS simplification; converted to new IMS Procedure Template and AECOM Style.	All

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Safety Gear

S3AM-208-PR2

1. Purpose and Scope

a. The purpose of this procedure is to define the process and criteria for the selection, issuance, and maintenance of personal protective equipment (PPE) and other safety equipment, including emergency safety equipment.

b. PPE must be used when identified hazards cannot be eliminated through substitution, engineering, or administrative controls or to provide additional protection (see Safety, Health, and Environment (SH&E) Risk Assessment and Planning – Americas).

c. This procedure applies to all AECOM Americas-based employees and operations as well as personnel contractually required to comply with this document's content.

2. Procedure

2.1 Determining the Need for PPE

a. The Project Team must:

   i. Identify necessary PPE-related control measures in task-specific risk assessments. Refer to SH&E Risk Assessment and Planning – Americas for risk assessment requirements.

   ii. Include PPE requirements in the applicable SH&E plan and task hazard assessments (THAs; e.g., field level risk assessments [FLRAs] in Canada).

b. Prior to entering any controlled or restricted work area, employees must review the project-specific SH&E plan and corresponding THA(s) to confirm that they are equipped with the required PPE appropriate to the specific work area's hazards.

c. As required, the Project Team and SH&E Manager should evaluate employee use of PPE and adequacy of PPE protection on a routine basis. This may be documented using Personal Protective Equipment (PPE) Inspection – Americas, or equivalent.

2.2 Minimum PPE Requirements

a. Minimum PPE requirements for employees working at locations outside of an AECOM office include:

- Safety glasses
- Hardhat
- Sleeves that cover the shoulders and long pants or coveralls
- Class 2 high-visibility reflective vests
- Work boots with defined heel and over-ankle support
- Protective gloves, carried on the person

b. PPE must also:

   i. Properly fit the Employee's body, with consideration given to gender-specific gear and sizing.

   ii. Be selected and used in accordance with recognized standards (e.g., applicable American National Standards Institute [ANSI]/Canadian Standards Association [CSA] standards) and provide effective protection. Employees must follow instructions and manufacturers' specifications on the care, use, and storage of PPE.

   iii. Not in itself create a hazard to the wearer.

   iv. Be compatible so one item of PPE does not interfere with another.

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v. Be maintained in good working order and in a sanitary condition. Employees must inspect their required PPE prior to use. Worn out, expired, damaged, and/or defective equipment must be removed from service and replaced.

vi. Not be altered in any way.

a. Employees must obtain basic PPE (e.g., safety glasses, hardhat, reflective vest, gloves, and hearing protection) and required specialized PPE (e.g., fall protection equipment and respirators) from AECOM at no charge. Reimbursement approvals for any additional PPE (e.g., prescription safety glasses, safety-toed work boots, etc.) must be in accordance with employee's regional and/or business line policy, and legal requirements.

b. AECOM locations must maintain, or otherwise have readily accessible, a supply of PPE of appropriate types and sizes, such as hardhats, high-visibility vests, safety glasses, gloves, hearing protection, and chemical-resistant clothing as applicable to the nature of their field activities. The Project Manager or designee will be responsible for maintaining this inventory.

c. AECOM locations should review their PPE program on at least an annual basis.

d. Deviation from these minimum requirements may be allowed if the risk assessment deems appropriate and this deviation is approved by the Project Manager and SH&E Manager via the completion of SH&E Management System Variance Request– Americas or equivalent documentation.

2.3 Eye and Face Protection

a. AECOM employees must use appropriate eye and face protection when eye or face hazards are present or there is a potential for flying particles, molten metal, liquid chemicals, acid and caustic liquids, chemical gases or vapors, injurious light radiation, or arc flash when working on or near exposed energized apparatus.

b. The level of eye and face protection will be based on the risk assessment. Refer to Table 1 for several types of eye and face protection to consider.

c. Contact lenses must not be worn in areas where there is potential exposure to a welding arc or in chemical environments as required by the safety data sheet (SDS).

Table 1. Types of Eye and Face Protection

Type of Eye and Face Protection	Specifications and Usages
Safety glasses	The most used form of eye protection is safety glasses. To prevent lateral exposure to impact fragments, safety glasses should be equipped with side shields. Depending on the hazard, side shields can be either a cup-type or flat-folded. The cup-type provides more complete protection. Prescription safety glasses may be provided to employees who require vision correction and are working in areas where eye protection is mandatory. Alternatively, safety glasses designed to go over prescription glasses can be worn, when allowed by law.
Spoggles (foam or rubber lines)	Spoggles are safety glasses that include foam seals on frames to improve sealing against the face. They should be used when there is a potential for flying particles small enough to enter behind standard safety glasses.
Safety goggles (direct, indirect, or non-vent)	Goggles form a complete seal around the eye area, providing more coverage than safety glasses, and are more appropriate for chemical hazards and conducting tasks such as power washing or when working in an area or at a process involving high dust or particulate concentrations.

Type of Eye and Face Protection	Specifications and Usages
Face shields	Face shields should be used when there is danger from impact from flying particles or chemical splash. Face shields are secondary protectors and must be worn over safety glasses or goggles when using welding, cutting, chipping, grinding, or buffing tools. Hazards associated with drilling or operations involving striking should also be assessed for the need for dual eye protection.
Dual eye protection	This may be required to be worn by any employee undertaking or in proximity to a task producing projected particles or material due to hand tool use as determined by the project-specific risk assessment and/or THAs.

2.4 Head Protection

a. The main type of head protector is the hardhat. Hardhats are designed to protect employees from impact and penetration caused by objects hitting their head. The shell of the hardhat is designed to absorb some of the impact. The suspension, which consists of a headband and strapping, not only holds the hardhat in place but is critical for absorbing and distributing impact shock loads. Refer to Table 2 for types of hardhats.

b. Employees must:

   i. Not use bump caps as protection against head injury.

   ii. Use hardhats designed for a face shield attachment for tasks requiring face shields. Some hardhats also include attachment slots for hearing protection muffs.

   iii. Only wear AECOM-approved hardhats (cowboy style are not acceptable).

   iv. Avoid storing a hardhat in direct sunlight (e.g., vehicle back window), as it will be subjected to unnecessary UV exposure.

   v. Wear hardhats in the forward position. A hardhat can be worn backwards with written verification and instructions from the hardhat manufacturer indicating the hardhat has been tested and found compliant.

   vi. Wear hardhats whenever there is a danger of falling objects.

   vii. Avoid any contact of the hardhat with insect repellant. Some insect repellants can degrade hardhat materials.

Table 2. Head Protection Types

Type of Hardhat	Specifications and Usages
Type I	• Provides crown protection from penetration and impact. • Intended to reduce the force resulting from a blow only to the top (crown) of the head.
Type II	• Provides crown and lateral penetration and impact protection. • Intended to reduce the force resulting from a blow received off center or to the top of the head. • Typically lined on the inside with thick, high-density foam.

2.5 Foot Protection

a. Safety-toed (steel or composite) boots with a minimum of 6 inches (15.2 centimeters) of ankle support, an oil-resistant sole, and a distinctive heel must be the minimum footwear requirement of all employees engaged in construction, operation, maintenance, or when hazards to feet are present or have the potential to be present (this includes impact, puncture, cut, electrical, thermal, or chemical hazards).

b. Employees assigned to field projects who are not required to wear specified protective footwear (e.g., steel-toed boots) will wear substantial, high-sided work boots.

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2.6 Hand Protection

a. Employees must have gloves in their immediate possession whenever they are on a work site.

b. Employees must use appropriate hand protection when their hands are exposed to hazards such as skin absorption of harmful substances, severe cuts or lacerations, severe abrasions, punctures, chemical burns, thermal burns, harmful temperature extremes, high hand vibration, and sharp objects.

c. Gloves must be sized correctly for the Employee.

d. After physical guards, gloves provide the most common hand protection.

e. In most cases there are trade-offs between hazard protection and functional performance of a glove. These factors are equally important. The higher the severity of the hazard, the more important hazard protection is. Table 3 offers additional guidance on key considerations when selecting a glove for certain protection and performance properties.

Table 3. Key Considerations and Selection Criteria for Gloves

Category	Properties	Protection and Performance Needs	Key Considerations and Selection Criteria
Mechanical	Cut Resistance	Protection from sharp edges, blades, and other cutting hazards	**Testing Standard: American Society for Testing and Materials (ASTM) F1790 and ASTM F1970-05** There are 5 levels of cut resistance; 5 is the highest.
	Puncture Resistance	Protection from sharp objects like nails, pins, needles, and wire	**Testing Standard: EN 388:2003** This testing measures the force required to pierce the sample with a standard sized point.
	Abrasion Resistance	Durability and resistance to abrasive objects or materials	**Testing Standard: ASTM D3389-05 and ASTM D3884-09** Abrasion resistance testing measures how well the glove material resists loss of material from rubbing on rough surfaces.
	Shielding	Protection from impact, ricochet, and small projectiles	Some gloves have thick padding or hard guards around the back of the hand or knuckles. These can offer good protection against impact.
Chemical	Degradation & Absorption Resistance	Durability and resistance to breaking down and/or permeating the glove from exposure to chemicals	Identify products/chemicals that present potential exposure risks. Refer to the chemical's SDS and glove manufacturer's specifications for the appropriate glove choice.
Thermal	Heat Resistance	Thermal protection from hot objects or materials	**Testing Standard: ASTM F1060-08** This testing measures the insulation provided by the glove when contacting a hot surface. Higher temperatures reported indicate a glove with greater insulation.
	Cold Resistance	Thermal protection from cold weather, objects, or materials	**Testing Standard: EN 511:1994 (for ambient temperature)** **Testing Standard: International Organization for Standardization (ISO) 5085:1989-1 (for cold surfaces)** Choosing the right glove depends on whether protection is needed from cold weather or cold surfaces.

Category	Properties	Protection and Performance Needs	Key Considerations and Selection Criteria	
Vibration	Anti-Vibration	Vibration reduction from operating certain tools and equipment	**Testing Standard: ANSI S2.73-2002 (R2007)** This testing method measures the vibration transmission of the glove.	
Electrical	Insulation	If performing work on electrical equipment, this must be the top priority	**Testing Standard: ASTM D120-09** Glove protection depends on the maximum voltage of energized components:	
			50 – 480 V	Class 00 with Leather Protectors
			480 – 600 V	Class 0 with Leather Protectors
			600 V and above	Class 0 or higher (depending on maximum voltage) with Leather Protectors
Function	Dexterity	Ability to manipulate objects and control hands in the desired manner	**Testing Method: EN 420:2003** This testing method assesses the wearer's ability to pick up small diameter pins lying on a flat surface with their thumb and forefinger. If high dexterity is needed, and the hazards are relatively low to the forefinger and thumb, consider a glove that is tipless for those two digits.	
	Tactility	Ability to sense objects by touch	There is no standard test. However, a common field test is to determine if the wearer can feel a pulse while wearing the glove. This is affected by the thickness of the glove, presence of liners, glove surface characteristics, and properties of the coating material.	
	Grip	Ability to exert pressure on an object when holding it	**Testing Standard: National Fire Protection Association (NFPA) 1971 (Grip)**	

2.6.1 Hazardous Substances

a. Review SDSs for project or task-specific chemicals to determine appropriate gloves. Consult with an SH&E Manager for assistance, as needed.

b. Review glove manufacturer specifications for both physical and chemical protection.

c. When both chemical and physical protection is of concern, wear the chemical protection gloves (e.g., nitrile) inside the physical protection gloves (e.g., leather, Kevlar®).

d. Nitrile or equivalent chemical-resistant gloves must always be used for protection from hazardous fluids or non-corrosive chemicals.

2.6.2 Cuts, Lacerations, and Punctures

a. If cut or laceration hazards are present, appropriate gloves with the applicable ANSI/CSA cut resistance rating for the task should be selected.

b. Gloves providing cut resistance may be constructed of leather, synthetic materials (e.g., polyester and nylon), high-performance materials (e.g., Kevlar®), or metal mesh.

Note: Not all gloves providing cut/laceration resistance provide equal puncture resistance. Thus, when selecting a glove for puncture protection, review the manufacturer's specifications specific to puncturing.

2.6.3 Abrasions

a. Leather gloves offer some abrasion protection but should only be selected for light abrasion protection. Appropriate activities for leather gloves may include moving light equipment where cuts and lacerations are of minimal concern.

b. Gloves with abrasion-resistant surfaces in high contact areas (e.g., knuckles and palm) should be considered for tasks involving high potential for abrasion hazards (e.g., construction activities).

2.6.4 Vibration

Gloves meeting the applicable ANSI/CSA standard for vibration reduction (also known as anti-vibration gloves) should be selected if performing activities requiring handling of vibrating tools (chainsaw, jackhammer, grinder, etc.). Anti-vibration gloves should completely cover the fingers.

2.7 High-Visibility Apparel

a. "High-visibility safety apparel" means personal protective safety clothing intended to provide conspicuity during both daytime and nighttime usage and meeting ANSI/International Safety Equipment Association (ISEA)/CSA standards. Refer to Table 4 for more information on high-visibility apparel.

b. The color of apparel (orange or lime) may be client or project specific.

c. Work conducted at night may require that the minimum level of safety apparel worn be ANSI/CSA Class 3, and in accordance with local law.

Table 4. High-Visibility Safety Apparel

Class Type	Specification	Usage	Examples of Pedestrian Workers
2	Provides superior visibility for the wearers by the additional coverage of the torso.	• Inclement weather conditions • Complex backgrounds • Work activities near vehicle traffic 0 mph to 25 mph (40 kph)	• Construction managers/inspectors • Survey crews • Bridge inspectors • Utility workers • Environmental samplers • Resident engineers
3	• Offers greater visibility to the wearer in both complex backgrounds and through a full range of body movements. • Visibility is enhanced beyond Class 2 by the enhancement of background and reflective materials to arms and/or legs. • Typically consists of coveralls, jumpsuits, long- or short-sleeved jackets, or long-sleeved shirts with retro-reflective bands.	• High vehicle speeds (50 mph [80 kph] or more) • Reduced sight distances • Worker and vehicle operator have high task loads, clearly placing the worker in danger • The wearer must be conspicuous through a full range of body motions at a minimum of 1,280 feet (390 m)	

d. Other high-visibility apparel includes Class E and headwear:

   i. Class E apparel includes trouserss that are part of a Class 3 apparel ensemble. Frequently a Class 2 vest is paired with Class E trousers, creating an overall ensemble that meets Class 3 apparel requirements. Class E garments are not intended to be worn without Class 2 or 3 garments.

   ii. Headwear is considered an important accessory and compliments the overall visibility of the wearer. High-visibility headwear enhances visibility of the head of a moving worker in daylight and helps define the shape of the human form during nighttime.

2.8 Personal Clothing

a. Employees on a project site must wear full-length trousers and shirts covering shoulders.

b. For personal safety on the job site, do not wear:

   i. Loose or unsecured clothing or loose-fitting cuffs;

   ii. Greasy or oily clothing, gloves, or boots;

   iii. Torn or ragged clothing; or

   iv. Jewelry (e.g., rings, bracelets, neck chains) when working around moving parts.

c. Long hair must be tied back or otherwise confined when there is a risk of entanglement with moving parts.

d. Cotton or wool fabrics are recommended for general use.

e. Shoes made of leather, canvas, tennis, deck, or other types of non-protective material, including sandals and high-heeled shoes, are not allowed on field project sites. Refer to Section 2.5 for requirements.

2.9 Specialized PPE

In addition to basic PPE, additional specialized PPE may be required to provide appropriate protection to the Employee. Protective equipment must be of heat-, fire-, chemical-, and/or electrical-resistive material when conditions require protection against such hazards. Refer to applicable law, related SH&E procedures, and the SH&E Manager for additional information on PPE requirements.

2.9.1 Temperature Extremes

Refer to the Heat and Cold Stress – Americas for detailed requirements related to temperature extremes.

2.9.2 Chemical-Resistant Clothing

a. The Project Team must consult the SDS of the material(s) being handled, as well as the SH&E Manager and subject matter experts (e.g., Certified Industrial Hygienist), as needed, to appropriately select chemical-resistant clothing, gloves, and boots.

b. The objective of chemical-resistant clothing is to separate the person from a hazardous material. Whenever there is a potential for chemical exposures, chemical-resistant clothing (e.g., latex or nitrile gloves, Tyvek coveralls or aprons, and chemical-resistant boots) should be considered during the risk assessment.

c. Consideration must be given to allergies, and alternatives must be provided if necessary.

2.9.3 Fall Protection

a. Selection and use of fall arrest equipment/systems must be planned and established by a competent person as defined in applicable local law, code of practice, or standards. Personal fall protection equipment and systems (to include fall arrest, positioning, and restraint) must be used when a person is working at heights and/or exposed to a fall hazard. Integral chinstraps should be worn when working overhead.

b. Refer to Work at Height – Americas for detailed requirements related to fall protection and arrest system requirements.

c. Confined space hazards may necessitate the use of specific harnesses attached to retrieval lines to facilitate rescue. Refer to Confined Spaces – Americas.

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2.9.4 Respiratory Protection

a. Respiratory protection must be selected based on the contaminant and concentration to which the Employee will be exposed. The use of respirators is required when occupational exposure levels approach or exceed Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) or American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), and engineering or administrative exposure controls are not feasible to implement.

b. For specific requirements, refer to Respiratory Protection – Americas, the task- or project-specific hazard assessments, and the applicable SDSs.

2.9.5 Hearing Protection

a. Noise levels in the work environment that cannot be eliminated or reduced to acceptable levels by elimination or engineering controls require employees to be protected from exposure. Hearing protection devices must be able to attenuate noise to acceptable levels (i.e., 85 dBA for continuous [steady-state] noise). If necessary to hear audible warnings, hearing protection devices should not attenuate hearing levels below an individual's hearing threshold.

b. Dual hearing protection (i.e., earplugs and a second method such as earmuffs worn concurrently) must be based on the attenuation of the specific hearing protection. Generally, double hearing protection should be used whenever employees are exposed to continuous noise greater than 115 dBA.

c. The attenuation of the specific hearing protection must be determined using the National Institute for Occupational Safety and Health (NIOSH) de-rating scheme. Ear insert devices, to include disposable, pre-formed, or custom-molded earplugs, must be fitted to the exposed individual. Plain cotton is not an acceptable hearing protection device.

d. Refer to Noise – Americas for additional information.

2.9.6 Protection from Drowning

Whenever there exists the possibility of falling into water, personnel must wear personal flotation devices (PFDs) or life jackets. Refer to Work On, In, or Near Water – Americas for requirements on PFDs and related PPE.

2.9.7 Fire-Resistant Clothing (FRC)

a. Fire-resistant clothing (FRC) is required to be worn by all personnel under the following circumstances:

   i. Where they are exposed to hot work in hazardous areas unless deemed unnecessary through risk assessment.

   ii. Where there is a risk of exposure to an electrical arc flash (e.g., work in electrical substations).

   iii. FRC use is mandated by the client or site owner/operator.

b. FRC should be worn as the outermost layer of clothing.

2.9.8 Electrical Safety

a. Work on or around electrical utilities and equipment should only be done in accordance with Hazardous Energy Control – Americas.

b. PPE must be appropriate for the level of electrical hazard present based on a risk assessment conducted according to the applicable standard (e.g., National Fire Protection Association [NFPA] 70E Standard for Electrical Safety in the Workplace and Canadian Standards Association [CSA] Z462 Workplace Electrical Safety Standard), which also specify PPE requirements based on hazard risk classifications.

c. Synthetic clothing must not be worn; synthetic clothing includes acetate, nylon, polyester, and rayon (either alone or in blends with cotton).

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d. Gloves made from layers of flame-resistant material provide the highest level of protection.

e. Leather glove protectors should be worn over voltage-rated rubber gloves.

f. Dielectric overshoes are required where electrically insulated footwear is used for protection against step and touch potential.

g. Safety shoes/boots must be in good condition with no evidence of exposed metal such as steel toe-caps.

2.9.9 Limb Protection

a. Employees must wear the appropriate chainsaw chaps when operating a chainsaw and snake chaps if potentially exposed to snake bites. Protective leg chaps must meet ASTM specifications.

b. Limb and body protection should not be modified without manufacturer's approval, as the protective qualities may be compromised.

c. Boots providing metatarsal protection provide above-the-toe protection from rolling or crushing hazards, as well as punctures or cuts from equipment such as chainsaws.

2.10 Emergency Safety Equipment

2.10.1 First Aid Supplies

a. All AECOM locations must maintain an adequate amount of first aid supplies in an easily identifiable and accessible location. All locations must be equipped with a complete first aid kit appropriate to the number of staff, location of work, and site hazards, according to applicable law.

b. First aid kits must be inspected to confirm the contents meet legal requirements given the number of staff, work location, and potential hazards prior to being placed in the determined location or sent to a job site and, as a minimum, monthly thereafter.

c. An inventory (listing required and approved items) and inspection form must be included with each first aid kit. Any items not listed on the inventory (listed as required or approved for the kit) will be removed during the inspection unless specifically approved by a health care professional for inclusion and added to the inventory.

d. At no time will over-the-counter medications such as antacids, aspirin, cold or cough drops, or other sundry items be stored in the kits without the prior approval of a health care professional (where permitted by local law) and inclusion in the kit's listed inventory.

e. Each item in first aid kits must be individually sealed to protect the contents from contamination. The first aid equipment and supplies must be maintained in a clean, dry, and serviceable condition, contained in a material that protects the contents from the environment, and clearly identified as first aid equipment and supplies.

2.10.2 Automated External Defibrillator (AED)

a. While locations are not mandated to acquire AEDs, an AED should be considered based on the number of employees, response time of local Emergency Medical Services (EMS), and access to other AED units (e.g., those provided by the office building management).

b. The selection of AED equipment will be based on the most current listing of approved AED manufacturers as provided by the American Heart Association, Heart and Stroke Foundation of Canada, or country equivalent.

c. Local law may require notification to EMS of AED locations. This allows the servicing or responding agency to know that an AED is at a particular location.

d. AEDs should be placed in a location that optimizes the fastest response time for an individual walking at a rapid pace to reach the victim. A general rule of thumb by the American Heart Association is that it should take no longer than 3 minutes to retrieve an AED and return to the victim. The AED should be in an easily accessible position with the location well-communicated to all staff.

e. To confirm readiness for use and integrity of the device, AEDs must be inspected monthly, and maintained, cleaned, serviced, and tested according to manufacturer's specifications. All documentation (e.g., inspections, service records) will be delivered to the Designated Individual and maintained in the applicable project/location files.

f. AEDs must be used in conjunction with cardiopulmonary resuscitation (CPR) according to training and the equipment's operating directions when a victim is unresponsive and not breathing.

2.10.3 Eyewash and Body Flush (Shower) Facilities

a. If corrosive, irritating, or otherwise hazardous materials are used, review applicable SDSs to assist in determining whether eyewash and body flush (shower) facilities must be provided. This may include permanent or portable eyewash stations.

b. Employees who may be exposed to corrosive, irritating, or otherwise hazardous materials must be instructed in the location and proper use of emergency eyewash units and body flush (shower) facilities.

c. Eyewash and body flush (shower) facilities must be assembled and installed in accordance with the manufacturer's specifications.

d. These facilities must be readily available and should be highly visible, clearly identified, and, if possible, within 10 seconds of the hazard. The water source / flushing fluid must be tepid, pressure controlled, and maintained to prevent freezing and contamination of the fluid.

e. All eyewash and body flush (shower) equipment must be inspected for compliance with applicable ANSI and CSA standards, as well as the manufacturer's specifications.

2.10.4 Fire Extinguishers

a. Portable fire extinguishers must be selected, located, inspected, maintained, and installed in accordance with local law and building and fire life safety code.

b. Fire extinguishers must be readily available wherever the potential for fire exists, properly maintained, regularly inspected, and promptly recharged and replaced immediately after use.

c. Class B (or ABC) fire extinguishers must also be available in locations where flammable or combustible liquids are stored, handled, or used.

d. In the event of a fire, follow the emergency response plan (ERP) outlined in the applicable SH&E plan to contact the appropriate firefighting personnel (e.g., local fire department, plant fire crew). Refer to SH&E Risk Assessment and Planning – Americas for ERP and SH&E plan requirements.

e. Only trained employees should use a fire extinguisher, and only if operation does not endanger the user.

f. Portable extinguishers must be of suitable types and sizes. Refer to Table 5 for the different fire extinguisher classifications and what types of fires they are meant for.

Table 5. Fire Extinguisher Classifications

Classification	Type of Fire
Class A	Combustible materials
Class B	Flammable liquid, gas, or grease
Class C	Electrical equipment
Class D	Combustible metal

g. The use or discharge of any fire extinguisher by an AECOM employee must be immediately reported to the Supervisor and in accordance with SH&E Incident Response and Investigation – Americas.

h. Extinguishers must be inspected monthly to ensure that they are still in the proper location, have not been used or tampered with, are still properly charged, and have no obvious external damage. The initials of the inspector and the date of inspection must be noted on the tag attached to the extinguisher.

i. A thorough inspection will be performed annually by personnel specifically trained in the inspection (e.g., extinguisher supplier).

3. Training

a. If PPE is planned to be used for a high-risk task, the person approving the purchase and issue of PPE must consult with the SH&E Manager. The SH&E Manager must provide or arrange for appropriate training.

b. Where training on the use and maintenance of specific PPE has been identified, the PPE must only be used by employees who have undergone training or have been assessed as competent by holding the relevant certification.

c. Training and demonstrated competency is mandatory prior to using any specialized PPE.

d. Employees will receive adequate instruction on the correct use, limitations, and assigned maintenance duties for the equipment to be used. The following information, at a minimum, will be covered during PPE training:

   i. What, when, and why PPE is required.

   ii. How to properly don, doff, adjust, and wear the PPE described.

   iii. The limitations of the PPE, including its expected useful life.

   iv. How to properly care for, maintain, and dispose of the PPE.

e. Retraining may be required as applicable (e.g., observed non-compliance, changes in procedure).

f. Employees must confirm they have reviewed and understand the manufacturer's specifications for the relevant PPE before work commences.

g. For training on the use of first aid supplies, AEDs, and fire extinguishers, refer to SH&E Incident Response and Investigation – Americas and Assessment of SH&E Training Requirements– Americas.

4. Terms and Definitions

a.	ANSI	American National Standards Institute
b.	ASTM	American Society for Testing and Materials
c.	CSA	Canadian Standards Association
d.	NFPA	National Fire Protection Association
e.	PPE	Personal Protective Equipment
f.	SDS	Safety Data Sheet
g.	SH&E	Safety, Health, and Environment
h.	THA	Task Hazard Assessment

5. References

a. SH&E Incident Response and Investigation – Americas S3AM-004-PR2

b. Heat and Cold Stress – Americas S3AM-112-PR2

c. Noise – Americas S3AM-118-PR1

d. Respiratory Protection – Americas S3AM-123-PR1

e. SH&E Risk Assessment and Planning – Americas S3AM-209-PR2

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f. Confined Spaces – Americas S3AM-301-PR1

g. Hazardous Energy Control – Americas S3AM-302-PR2

h. Work at Height – Americas S3AM-304-PR2

i. Work On, In, or Near Water – Americas S3AM-315-PR2

j. NFPA 70E – U.S. Standard for Electrical Safety in the Workplace

k. CSA Z462 – Canadian Standard for Electrical Safety in the Workplace

6. Records

a. Personal Protective Equipment (PPE) Inspection – Americas S3AM-208-FM2

b. Assessment of SH&E Training Requirements – Americas S3AM-003-FM1

c. SH&E Management System Variance Request – Americas S3AM-215-FM2

7. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Dec-2025	Initial release as S3AM-208-PR2; consolidated portions of the contents from the following retired documents: Personal Protective Equipment – Americas S3AM-208-PR1, Eye & Face Protection – Americas S3AM-208-ATT1, Head Protection – Americas S3AM-208-ATT2, Foot Protection – Americas S3AM-208-ATT3, Hand Protection – Americas S3AM-208-ATT4, Limb & Body Protection – Americas S3AM-208-ATT5, High Visibility Safety Apparel – Americas S3AM-208-ATT6, Fire Protection – Americas S3AM-011-PR1, Portable Fire Extinguishers – Americas S3AM-011-ATT1, First Aid – Americas S3AM-012-PR1.	All

Americas

Subcontractor Selection and Stewardship

S3AM-213-PR1

1. Purpose and Scope

This procedure:

a. Provides requirements on the evaluation of subcontractor safety, health, and environmental (SH&E) programs; contractual risk management; subcontractor safety performance on the job site; and the responsibilities of the Project Manager with respect to subcontractor jobsite performance.

b. Applies to all AECOM Americas-based employees and operations, as well as contracted personnel, including subcontractors of all tiers, who are required to comply with this document's content.

c. Does not apply to vendors.

d. Does not apply to third-party contractor operations for which there is no subcontract relationship between the contractor and AECOM. Safety issues regarding third-party contractor operations are governed by project-specific contracts and are not covered by this procedure.

2. Procedure

The Project Manager directing activities of the facility, site, or project location is responsible for implementing this procedure and confirming that employees responsible for overseeing subcontractor work have been trained appropriately.

2.1 Pre-Qualification of Subcontractors

a. The Project Manager must confirm:

   i. Each subcontractor has successfully completed safety pre-qualification to demonstrate an effective SH&E program and a historical ability to conduct its operations in an intrinsically safe manner.

   ii. Variance forms, where applicable, are completed and contain appropriate risk mitigations.

   iii. Direct subcontractors cascade these pre-qualification requirements down to all their subcontractors of any tier.

   iv. Each approved subcontractor is re-evaluated at least annually.

b. Subcontractors are prohibited from commencing work until they have been approved in AECOM's third-party pre-qualification system (i.e., Coupa) and/or other AECOM-approved pre-qualification system.

c. Any prospective subcontractor must have the necessary organization, experience, and operational controls (including SH&E programs) applicable to the services to be produced or performed.

2.1.1 United States Requirements

d. To be considered for work on an AECOM project in the U.S., subcontractors must meet the following SH&E requirements:

   i. Provide a letter from the Subcontractor's insurance company confirming an Experience Modification Rating (EMR) of less than 1.0 or stating that they do not qualify for an EMR.

   ii. Valid workers compensation insurance (U.S.).

   iii. No fatalities in the last 3 calendar years.

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iv. Lost Work Day Case Rate is equal to or less than 1.0 in the past 3 calendar years.

v. Total Recordable Incident Rate is equal to or less than 4.0 in the past 3 calendar years.

vi. No willful, serious, or repeat citations or violations within the past 3 calendar years.

vii. An acceptable written SH&E program with required elements such training, hazard assessment, inspections, incident reporting and investigation, and emergency response.

e. If the Subcontractor does not meet the criteria outlined above, the Subcontractor must not be used unless ALL the following apply:

i. a unique business need exists, such as:

1. The Subcontractor is a specialty subcontractor
2. The lowest or only bid
3. Client requirement
4. Small business/minority

ii. The Project Manager completes, and the appropriate parties approve a Subcontractor Variance Form – Americas or follow the equivalent Business Group review and approval process. Subcontractor Variance documentation must clearly identify how the risk of the unmet criteria will be managed, including expectations and requirements of the Subcontractor in managing the risk. Examples may include, but are not limited to, requiring the Subcontractor to:

1. Submit a detailed SH&E mitigation plan associated with the unmet criteria.
2. Explain the root cause associated with excessive EMR or incidence rates.
3. Provide corrective actions for violations or instances of non-compliance.
4. Define specific hold points and control measures to confirm that the risk of future unsafe performance is managed continuously.
5. Assign responsibility to a member of the Subcontractor's senior management who will supervise the implementation of the mitigation plans.
6. Utilize specific programs associated with the AECOM SH&E Management System.
7. Engage in inspections at greater frequency.
8. Increase oversight staff and reporting requirements at their expense.

2.1.2 Canada Requirements

a. To be considered for work outside of an AECOM office in Canada, subcontractors must have active Workers Compensation Coverage. The appropriate SH&E team must review Worker Compensation Rate Statements to identify if the subcontractor has a surcharge.

b. If the Subcontractor has had any fatality in the past 3 calendar years, the Subcontractor must not be used unless the Subcontractor Variance Form – Americas or equivalent Business Group review and approval process is completed.

2.1.3 Additional Variance Requirements

a. The Project Manager must consult AECOM SH&E and Legal to confirm the proposed variance conditions for the Subcontractor do not impose undue risk and liability for AECOM.

b. Variance requirements must be acknowledged by the Subcontractor prior to work commencing.

c. The Project Manager must monitor compliance with the variance requirements.

2.2 Contractual and Risk Management Requirements of Subcontractors

a. Subcontractors must:

   i. Take all necessary precautions for the health and safety of its employees and other persons and the protection of the environment under the Subcontractor's responsibility or control

   ii. At a minimum, comply with the applicable local safety and occupational health law, and environmental local law

   iii. Be contractually bound and maintain appropriate SH&E plans and procedures to comply with applicable client and AECOM SH&E program requirements

   iv. Be appropriately trained, competent, and capable of performing their activities in a safe, healthful, and environmentally responsible manner; and

   v. Remain solely responsible for independently evaluating the risks specifically related to the subcontracted services and take such additional safeguards as appropriate.

b. If the subcontracted services require access to a project site and the Subcontractor's scope of work has the potential to involve exposure to safety, health, or environmental hazards, the Subcontractor must:

   i. Develop and implement a subcontractor project-specific SH&E plan and Task Hazard Assessments (THAs; e.g., Field Level Risk Assessments in Canada), or equivalent risk assessments, meeting all applicable regulatory requirements and that are as stringent as, or more protective than, the requirements set forth in AECOM's and the client's SH&E plans

   ii. Assign a subcontractor safety representative (SSR) to implement and enforce the Subcontractor's SH&E plan; and

   iii. Provide appropriate personal protective equipment (PPE).

c. AECOM reserves the right to require the Subcontractor to amend its SH&E plan at any time as may be necessary to respond to changes to existing conditions or the appearance of new conditions affecting the subcontracted services, and to submit a copy of the Subcontractor's revised plan to AECOM for its review.

d. If the Subcontractor is required to develop an SH&E plan, the SH&E plan must meet or exceed the AECOM project plan, and address, at a minimum, the following areas, as applicable:

   i. Applicable SH&E-related laws and regulations, and the client's and AECOM's requirements

   ii. Short Service Employee (SSE) Program

   iii. Injury Management and Return to Work Program (including map to the approved occupational clinic)

   iv. Emergency Action Plan (including map to the hospital and practice drill requirements)

   v. Fitness for Duty (including a drug and alcohol testing program)

   vi. Training requirements

   vii. Formal subcontractor's site safety orientation

   viii. Equipment inspection checklists and third-party certifications

   ix. PPE requirements

   x. Site restrictions

   xi. Pre-field Job Safety Analyses, daily THAs, and Change Management

   xii. Stop Work Authority - Red Card

   xiii. Required SH&E Audits and Inspections

   xiv. Driver Safety Program

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xv. Project Security Plan

xvi. Project Environmental and Sustainability Plan

xvii. Confined Space Entry Plan

xviii. Fall Protection Plan for working at height

xix. Concrete and Masonry

xx. Rigging Inspection Program

xxi. Lockout/Tagout

xxii. Lift Plans for every lift or series of lifts

xxiii. Disciplinary Action Plan

e. AECOM retains the right to review the Subcontractor's SH&E plan to monitor the Subcontractor's compliance. SH&E plans reviewed by AECOM, the client, or both that inadequately address the tasks or hazards to be performed by the Subcontractor must be returned for resubmission at the Subcontractor's expense.

f. Before subcontractor personnel are allowed on the job site, the Subcontractor must furnish proper documentation to the Project Manager of any required regulatory training, drug and alcohol testing, medical surveillance, and respirator fit-testing when applicable for all subcontractor personnel on the job site and any applicable equipment certifications, inspection documentation, written authorizations, permits, or other SH&E-related documentation required to perform the fieldwork in a lawful and safe manner.

2.3 Subcontractor's Safety Representative

a. Where applicable or required by contract, each subcontractor must appoint an SSR who:

i. Is knowledgeable of the Subcontractor's activities.

ii. Understands the safety requirements of the Subcontractor's activities.

iii. Has the ability to recognize and the authority to correct safety deficiencies and execute a stop work order should an imminent danger arise.

iv. Has the responsibility for the administration of the subcontractor safety program.

v. Will serve as the direct contact with AECOM regarding resolution of SH&E issues.

vi. Will report work-related injuries/illnesses/incidents, environmental incidents, and regulatory inspections and violations to AECOM according to AECOM procedures and/or client requirements.

b. AECOM retains the right to review the Subcontractor's proposed SSR(s) and accept or deny them based on acceptable knowledge, skills, and ability as it relates to the subcontracted services.

c. SSRs have the primary responsibility for confirming compliance with applicable codes and regulation. SSRs must complete one daily safety report (DSR) for each shift or work activity covered. DSRs must include photos of the observation to document findings and eliminate differences of opinion after the fact.

2.4 Communication

a. As the prime contractor/consultant, AECOM must provide a single copy of AECOM's and/or the client's site-specific SH&E plan to the Subcontractor prior to the commencement of any subcontracted services for which AECOM, in its sole discretion, determines an SH&E plan is required. SH&E plans must define key minimum SH&E requirements as they relate to the project.

b. The AECOM SH&E plan does not, nor is it intended to, address subcontractor procedures during site activities.

c. AECOM reserves the right to amend its SH&E plan at any time as may be necessary to respond to changes to existing conditions or the appearance of new conditions affecting the work.

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d. Subcontractors must:

   i. Notify the Project Manager when they must utilize an SSE to perform on-site activities.

   ii. Obtain AECOM manager approval of any SSE prior to mobilization.

   iii. Participate in site safety briefings including, and as applicable, orientations, project kick-off meetings, hazard assessments, inspections, daily tailgate/toolbox/safety meetings, and post-job meetings.

   iv. Comply with all safety directives and/or stop work orders issued by the AECOM representatives.

e. Prior to the start of work, roles, responsibilities, communication chain-of-command, and emergency preparedness procedures must be established.

f. The Project Manager and SH&E Manager must determine whether the Subcontractor will be required to use AECOM's safety observation system, or equivalent. Observations must be addressed in a timely manner and in association with the determined risk.

g. Safety communication must be directed to the Subcontractor's management (foreman, supervisor, Site Safety Representative, etc.) who are then responsible for directing it to their employees.

h. In addition to any client and regulatory reporting requirements, the Subcontractor must immediately report to the Project Manager any:

   i. Incident including death, and any injury, illness, or near miss event that could reasonably have caused death, injury, or illness to persons

   ii. Known change in the physical conditions of the project site likely to increase the risk of death, injury, or illness to persons; and

   iii. Incident resulting in property damage; impact to the public or environment; security-related incident; first aid, recordable, or lost time incident; or incident reported to regulatory agencies or that garners media attention.

i. The Subcontractor is solely responsible for identifying and implementing immediate corrective actions needed to prevent recurrence.

j. The Subcontractor must investigate all incidents related to the Subcontractor's activities and provide a written initial investigation report to the Project Manager by the close of business on the day of the incident regardless of the severity of the incident. The Subcontractor is required to submit a final written investigation report to AECOM at a mutually agreed upon time.

2.5 Subcontractor Performance

a. To the extent reasonable considering AECOM's scope of work under the client contract, the Project Manager or Designee should visit the work site and periodically observe the Subcontractor's operations (i.e., conduct spot checks) to assess whether the Subcontractor appears to be conducting its operations in accordance with applicable safety requirements.

b. Subcontractor employees found to be violating elements of the SH&E plan, regulations, rules, or policies are subject to immediate and permanent removal from the project site.

c. As determined by client requirements, the Project Manager, and/or SH&E Manager, Subcontractors may be required to provide AECOM with a monthly SH&E report with, at the minimum, monthly hours worked on the project site and associated incident rates; SH&E training conducted; incidents and associated investigation reports; lessons learned and corrective actions taken; environmental pollution prevention and sustainability numbers; and SH&E audits, observations, and inspections conducted.

d. The Subcontractor must report in a client- and/or AECOM-defined format and reporting system. Subcontractor SH&E Data Submission – Americas may be used to obtain monthly SH&E metrics from the Subcontractor.

e. Project Managers are highly encouraged to complete post-job performance reviews for managed subcontractors in Coupa.

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3. Training

Refer to SH&E Training – Americas and its associated Assessment of SH&E Training Requirements – Americas for training requirements.

4. Terms and Definitions

a.	DSR	Daily safety report.
b.	EMR	Experience Modification Rating.
c.	PPE	Personal Protective Equipment.
d.	SSE	Short Service Employee.
e.	SSR	Site Safety Representative.
f.	Subcontractor	A person or business that has a contract directly with AECOM to provide work or services related to AECOM or client work scopes beyond delivery. A person or business with a contract directly with AECOM that does not fall clearly within this definition may also be required by the applicable business group to comply with this procedure.

5. References

a. SH&E Training – Americas S3AM-003-PR2

6. Records

The following documentation must be maintained in the project file:

a. Subcontractor Variance Form – Americas S3AM-213-FM2 or equivalent, if applicable.

b. Subcontractor SH&E Data Submission – Americas S3AM-213-FM4, if applicable.

c. Assessment of SH&E Training Requirements– Americas S3AM-003-FM1

d. Identified safety deficiencies as applicable for subcontractors and verification of correction of conditions.

e. All other safety-related subcontractor documentation (e.g., training certifications, incident reports, etc.)

7. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Oct-2010	Initially released as S3NA-213-PR	
1	15-Jul-2013		
2	15-Dec-2016	Re-released as S3AM-213-PR1	
3	26-Jun-2017		
4	15-Jan-2019		
5	01-Dec-2025	2025 review; comprehensive revision as part of the Americas SH&E Integrated Management System (IMS) simplification; converted to new IMS procedure template and AECOM style.	All

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Subcontractor Variance Form

S3AM-213-FM2

1. **This form is to be completed in accordance with Subcontractor Selection and Stewardship – Americas S3AM-213-PR1.**
2. **If the Subcontractor has any of the conditions stated below (See for the U.S. and for Canada), the Subcontractor must not be used unless a unique business need exists and the Project Manager completes this form or an equivalent Business Group review and approval process.**
3. **After the form is completed, it must be retained in the project files.**

Details

Subcontractor Name	….	**Date**	…..
Project or Site Location	….	**Project #**	….
Description of Work to be Performed	….		

U.S. - Check all the conditions that apply to the subcontractor (If any box is checked, completion of this form or an equivalent process is required):

☐	Experience Modification Rate (EMR) exceeds 1.00
☐	No workers' compensation insurance
☐	Fatalities in the past 3 calendar years (if checked, requires SH&E Director approval)
☐	Lost Workday Case Rate greater than 1.0 in the past 3 calendar years
☐	Total Recordable Incident Rate greater than 4.0 in the past 3 calendar years
☐	Willful, serious or repeat regulatory citation in the past 3 calendar years
☐	Inadequate Safety Program(s)

Explain the applicable conditions	….

Canada - Has the subcontractor had any fatalities in the past 3 calendar years?	☐	Yes	☐	No

If Yes is checked, explain the condition. Completion of this variance form or equivalent process is required:	….

What conditions warrant selection of this subcontractor?

☐	Sole subcontractor available for specialty work	
☐	Current subcontractor for work to be continued	
☐	Small or minority business set aside requirement	
☐	Existing site or client agreement requires use of subcontractor	
☐	Site/project security requirements preclude other subcontractors	
☐	Subcontractor has made efforts to improve safety performance and improvements are apparent	
☐	Other – Explain:	….

Have other similar subcontractors been evaluated? If so, please explain in general terms why they were not selected (do not identify the similar subcontractors by name in this document).	….

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Mitigations by AECOM and Subcontractor actions required to manage the risks.	....

Project Manager Requesting Variance

....		.....
Project Manager Name	**Signature**	**Date**

SH&E Manager Approval

....		.....
SH&E Manager Name	**Signature**	**Date**

Comments

....

Subcontractor Acknowledgement

The subcontractor representative, on behalf of the subcontractor, acknowledges and agrees to the content and requirements contained in this document.

....	....		.....
Subcontractor Name	**Representative Name**	**Signature**	**Date**

SH&E Director Approval

Required for any fatalities in the last three years:

....		.....
SH&E Director Name	**Signature**	**Date**

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Subcontractor SH&E Data Submission

S3AM-213-FM4

1. This form is to be completed in accordance with Subcontractor Selection and Stewardship – Americas S3AM-213-PR1.
2. This form may be completed and submitted to AECOM Project Management by the named Subcontractor. Subcontractors must be prepared to provide evidence to support the data below.
3. After the form is completed, it must be retained in the project files.

Subcontractor Name	….	**Year**	….
Completed By (Name)	….	**Project**	….

	JAN	FEB	MAR	APR	MAY	JUN
# Site specific orientations	….	….	….	….	….	….
# Short service workers onsite	….	….	….	….	….	….
# Jobsite safety meetings	….	….	….	….	….	….
# Hazard assessments	….	….	….	….	….	….
# Worksite inspections & audits	….	….	….	….	….	….
# First aid incidents	….	….	….	….	….	….
# Medical aid incidents	….	….	….	….	….	….
# Lost time incidents	….	….	….	….	….	….
# Restricted work incidents	….	….	….	….	….	….
# Environmental incidents	….	….	….	….	….	….
# Property damage incidents	….	….	….	….	….	….
# Preventable vehicle incidents	….	….	….	….	….	….
# Near miss incidents	….	….	….	….	….	….
# Observations	….	….	….	….	….	….
# Investigations	….	….	….	….	….	….
Other: ….	….	….	….	….	….	….
Other: ….	….	….	….	….	….	….

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	JUL	AUG	SEP	OCT	NOV	DEC
# Site specific orientations	….	….	….	….	….	….
# Short service workers onsite	….	….	….	….	….	….
# Jobsite safety meetings	….	….	….	….	….	….
# Hazard assessments	….	….	….	….	….	….
# Worksite inspections & audits	….	….	….	….	….	….
# First aid incidents	….	….	….	….	….	….
# Medical aid incidents	….	….	….	….	….	….
# Lost time incidents	….	….	….	….	….	….
# Restricted work incidents	….	….	….	….	….	….
# Environmental incidents	….	….	….	….	….	….
# Property damage incidents	….	….	….	….	….	….
# Preventable vehicle incidents	….	….	….	….	….	….
# Near miss incidents	….	….	….	….	….	….
# Observations	….	….	….	….	….	….
# Investigations	….	….	….	….	….	….
Other: ….	….	….	….	….	….	….
Other: ….	….	….	….	….	….	….

Comments

….

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Ground Disturbance

S3AM-303-PR2

1. Purpose and Scope

a. The purpose of this procedure is to safeguard employees, property, and the environment from hazards associated with excavation, drilling, surface mining, and other ground disturbance operations.

b. For underground work, including underground mines, refer to Underground Work – Americas.

c. This procedure applies to all AECOM Americas-based employees and operations, as well as contracted personnel required to comply with this document's content.

2. Procedure

2.1 Critical Controls

The following are the minimum required critical controls to prevent high-potential and/or significant incidents to be implemented by the Project Manager or Designee.

a. Protective systems must be used to protect workers entering an excavation and are required when an excavation is greater than 5 feet deep (1.22 meters in Canada) and is not entirely in stable rock, unless local law is more stringent.

b. If there is a danger of a worker or equipment falling into an excavation, or whenever the edge is not clearly visible, identify the trench or excavation perimeter with visual markers (e.g., barricade tape, wooden railings, stop logs, etc.). If the trench or excavation is 4 feet (1.22 meters) or greater in depth, the visual barrier must be a minimum of 6 feet (1.83 meters) from the edge. If possible, the grade should be away from the excavation.

c. Prior to beginning ground disturbance work at a site, the location of all underground and overhead utilities must be identified, and work locations must be carefully planned to avoid any potential for inadvertent contact with them. Appendix 1 provides a summary of these requirements. Also, the Utilities and Subsurface Clearance Checklist – Americas must be completed, reviewed, and signed by the Project Manager.

d. Refer to Hazardous Energy Control – Americas for additional requirements regarding overhead utilities present at a work location.

2.1 Utilities

2.1.1 Utility Locating Services

a. Contact the regional one-call/click-before-you-dig provider at least 3 working days prior to commencing ground disturbance.

b. The route and/or area of the proposed ground disturbance must be identified using flags, paint, or stakes prior to the arrival of the locator.

c. In urban areas, roadways, areas of high utility density, and/or areas where one-call/click-before-you-dig services are not available, private utility locating companies must be called to identify and locate the presence of underground utilities through geophysical surveys and/or other means.

2.1.2 Surface Markings

a. Markings must be maintained and remain visible throughout the duration of the ground disturbance activities on the project of the.

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b. If the surface over a buried installation is to be removed, supplemental offset markings must be used. Offset markings must be on a uniform alignment and must clearly indicate the actual installation is a specific distance away.

c. Uniform Color Coding – The colors and corresponding installation type are listed in Table 1 unless otherwise contract-specified:

Table 1. Color Coding for Marking of Buried Facilities

White	Proposed Ground Disturbance Area
Pink	Temporary Survey Markings
Red	Electric Power Lines, Cables, Conduit and Lighting Cables
Yellow	Gas, Oil, Steam, Petroleum Lines or Gaseous Materials
Orange	Conduit, Cable, Communication, Alarm or Signal Lines
Blue	Potable Water
Green	Sewer, Storm Sewer and Drain Lines
Purple	Reclaimed Water, Irrigation and Slurry Lines (non-potable)

2.1.3 Mapping Underground Utilities

a. The locations of subsurface utilities and subsurface installations must be documented on a site plan (a scaled site plan must be used when feasible).

b. The site plan must be available on the worksite where ground disturbance activities will be conducted.

2.1.4 Site Walk

a. A site walk will be conducted by the Project Manager, or their designee, and any other appropriate personnel with the objectives of reviewing all planned ground disturbance locations, the location of subsurface and overhead utilities, overhead obstructions, and the potential for subsurface installations, to determine the appropriate utility clearance activities, and to observe other physical hazards.

b. Site walks should be repeated as necessary following the identification and mapping of utility and subsurface structures as visual verification of the hazards.

2.1.5 Ground Disturbance Set Back Distance

Minimum set back distances from subsurface and overhead utilities and subsurface installations must be established including 5 feet (1.5 meters) from any subsurface utility, 7 feet (2.1 meters) from the pad surrounding any underground storage tanks, and 10 feet (3 meters) from any overhead energized electrical line (or farther depending on the voltage of the line). Government regulations, client requirements, and utility requirements may dictate a greater set back distance.

2.1.6 Utility Clearance Investigation / Location Confirmation

a. The Utilities and Subsurface Clearance Checklist – Americas must be completed, reviewed, and signed by the Project Manager.

b. At a minimum, all underground utilities and subsurface installations within a 5-foot (1.5-meter) radius of the work site must be identified and physically located (seen) using non-destructive techniques before use of mechanical excavation equipment is permitted. Legal, client, landowner, and utility owner requirements must be consulted, as the required hand exposure radius may be larger.

c. Non-destructive ground disturbance techniques must be acceptable by project stakeholders.

d. Equipment must be designed and operated with proper grounding controls in place.

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e. In urban areas, roadways, and/or areas of high utility density, proposed subsurface locations must be cleared by hand / non-destructive technique to 5 feet (1.5 meters) using non-mechanical methods. If boring depth is less than 5 feet, clearance depth must be discussed with the Project Manager and Safety, Health, and Environment (SH&E) Manager.

f. In non-urban areas, clearing by hand/non-destructive technique is still recommended or conducted if required by local law.

g. Hand/non-destructive technique clearance should be extended if locations of deep utilities and structures are not known, or if frost line depth indicates the potential presence of deep utilities.

h. Large mechanical equipment and attachment dimensions may require expanding the established zone around underground utilities and subsurface installations physically located (seen) prior to the use of the equipment. Borehole diameters must be cleared to 120% of the proposed borehole diameter.

i. Warning tape, pea gravel, sand, non-indigenous material, bentonite, red concrete (indicative of electrical duct banks), and any departure from native soil or backfill may be evidence of subsurface installations and utilities.

2.2 Drilling, Boring, and Direct-Push Probing

2.2.1 Site Set-up

The Project Manager and/or Site Supervisor must:

a. Confirm the work area is adequately identified:

   i. Including the zone around the drilling, boring, or direct-push equipment, as well as fluid carrying equipment, entry point, exit point, and any excavated areas.

   ii. Utilize barricades, signage, pylons, snow fence, etc. as appropriate.

b. Implement traffic control as necessary.

   i. When operating near public vehicular and pedestrian traffic, the on-site personnel must take every precaution necessary to see that the work zone is properly established, identified, and isolated from both moving traffic and pedestrians.

   ii. All traffic control devices must be installed, placed, and maintained in accordance with a Traffic Control Plan, Highway and Road Work – Americas, client specifications, and/or the Manual of Uniform Traffic Control Devices.

c. Coordinate concurrent operations to identify their associated hazards and controls.

d. Provide sufficient lighting.

e. Confirm that the cleared/levelled area is large enough to accommodate the drill rig and supplies.

f. Set up any sample tables and general work areas for employees at a safe distance from the rig. The recommended minimum safe distance is the height of the fully extended mast plus 5 feet (1.5 meters).

2.2.2 Equipment Inspections

a. Drillers are required to inspect all equipment prior to the initiation of operations and daily during operations. Drill Site Safety Inspection Checklist – Americas, or equivalent, must be completed by AECOM staff responsible to confirm that drill inspections are being conducted by the drillers prior to the start of drilling each day.

b. Defective equipment must be immediately tagged and taken out of service until repaired, altered, or replaced, and appropriately verified as safe for operation by a Competent Person.

2.2.3 Operating Requirements

a. Operation of the rotary drilling, coring, boring or direct-push equipment must be restricted to the designated operator except to activate the emergency shut-off as required.

b. Sit-on track mounted direct push rigs are not permitted unless the rig has been modified (in accordance with manufacturer's requirements) to be operated by remote control

c. The use of J-hooks and catheads are prohibited.

d. Consult local law and client requirements regarding the use of auger guards, which may be required during hollow-stem auger drilling operations.

e. The following safety measures must be taken during drilling, boring or probing operations on site:

   i. The rig operator and helper must be present during all active rig operations.

   ii. Hands, feet, and other body parts must be kept away from moving parts (e.g., hoisted, rotating, pushing, etc.) including augers, drill rods, and reamers.

   iii. When observing drilling, stand upwind and uphill of the drill rig to prevent potential exposure to vapors emitted from the borehole. Gas monitoring must be conducted at all sites.

   iv. The rig's emergency shut-off switch must be identified to site personnel and tested daily by the operator.

   v. Unauthorized personnel must be kept outside of the established work zone.

   vi. Rig crew and other worksite personnel must not use a cell phone while operating the drill rig or other equipment or within the rig work zone.

   vii. Do not drive the rig from hole to hole with the mast (derrick) in the raised position.

   viii. Before raising the mast (derrick), look up to check for overhead obstructions.

   ix. Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig must be first levelled and stabilized with levelling jacks and / or solid cribbing.

   x. Before raising the mast (derrick), all non-essential personnel and visitors should be cleared from, any area within the fall radius of the mast All rig personnel and visitors should be informed the mast is being raised prior to raising it.

   xi. The drill rig must be releveled immediately if it settles after initial set up or at any time during operation that the rig becomes unlevel

   xii. Lower the mast (derrick) only when the levelling jacks are down and engaged, and do not retract the levelling jack pads until the mast (derrick) is lowered completely.

   xiii. After the rig has been positioned to begin drilling, all brakes and / or locks must be set before drilling begins.

   xiv. The rig operator must only operate the drill rig from the position of the controls. The rig must not be in operation if the operator of the rig leaves the area of the controls.

   xv. If it is necessary to operate the rig within an enclosed area, make certain exhaust fumes are ventilated out of the area.

   xvi. All unattended bore holes must be adequately covered and marked or otherwise protected to prevent rig personnel, site visitors, or animals from stepping or falling into the bore hole.

   xvii. Upon completion of the drilling project, all open bore holes must be covered, protected, or backfilled adequately and according to local law.

f. Stop work if unanticipated concrete, gravel, or other types of fill material are encountered and/or a void is encountered, as these conditions may indicate the presence of underground utilities or subsurface installations. If these conditions are encountered. drilling may only proceed with Project Manager or SH&E Manager approval.

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2.3 Excavation and Trenching

2.3.1 Excavation Requirements

a. A Professional Engineer must be engaged if specified by the applicable local law and as appropriate to the soil conditions and proposed excavation considerations (e.g., wall slope, shoring requirements, load calculations, etc.).

b. Excavated (spoil) material must be kept at least 2 feet (0.61 meters) from the edge of the excavation, or farther if local law is more stringent.

c. Excavated (spoil) material must be piled in a manner to prevent sloughing of loose material. Local law may specify spoil pile sloping requirements.

d. If the walls of an excavation or trench are 6 feet (1.83 meters) in depth and not sloped or cut back, barriers must be placed around the perimeter. The barrier must be at least 3.5 feet (1.07 meters) in height.

e. Regularly monitor water removal equipment controlling water accumulation to confirm proper operation.

f. If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means must be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation.

g. All excavations must be appropriately secured at the end of the day to prevent unauthorized or inadvertent entry into the excavation. This may require a protective covering, barriers, fencing, signage, or other measures appropriate to the excavation and associated conditions.

h. Backfill as soon as reasonably possible after work is complete.

2.3.2 Soil Classification

a. Soil classification must be conducted to confirm appropriate measures are taken to protect workers and to secure excavation walls.

b. Soil characteristics evaluated when classifying include, but are not limited to:

   i. Cohesiveness/compaction/compressive strengths (e.g., fissured, hardpan, fractured rock, etc.).

   ii. Composition (sand, clay, gravel, layered, etc.).

   iii. Moisture content/submersion.

   iv. Compaction.

   v. Exposure to vibration (e.g., traffic, pile driving, etc.).

   vi. Previous disturbances.

c. Consult the applicable local law, as classification methods, definitions, and terms can vary. In general classifications or types, include:

   i. Stable soil, dense, and heavy and primarily consisting of clay.

   ii. Soil with a medium level of stability and generally including silt, sandy loam, and medium clay.

   iii. Unstable soil, which generally includes gravel, loamy sand, and soft clay.

d. Methods of soil classification include:

   i. Plasticity Test

   ii. Dry Strength Test

   iii. Thumb Penetration Test

   iv. Pocket Penetrometer

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e. Type A Soil:

   i. Type A soils are cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) or greater. Examples of cohesive soils are clay, silty clay, sandy clay, clay loam, and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A.

   ii. However, no soil is Type A if ANY of the following conditions apply:

      1. The soil is fissured.

      2. The soil is subject to vibration from heavy traffic, pile driving, or similar effects.

      3. The soil has been previously disturbed.

      4. The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of 4 horizontal to 1 vertical (4H:1V) or greater.

      5. The material is subject to other factors requiring it to be classified as a less stable material.

f. Type B Soil includes ANY of the following:

   i. Cohesive soil with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf.

   ii. Granular cohesionless soils including angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and, in some cases, silty clay loam and sandy clay loam.

   iii. Previously disturbed soils except those which would otherwise be classed as Type C soil.

   iv. Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration.

   v. Dry rock that is not stable.

   vi. Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than 4H:1V, but only if the material would otherwise be classified as Type B.

g. Type C Soil includes ANY of the following:

   i. Cohesive soil with an unconfined compressive strength of 0.5 tsf or less.

   ii. Granular soils including gravel, sand, and loamy sand.

   iii. Submerged soil or soil from which water is freely seeping.

   iv. Submerged rock that is not stable.

   v. Material in a sloped, layered system where the layers dip into the excavation or a slope of 4H:1V or steeper.

2.3.3 Protective System Requirements

a. Protective systems must be used to protect workers entering an excavation and are required when an excavation is greater than 5 feet deep (1.22 meters in Canada), unless otherwise noted per local law, and is not entirely in stable rock.

b. The protective system may include sloping the excavation walls, shoring the excavation walls, and/or installing a shielding system. The protective system(s) chosen must have the capacity to resist, without failure, all loads to be applied to the system as determined by the Competent Person. All sloping, shielding, or shoring must be conducted in accordance with applicable local law.

c. Slope angle, or type of shoring or shielding, must be determined by:

   i. Soil classification, including structure, strength, moisture content.

   ii. Depth of the excavation.

   iii. Weather and environmental conditions.

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iv. Anticipated duration of excavation activities.

v. Loading of soil and soil stress (e.g., proximity of structures, location of equipment, stored material, anticipated vibration, etc.).

d. Refer to Figure 1 for an example diagram of slope height-to-depth ratio and angle, and refer to Figure 2 for an example drawing of a simple 34-degree slope sketch commonly used around the site for cave-in protection.

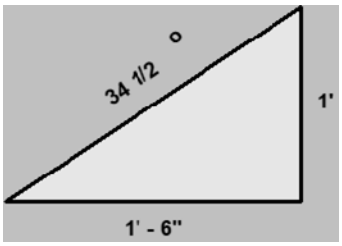


Figure 1. Slope Height-to-Depth Ratio and Angle Example Diagram

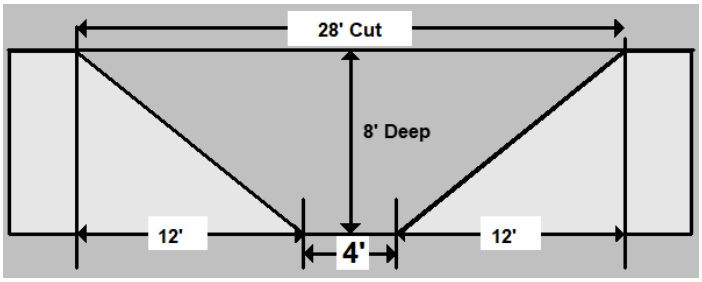


Figure 2. Example of a simple 34-degree slope commonly used around the site for cave-in protection

e. If an excavation may affect the stability of an adjacent building or structure, precautions must be taken to prevent damage to the structure. The precautions must be specified in writing by a Professional Engineer.

f. The depth of the excavation or trench is to be measured at its greatest vertical dimension. Be aware that crouching or kneeling in any unprotected trench, regardless of depth, may still pose significant hazard for the employee involved.

g. Use of Sloping or Benching as a Means of Protection:

i. If sloping is used as the means of protection, the trench or excavation walls must be sloped back so the ratio of the horizontal distance to the vertical rise (H:V ratio) of the sloped wall or degree from horizontal is appropriate to the soil type as determined by the Competent Person.

ii. If benching is used as the means of protection, the soil must be classified as Type A or Type B as determined by the Competent Person.

h. Use of Shoring as a Means of Protection:

i. Workers must be protected whenever shoring is being installed or removed.

ii. Shoring, stringers, or bracing must be installed from the top of the trench or excavation down. Removal must be completed from the bottom up unless conditions exist that would make doing so unsafe. A removal method must be developed without worker entry.

iii. Check hydraulic shoring (leaking hoses and/or cylinders, broken connections, cracked nipples, bent bases, other damaged or defective parts) once per shift at a minimum and more frequently as required.

iv. Hydraulic or pneumatic trench jacks must have a means of ensuring they will not collapse in the event of loss of internal pressure.

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i. Use of Shielding as a Means of Protection:

   i. Other protective systems meeting applicable legislative regulations must be utilized (e.g., shield systems, trench jacks, aluminum hydraulic shoring, etc.), and the manufacturer's data must be explicitly followed.

   ii. Shielding and trench boxes may be used in combination with sloping and benching.

   iii. The excavated area between the outside of the trench box and the face of the trench should be as small as possible and must be backfilled to prevent lateral movement of the shield.

   iv. The box must extend at least 18 inches (0.45 meters) above the surrounding area, or as specified by local law.

   v. Earth excavation below the shield is permitted only if:

      1. The excavation does not exceed a depth of 2 feet (0.61 meters) below the shield,

      2. The shield can withstand the forces calculated for the full depth of the trench, and

      3. There are no indications while the trench is open of possible loss of soil from behind or below the bottom of the support system.

   vi. A shield must not be subjected to loads exceeding those for which it was designed to withstand.

2.3.4 Work Around the Trench/Excavation

a. Structural ramps used for excavation access or egress of equipment must be constructed in accordance with local law and the instructions or designs of an individual competent and qualified in structural design.

b. If the ramp has an open side, it must have a curb or a restraining device.

c. Confirm equipment placement does not compromise the integrity of the excavation wall and optimizes visibility of the work zone and any contact hazards (spoil placement should also take these into consideration). Use wheel chocking or barricades as necessary to prevent encroachment of the edge.

d. If the appropriate setback of equipment is not possible, confirm appropriate blocking or matting is used to disperse weight. These requirements may need to be determined by a Professional Engineer.

e. While workers are in a trench, an aboveground observer or spotter must be present to warn of earth movements and to advise equipment operators of the presence and location of those in the trench to avoid vibrating equipment near trenches or excavations.

f. If there is a danger of a worker or equipment falling into an excavation, or whenever the edge is not clearly visible, identify the trench or excavation perimeter with visual markers (e.g., barricade tape, wooden railings, stop logs, etc.). If the trench or excavation is 4 feet (1.22 meters) or greater in depth, the visual barrier must be a minimum of 6 feet (1.83 meters) from the edge. If possible, the grade should be away from the excavation.

g. If walkways are permitted over excavations or trenches (e.g., trench over 6 feet [1.8 meters] in depth and wider than 30 inches [76 centimeters]), the installation must be in such a manner as to not compromise the stability of the excavation.

h. Crossings and/or walkways must be equipped with guardrails and constructed in accordance with local law.

i. If vehicle crossings over excavations are required, they must be designed by and installed under the direction of a Professional Engineer.

j. Precautions must be taken to isolate or remove loose rocks, trees, or other materials that may slide, roll, or fall into the trench and onto workers prior to entry by workers into an excavation.

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2.3.5 Work Within the Trench/Excavation

a. Personnel must not be permitted on the faces of sloped or benched excavations at levels above other workers unless those workers at lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

b. Employees must not work in excavations in which there is accumulated water or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation.

c. The precautions necessary to protect employees adequately vary with each situation but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and retrieval line.

d. A stairway, ladder, ramp, or other safe means of egress must be in excavations or trenches that are 4 feet (1.22 meters) or more in depth to minimize lateral travel for employees. Maximum lateral travel distances must be no more than 25 feet (7.6 meters). Ladders should extend at least 3 feet (0.91 meters) above the trench top.

e. Structural ramps used by employees or equipment as a means of access or egress from excavations must be designed by a Competent Person.

2.3.6 Confined Spaces and Hazardous Atmospheres

a. An excavation may contain hazardous gases, vapors, dusts, fumes or an oxygen-deficient or -enriched atmosphere:

   i. To prevent exposure to harmful levels of atmospheric contaminants, the task hazard assessment (THA; e.g., field level risk assessment [FLRA] in Canada) must evaluate atmospheric hazards when workers are required to enter trenches and excavations.

   ii. Appropriate atmospheric testing is necessary to accurately identify these hazards. Ongoing atmospheric monitoring, use of attendants, and rescue equipment may be necessary to address the identified hazards.

b. Hazardous atmospheres may exist in excavations where there is limited access or egress and in which a hazardous gas, vapor, dust, or fume or an oxygen-deficient atmosphere may occur. Consult local law, as the excavation may or may not be subject to confined space requirements.

2.3.7 Stability of Adjacent Structures

a. Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning must be provided to confirm the stability of such structures for the protection of employees.

b. Excavation below the level of the base or footing of any foundation or retaining wall that could reasonably be expected to pose a hazard to employees must not be permitted except when:

   i. A support system, such as underpinning, is provided to confirm the safety of employees and the stability of the structure; or

   ii. The excavation is in stable rock; or

   iii. A Professional Engineer has approved the determination that the structure is sufficiently distanced from the excavation and will not pose a hazard to employees.

c. In addition, sidewalks, pavements, and secondary structures must not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

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2.3.8 Inspections

a. Daily inspections of excavations, the adjacent areas, and protective systems must be made by a Competent Person for evidence of situations that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. In these situations, exposed employees must be removed from the hazardous area until the necessary precautions have been taken to confirm their safety. Refer to Daily Excavation Checklist – Americas.

b. An inspection must be conducted by the Competent Person prior to the start of work and as needed throughout the shift. Inspections must also be made after every rainstorm or other hazard-increasing occurrence.

2.3.9 Backfilling

a. Perform any required notifications within the necessary timeframes prior to backfilling.

b. Confirm accurate classification of soil types of backfill material and absence of signs of contamination, discoloration, and smell.

c. Confirm the re-establishment of the original soil integrity using the original material (if suitable) or designated fill material(s).

d. Backfilling must be done with care to prevent damage to any exposed utilities or facilities.

e. A spotter may be necessary to avoid encroachment (e.g. working around other equipment, traveling under overhead lines, working in close conjunction to underground facilities and other workers, compromised line of vision) and to watch for any rocks falling into the excavation, which may damage exposed facilities. If fill contains rocks or hard material, a shield or alternate fill material may be used to protect the facilities.

f. Confirm piping or facilities are properly supported prior to backfilling.

g. If shoring was used, remove from the bottom up.

h. If a trench box has been used, it should be placed no more than 24 inches above the base of the excavation or a sub-trench bed containing the pipe.

i. Appropriate measures must be taken to confirm proper backfilling and compaction of soil below the trench box.

j. No worker must occupy a trench box while it is being moved.

k. If compaction is required, confirm the appropriate method is employed and compaction testing is conducted in a manner that does not damage any facilities or pipelines in the excavation.

l. Final grading and cover of the ground disturbance should be done so that erosion is controlled. The original state of the area and access must be considered when backfilling.

m. Any excess excavation material must be properly disposed of.

2.4 Ground Disturbance at Potential MEC / UXO Sites

If there is a potential to encounter munitions and explosives of concern (MEC), which includes unexploded ordnance (UXO), discarded military munitions (DMM), and explosive compounds, on a project site, the Project Manager must contact the SH&E Manager who must then engage the AECOM Munitions Response Program (MRP) Technical Group to determine what type of site-specific documents and staffing are required to safely conduct the project.

3. Responsibilities

a. A Competent Person must:

   i. Be present during all work that involves excavations greater than 5 feet (1.52 meters) in depth and/or whenever workers need to enter an excavation.

   ii. Identify prompt corrective measures to eliminate recognized present or anticipated hazards.

iii. Determine the maximum allowable slope for the walls of the trench or excavation.

iv. Classify the soil in the trench or excavation.

v. Inspect the excavation or trench daily when the potential for employee exposure to the hazards of the trench or excavation exists (use the Daily Excavation Checklist – Americas).

vi. Training

vii. The list below includes the most common training that may apply to ground disturbance activities. requirements.

viii. Excavations/Trenching

ix. Competent Person – Excavations

x. Confined Spaces Training

xi. Ground Disturbance/Utility Clearance Training

xii. Driller Safety Training

xiii. Occupational Safety and Health Administration (OSHA) 10-Hour Construction Safety Training

xiv. OSHA 30-Hour Construction Training

xv. Hazardous Waste Operations and Emergency Response (HAZWOPER)

xvi. Hydrogen sulfide (H2S) Alive

xvii. H2S Awareness

b. Refer to SH&E Training – Americas and its associated Assessment of SH&E Training Requirements – Americas for additional training.

4. Terms and Definitions

a.	Clearance	Includes the following: The positive locating of underground utilities or subsurface installations in or near the work area and/or a signed statement by an appropriate representative attesting to the location of underground utilities and/or the positive de-energizing (including lockout) and testing of electrical utilities.
b.	Competent Person	Person, who, by way of training, knowledge, and/or experience, is capable of classifying soils and is also capable of identifying existing and predictable hazards in excavation/trenching work areas and who has the authority to take prompt corrective measures to eliminate them.
c.	Excavation	A manmade cut, cavity, trench, or depression in an earth surface formed by earth removal.
d.	Faces (or sides)	The vertical or inclined earth surfaces formed as a result of excavation work.
e.	Ground Disturbance	Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work in which the ground is penetrated. Examples: Excavation of soil borings, installations of monitoring wells, installation of soil gas sampling probes, excavation of test pits/trenches or other man-made cut, cavity, trench, or depression in an earth surface formed by earth removal.
f.	Hazardous Atmosphere	An atmosphere that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic, or otherwise harmful may cause death, illness, or injury.
g.	HAZWOPER	Hazardous Waste Operations and Emergency Response.
h.	Non-Destructive Ground Disturbance Technique	A safe excavation method that is used to visually expose an underground utility without causing damage. Non-destructive ground disturbance techniques may include, but are not limited to:

		i. Hand digging. ii. Use of non-conductive tools. iii. Air knifing. iv. Hydro-vacuuming.
i.	OSHA	Occupational Safety and Health Administration.
j.	Protective Systems	Devices or methods that protect employees in an excavation from cave-ins, a collapse, or falling material. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.
k.	Subsurface Installations	Structures beneath the surface. Examples: Subterranean tunnels, underground parking garages, and other structures beneath the surface.
l.	Tolerance Zone	A pre-defined horizontal distance (5 feet) extending from the outer edge of a line or pipe, or 7 feet extending from the outer edge of subsurface structures, that acts as a warning to proceed with caution while digging in this area. Ground disturbance within the tolerance zone requires use of non-destructive techniques. Visual exposure of the utility is required before mechanical excavation equipment may be used. Tolerance zones may be larger based on local utility requirements.
m.	Trench	An open, narrow excavation made below the surface of the ground. In general, the depth is greater than the width.
n.	Underground Utilities	All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling, and communications, etc.

5. References

a. SH&E Training – Americas S3AM-003-PR2

b. Hazardous Substances and Communication – Americas S3AM-110-PR2

c. Noise – Americas S3AM-118-PR1

d. Safety Gear – Americas S3AM-208-PR2

e. SH&E Risk Assessment and Planning – Americas S3AM-209-PR2

f. Subcontractor Selection and Stewardship – Americas S3AM-213-PR1

g. Confined Spaces – Americas S3AM-301-PR1

h. Hand and Power Tools – Americas S3AM-305-PR2

i. Highway and Road Work – Americas S3AM-306-PR1

j. Heavy Equipment and Machines – Americas S3AM-309-PR2

k. Hazardous Energy Control – Americas S3AM-302-PR2

l. Underground Work – Americas S3AM-330-PR2

6. Records

a. Daily Excavation Checklist – Americas S3AM-303-FM1

b. Drill Site Safety Inspection Checklist – Americas S3AM-303-FM3

c. Utilities and Subsurface Clearance Checklist – Americas S3AM-303-FM4

d. Assessment of SH&E Training Requirements – Americas S3AM-003-FM1

7. Appendices

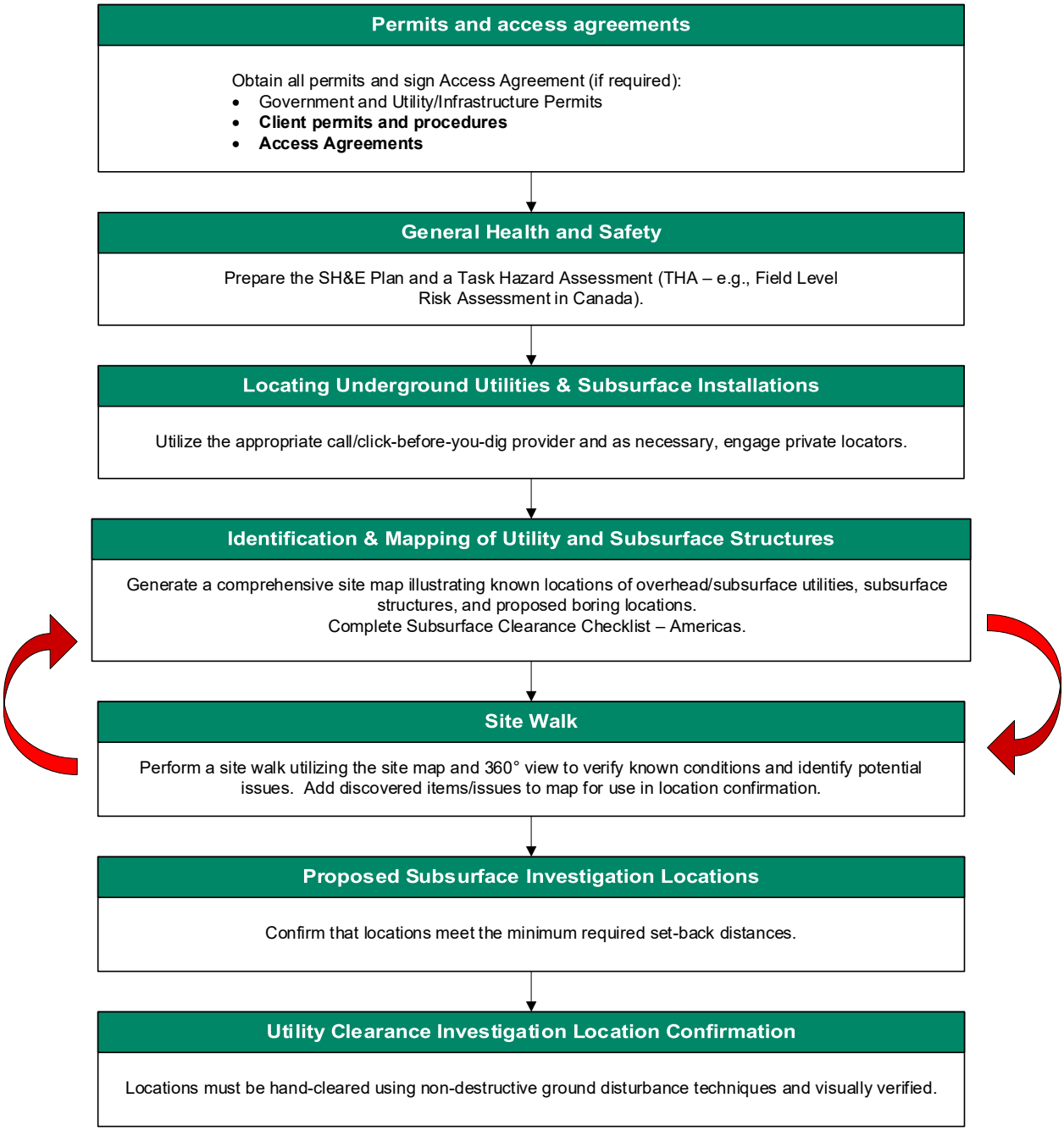
a. Appendix 1 – Underground Utilities and Subsurface Installation Flow Chart

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8. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Dec-2025	Initial release as S3AM-303-PR2; consolidated portions of the contents from the following retired documents: Excavation – Americas S3AM-303-PR1, Drilling, Boring, & Direct Push Probing – Americas S3AM-321-PR1, Core Drilling, Boring & Direct Push Probing Flow Chart – Americas S3AM-321-ATT1, Underground Utilities– Americas S3AM-331-PR1, and Underground Utilities & Subsurface Installation Clearance Flow Chart – Americas S3AM-331-ATT2.	All

Appendix 1 Underground Utilities and Subsurface Installation Flow Chart



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Hand and Power Tools

S3AM-305-PR2

1. Purpose and Scope

a. The purpose of this procedure is to provide a set of minimum controls for the use of hand and power tools, including portable and powered equipment used on sites such as chain saws, brush cutters, powder-actuated tools, and similar high-hazard implements.

b. This procedure applies to all AECOM Americas-based employees and operations, as well as contracted personnel required to comply with this document's content.

2. Procedure

2.1 Critical Controls

The following is a list of the minimum required critical controls to be implemented as applicable by the Project Manager or Designee to prevent high potential/significant incidents.

a. All tools and equipment used by employees or managed subcontractors to conduct work on projects or sites under AECOM control must be maintained and operated in compliance with local law and the manufacturer's specifications.

b. No employee or subcontractor must use any hand or power tool unless they are familiar with the use and operation of the equipment and have received specific instruction on its use and operation.

c. A task hazard assessment (THA; e.g., field level risk assessment [FLRA] in Canada) or equivalent must be completed, reviewed, and approved before beginning any activity involving tools, machines, and/or equipment. Any task involving high-risk work requires review and approval by a Safety, Health, and Environment (SH&E) Manager. See SH&E Risk Assessment and Planning – Americas.

d. All tools must be used for the jobs for which they were designed and in accordance with manufacturer's specifications. Do not use tools for jobs they are not intended for. For example, do not use a slot screwdriver as a chisel, pry bar, wedge, or punch, or use wrenches as hammers.

e. Confirm lockout devices (padlocks, multiple lock hasps, tags) are utilized as necessary. Refer to Hazardous Energy Control – Americas.

2.2 General Requirements

a. Use approved tools only. Never modify or use makeshift tools.

b. Keep surfaces and handles clean and free of excess oil and grease to prevent slipping.

c. Do not carry sharp tools (e.g., knives, chisels, screwdrivers) in pockets; this practice may cause puncture wounds.

d. All tools must be properly maintained. Clean, dry, lubricate, and repair tools as applicable, and return to a suitable toolbox, room, rack, or other storage area upon completion of a job.

e. All tools designed to accommodate guards must have the guard(s) in place when the tool is in use. Do not modify, remove, or disable any machine guards.

f. Do not allow loose clothing, long hair not tied up, loose jewelry, rings, and chains to be worn while working with power tools.

g. Utilize good housekeeping practices to confirm tools do not present a tripping hazard.

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h. Do not throw tools from place to place or from person to person or drop tools from heights. Hand them, handle first, directly to other workers.

i. Screens must be set up to protect nearby workers from being struck by flying fragments around chippers, riveting guns, staplers, or air drills.

j. Confirm that proper ergonomic principles are being observed when using hand and power tools, such as but not limited to:

    i. Avoid static and awkward positions when possible by doing the following:

        1. Move at intervals to reduce muscle fatigue.

        2. Consider tools with a trigger strip, rather than a trigger button. This strip exerts force over a greater area of the hand that, in turn, reduces muscle fatigue.

    ii. Do not apply excessive force or pressure on tools.

    iii. If possible, use tools with comfortable grips that are designed to allow the wrist to stay straight. Avoid using a bent wrist.

    iv. Choose hand tools that have a center of gravity within or close to the handle.

    v. Frequently used tools weighing more than 1 pound (0.45 kilograms) should be counterbalanced.

    vi. Position the body properly when using a tool to prevent slips or falls in the event of unanticipated tool behavior (slip, kickback, etc.). Avoid over-reaching.

    vii. Pull on tools such as wrenches or pliers whenever possible. Loss of balance is more likely when pushing if the tool slips. If pushing is necessary, hold the tool with an open palm.

    viii. Reduce power to the lowest setting that can complete the job safely. This action reduces hand-arm vibration exposure associated with the use of hand tools.

    ix. Consider the need for controls such as limiting time of use.

    x. If safe to do so, adjust to a looser but stable grip, and use anti-vibration gloves.

    xi. Use of heavy tools such as jackhammers can cause fatigue and strains. Heavy rubber grips can reduce these effects by providing a secure handhold.

    xii. Do not increase a tool's leverage by adding sleeved additions (e.g., a pipe) to increase tool handle length.

k. Avoid placing fingers and hands in danger zones by doing the following:

    i. Confirm hands and fingers have enough clearance in the event the tool slips.

    ii. Confirm stability of the workpiece. Use workpiece holders (e.g., vice and chisel holder) whenever possible to prevent injury to hands or deflection of tool or workpiece.

    iii. Use push sticks or guides when cutting or machining smaller material.

l. If the task presents electrical hazards, the Employee must be competent and/or qualified and use the appropriate insulated tools to perform work that includes the risk of electrical shock. Cushioned grip handles do not protect against electrical shock. Refer to Hazardous Energy Control – Americas.

m. Secure or tether tools when working from heights to prevent them from falling. Never leave tools on ladders, scaffolds, or overhead work areas when they are not in use. Refer to Work at Height – Americas.

n. Make provisions to prevent tools from automatically restarting upon restoration of power. Refer to Hazardous Energy Control – Americas.

o. Use non-sparking and intrinsically safe tools in atmospheres with flammable or explosive characteristics and where highly volatile liquids and other explosive substances are stored or used. Refer to Hazardous Substances and Communication – Americas.

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2.3 Cutting Tools

a. When using cutting tools, employees must fully observe the following precautions when possible:

   i. Use the correct tool and correct size tool for the job. Tubing cutters, snips, self-retracting knives, concealed blade cutters, and related tools are task specific and minimize the risk of hand injury. For more information about cutting tools, see Appendix 1 – Alternative Cutting Tools.

   ii. Cut in a direction away from yourself and not toward other workers in the area. Direct the tools away from aisle areas and away from other employees working in proximity whenever possible.

   iii. Maintain the noncutting hand and arm toward the body and out of the direction of the cutting tool if it were to slip out of the material being cut.

   iv. Confirm the tool is sharp and clean; dirty and dull tools typically cause poor cuts and more hazard than a sharp, clean cutting tool.

   v. Store these tools correctly with covers in place or blades retracted, as provided by the manufacturer. Place sharp tools on benches so sharp points or edges face away from the edge.

   vi. On tasks where cutting may be very frequent or last all day (e.g., liner samples), consider cut-resistant (e.g., Kevlar®) gloves in the Personal Protective Equipment (PPE) evaluation for the project. Refer to Safety Gear – Americas.

b. Paper cutters must always be kept in a locked position when not in use. Do not remove guards on paper cutters.

c. Fixed open-blade knives (FOBKs) are prohibited from use during AECOM work. A FOBK is a tool with an exposed, prominent, sharp-edged blade that is fixed or can be locked into a fixed position. Examples of FOBKs include pocket knives, multi-tools, hunting knives, and standard utility knives.

   Note: Any exception to this requirement requires approval of the Project Manager and SH&E Manager via SH&E Management System Variance Request – Americas or an equivalent form.

2.4 Battery Powered Tools

a. Use only the type of battery specified by the tool manufacturer for the battery-powered tool to be used.

b. Recharge a battery or battery-powered tool only with a charger specified for the battery.

c. Store battery packs safely to prevent contact between the battery terminals and metal objects such as nails, screws, or wrenches. Such contact could cause a short circuit, potentially resulting in sparks, fire, or burns.

d. Battery storage and charging areas should be located in designated spaces that are dry, well-ventilated, and free from potential hazards such as combustible materials or incompatible substances. These areas should also include fire protection, adequate ventilation, and protection from foot or vehicle traffic.

2.5 Personal Protective Equipment (PPE)

a. Use PPE appropriate to the task: gloves, safety-toed boots, hard hats, safety glasses with side shields, goggles, hearing protection, respiratory protection, etc. Refer to SH&E Risk Assessment and Planning – Americas and Safety Gear – Americas.

b. Head and face protection is recommended for employees working with pneumatic tools.

c. Noise hazard is associated with pneumatic and many other tools. Working with noisy tools such as jackhammers requires proper, effective use of appropriate hearing protection. Refer to Noise – Americas.

2.6 Inspections

a. Inspect all hand tools on a regular basis and always prior to use. Defective tools must be immediately removed from service and tagged or destroyed to prevent further use.

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b. Where hand tools are identified as not fit for purpose, an observation report must be raised along with a corrective action. The corrective action must confirm that any non-compliant items identified during the inspection are rectified.

c. All tools must be inspected to confirm compliance with manufacturer's specifications. All tools must be inspected to ascertain all safety devices are present and functioning properly.

3. Training

a. Instruction in the proper use, safe handling, and maintenance of tools must be provided to employees unfamiliar with the tool. Training must include applicable manufacturer's specifications.

b. Employees must demonstrate knowledge and competency in the use, safe handling, and maintenance of the applicable tool prior to operation, especially in relation to the use of powered tools.

c. Refer to SH&E Training – Americas and its associated Assessment of SH&E Training Requirements – Americas for additional training requirements.

4. Terms and Definitions

a.	High Potential/Significant Incident	An incident with potential or actual consequences assessed at a severity level of Major, Critical or Catastrophic using the Severity Table found in SH&E Risk Assessment and Planning – Americas.
b.	PPE	Personal Protective Equipment.
c.	THA	Task Hazard Assessment.

5. References

a. SH&E Training – Americas S3AM-003-PR2

b. Hazardous Substance and Communication – Americas S3AM-110-PR2

c. Noise – Americas S3AM-118-PR1

d. Safety Gear – Americas S3AM-208-PR2

e. SH&E Risk Assessment and Planning – Americas S3AM-209-PR2

f. Hazardous Energy Control – Americas S3AM-302-PR2

g. Work at Height – Americas S3AM-304-PR2

h. Manufacturer's specifications

6. Records

a. The following documents, when applicable, must be maintained in the project file:

   i. Site briefings regarding appropriate use of tools and equipment.

   ii. Records of inspections of tools and equipment.

   iii. Copies of any required tool operating licenses (as applicable, e.g., powder-actuated tools).

   iv. Records of tools and equipment removed from service.

b. Assessment of SH&E Training Requirements – Americas S3AM-003-FM1

c. SH&E Management System Variance Request – Americas S3AM-215-FM2

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7. Appendices

a. Appendix 1 – Alternative Cutting Tools

8. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Dec-2025	Initial release as S3AM-305-PR2; consolidated portions of the contents from the following retired documents: Hand and Power Tools – S3AM-305-PR1, Hand Safety – Americas S3AM-317-PR1, and Safe Alternative Tools – Americas S3AM-317-ATT1.	All

Appendix 1 Alternative Cutting Tools

The following are types of safety knives or alternative cutting tools:



Figure 1. Self-retracting utility knives (brands – OLFA, Martor, Allway Tools)



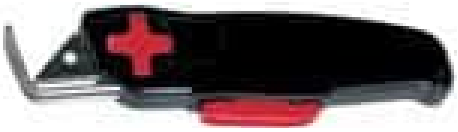


Figure 2. Guarded utility knives (brands – The Safety Knife Co., Martor)





Figure 3. Shears, snips, scissors (brands – Ridgid, Craftsman, Wolfcraft)







Figure 4. Concealed blade cutters (brands – The Safety Knife Co., Martor)







Figure 5. Pipe cutters (brands – Ridgid, Empire)



Figure 6. Specialty cutter (brand – Geoprobe)

Highway and Road Work

S3AM-306-PR1

1. Purpose and Scope

a. The purposes of this procedure are to:

   i. Comply with traffic control requirements established by law.

   ii. Address the potential hazards with working on public or private roadways or within the right-of-way of a public or private roadway.

   iii. Identify situations where the application of signs, signals, tags, and/or barricades may assist in the control of incidents on AECOM-managed project sites.

b. This procedure applies to all AECOM Americas-based employees and operations, as well as contracted personnel required to comply with this document's content.

2. Procedure

2.1 Critical Controls

The following are a list of minimum mandatory critical controls to be implemented, as applicable, by the Project Manager or Designee to prevent high potential and/or significant incidents:

a. For all field work:

   i. All work occurring in the right-of-way (including the traveled way, lanes, shoulders, and clear zone) or that may otherwise expose employees to the motoring public must have a traffic control plan (TCP) in place. This applies to both long and short duration activities in or adjacent to roadways.

   ii. Administration of the TCP must be verified by the Project Manager in accordance with local law.

b. For AECOM-managed sites:

   i. All approvals, as required by local law, must be in place from the relevant authorities before working in a roadway right-of-way.

   ii. A TCP must be prepared by a competent person with credentials, certifications, and experience, and adhered to and monitored by those implementing the TCP.

   iii. Traffic flaggers, spotters, and controllers (where required) must be in place, licensed (as needed), and competent to oversee the application of traffic control.

2.2 Traffic Control Plans

a. The Project Manager must coordinate the preparation and implementation of a TCP in accordance with local law. The TCP must be developed even where not required by local law.

b. The Project Manager must include the TCP in the project-specific Safety, Health, and Environment (SH&E) plan and communicate the TCP to all involved and affected employees. Refer to SH&E Risk Assessment and Planning – Americas for SH&E plan requirements.

c. The TCP must include a thorough assessment of all hazards with priority on eliminating the need to place workers on an active roadway, followed by using barriers to physically separate workers from traffic. Personal Protective Equipment (PPE) and other warning devices provide the least level of protection from moving vehicles and equipment and must be selected and used in combination with higher level controls.

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d. The TCP must also include a detailed plan for the protection of workers within the confines of the work zone.

e. When developing TCPs, the following elements and others, when required by local law, must be included:

   i. Site drive-by and visual assessment including review of an aerial photo of the work locations.

   ii. Review of elevations and topography.

   iii. Assessment of traffic patterns, flow, volume, speed, and general driver behavior.

   iv. Identification of driveways, arterial streets, parking (public and worker), sidewalks, bike lanes, railroads, overhead electrical systems, lines of sight, and blind spots (public and worker).

   v. Locations and specifications for:

      1. Warning signs (including size, shape, color, and message).

      2. Barricades, delineators, and cones (including size, shape, color, and spacing).

      3. Advanced controls (such as rumble strips and automated flagging devices).

   vi. Locations of:

      1. Support vehicles (work trucks, attenuators) and warning devices (beacons, striping) for vehicles.

      2. Flagger, spotter, and workers (consider the direction each will be facing and the space between them).

      3. Loading/unloading areas.

      4. Emergency supplies and equipment.

      5. Non-traffic hazards (line of fire, excavations, steep slopes, restricted work areas, hazardous plants, electrical, thermal, noise).

   vii. Evacuation routes and safe places of refuge.

   viii. Accessibility of work location to other contractors and the public.

   ix. A lighting plan for night work to facilitate proper warning lights, illumination of the work area and workers, and provision of support resources.

   x. Description of the traffic hazards to which workers may be exposed to on the project.

   xi. Detailed plan for the protection of workers within a work zone and maintaining pedestrian movement outside the work zone.

2.2.1 Physical Controls

a. Where using barricades, signals, and tags, they must have the correct rating for the traffic conditions and TCP of the project. Refer to local law for further guidance.

b. Barriers used to form the traffic control must be installed as per the manufacturers' specifications and the TCP. Planning considerations include verifying:

   i. Water-filled barriers are filled with water and barrier connections are in place.

   ii. Barriers are secured in place as required.

   iii. Privacy panels are secured in place where installed.

   iv. Deflection zones on the worksite side of physical barriers are implemented and marked.

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2.2.2 TCP Implementation and Review

a. All approvals must be in place from the relevant authorities before working on the road including, but not limited to, road occupancy permits, road controlling authority, and regulatory sign approvals (i.e., change of speed zones).

b. Implementation of TCPs on site must be completed by qualified and experienced employees.

c. Traffic controllers must be licensed through the applicable road authorities, be able to demonstrate experience for the specific traffic situations, and be adequately resourced.

d. The roles and responsibilities of traffic control team members must be clearly defined and understood.

e. The Project Manager must confirm with the lead traffic controller on site that traffic controls are implemented for the work to be undertaken prior to work commencing.

f. Regular compliance checks and self-audits must be conducted by qualified employees/traffic controllers as per local law.

g. Traffic control should be inspected by a qualified employee to verify working conditions are consistent with the TCP. Deficiencies should be reported to the traffic control provider consistent with project reporting requirements.

h. Persons who review and audit the TCP must hold the required qualifications.

2.2.3 Vehicle-Mounted Warning Devices

a. Vehicles used as part of roadside work must be equipped with a vehicle-mounted flashing amber light. The installation and operation of any such warning devices must be in accordance with local law.

b. Vehicle-mounted flashing amber lights must only be used while directly involved in roadside work activity.

2.2.4 Personal Protective Equipment

a. Selection and use of PPE must be in accordance with Safety Gear – Americas, the relevant project specific SH&E plan, and the applicable task hazard assessments (THAs; e.g., field level risk assessments [FLRAs] in Canada).

b. PPE requirements for traffic controllers must be in accordance with local law and may be different from PPE used by the work crew (e.g., night works and use of light wands).

2.2.5 Prior to Commencing Work on Site

a. The project-specific SH&E plan must be read and signed by all employees and managed subcontractors prior to commencing on-site work.

b. All traffic management signs and devices must be established on the worksite in accordance with the approved TCP.

2.2.6 Subconsultants/Contractors Undertaking Roadside Work

a. Only traffic control contractors who have been evaluated and approved in accordance with Subcontractor Selection and Stewardship – Americas must be engaged to work on projects.

b. Sub-consultants/contractors engaged by AECOM to undertake roadside work are responsible for preparing and implementing traffic management controls in accordance with local law and this procedure.

c. Traffic control contractors should conduct a site visit to develop the site-specific TCP. Positive protection (e.g., portable, movable, ballast-filled barriers; shadow trucks; and attenuators) and speed reductions should be included whenever possible, in accordance with local law.

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2.3 Additional Safety Work Practices

a. Workers must be fit for duty; refer to Fitness for Duty – Americas.

b. Workers must work distraction free. Use of cell phones, earphones/ear buds, headsets, or other distractions are prohibited while working within the work zone unless approved by the Project Manager and SH&E.

c. Photography, videography, note, or measurement taking should be done with the use of a spotter to monitor traffic while engaged in immersive tasks.

d. Vehicles should be positioned so access and egress to and from vehicles are protected from traffic.

e. Workers should maintain a body position:

   i. Allowing for visual monitoring of traffic. If such a position cannot be achieved or the assigned task prohibits a worker from monitoring traffic, then spotter(s) should be assigned.

   ii. Preventing them from being caught between two pieces of equipment, equipment and structures, or other crush points.

f. Crossing active lanes must only be done at identified pedestrian crossings.

g. Attenuator trucks must be placed an appropriate distance and immediately in advance of workers in shoulders or traveled lanes to protect workers from vehicle intrusions and to warn approaching drivers.

h. Local law enforcement should be used to calm traffic, monitor and enforce speed limits, identify and remove impaired motorists, and improve overall site security.

i. Consider larger temporary traffic control devices for increased reflectivity on night work.

j. Consider reducing the spacing between channelizing devices to half the normal tangent spacing or less for enhanced guidance through critical areas (i.e., intersections, ramps) and to discourage intrusions.

k. All reflective surfaces must be cleaned as required to prevent degradation of material reflectivity. Any areas of reflective surface that are damaged or obscured must be replaced.

l. Employees working at night must have reflective tape on their hardhats and wear retroreflective ensembles meeting legal requirements and best practices for night work.

m. Additional measures should be planned to increase worker visibility by motorists as well as motorist ability to differentiate a worker from the background.

n. Increasing the use of fluorescent materials during dawn or dusk may have a greater protective effect than reflectivity where light sources are low.

3. Training

a. Employees assigned to projects with TCPs must be trained in safe work practices at a level commensurate with their roles and responsibilities. Refer to SH&E Training – Americas and its associated Assessment of SH&E Training Requirements – Americas.

b. Employees with specific responsibilities and duties (e.g., Competent Person, Flag Person, Spotter, and Supervisor) must have additional training, experience, and authorization to perform assigned duties.

c. Equipment operators and spotters must be trained on communication methods, visibility limits, and blind spots for each vehicle on site.

d. Workers must be trained on the hazards associated with working on public or private roadways or within the right-of-way of a public or private roadway.

e. Supervisors provided by traffic control contractors should have the following verifiable qualifications, as required:

   i. Two years of traffic control supervisory experience for non-highway settings; and/or

   ii. Five years of traffic control supervisory experience in a highway setting.

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4. Terms and Definitions

a.	Barricade	An obstruction to prevent the passage of persons or vehicles.
b.	Clear Zone	The total roadside border area, starting at the edge of the traveled way, that is available for an errant driver to stop or regain control of a vehicle. This area might consist of a shoulder, a recoverable slope, and/or a non-recoverable, traversable slope with a clear run-out area at its toe.
c.	Competent Person	Those who are knowledgeable about the fundamental principles of temporary traffic control and the work activities to be performed, and who have the authority to propose and implement corrective measures to eliminate hazardous situations associated with temporary traffic control.
d.	Flag Person	A person who actively controls the flow of vehicle traffic into and/or through a temporary traffic control zone using hand-signaling devices or an Automated Flagger Assistance Device (AFAD).
e.	Highway	A general term for denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.
f.	PPE	Personal Protective Equipment.
g.	Right-of-Way	A general term for denoting the traveled way, and adjacent clear zone, berms, shoulders, and sidewalks that encompass public space potentially impacted by construction, maintenance, or other activities.
h.	Roadway	That portion of a highway improved, designed, or ordinarily used for vehicular travel and parking lanes. Excludes the sidewalk, berm, or areas used solely by persons riding bicycles or other human-powered vehicles.
i.	Worker	A person on foot whose duties place him or her within the right-of-way.
j.	Signals	Moving signs, provided by workers such as flaggers, or by devices, such as flashing lights, to warn of possible or existing hazards.
k.	Signs	A display warning of hazards, temporarily and permanently affixed or placed, at locations where said hazards exist.
l.	Tags	Temporary signs, usually attached to a piece of equipment or part of a structure, to warn of existing or immediate hazards.
m.	Temporary Traffic Control Device	A sign, signal, marking, or other device used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, private road open to public travel, pedestrian facility, or shared-use path by authority of a public agency or official having jurisdiction, or, in the case of a private road open to public travel, by authority of the private owner or private official having jurisdiction.
n.	Temporary Traffic Control Zone	An area of a highway where road user conditions are changed because of temporary traffic control devices, flag persons, uniformed law enforcement officers, or other authorized employees.
o.	TCP	Traffic control plan - A detailed plan for the control of traffic (public) during construction, maintenance, or utility operations on a highway/road, considering the organized, systematic, safe conduct of the project, including, as applicable, detours, staging sequences, work vehicle access and egress from worksites, temporary barriers, removal of old pavement markings, and selection and planned implementation of appropriate typical layouts for traffic control. The TCP also contains a written description of the traffic hazards to which workers may be exposed within the confines of a work zone. A traffic control plan must be written to meet legal requirements and guidance. Traffic control plans are commonly referred to as traffic management plans.
p.	Traveled Way	The portion of the roadway for the movement of vehicles, exclusive of the shoulders, berms, sidewalks, and parking lanes.

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5. References

a. SH&E Training – Americas S3AM-003-PR2

b. Fitness for Duty – Americas S3AM-008-PR2

c. Safety Gear – Americas S3AM-208-PR2

d. SH&E Risk Assessment and Planning – Americas S3AM-209-PR2

e. Subcontractor Selection and Stewardship – Americas S3AM-213-PR2

6. Records

a. Project-specific TCPs, permits, self-checks, audits, and completed equipment checklists must be maintained in the project files.

b. Assessment of SH&E Training Requirements – Americas S3AM-003-FM1

7. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Dec-2010	Initially released as S3NA-306-PR1	
1	01-Nov-2014		
2	01-Mar-2016		
3	15-Dec-2016	Re-released as S3AM-306-PR1	
4	31-Jul-2019		
5	13-Nov-2019		
6	28-Apr-2020		
7	01-Dec-2025	2025 review; replaced “&” in title to “and”; comprehensive revision as part of the Americas SH&E IMS simplification; converted to new IMS Procedure Template and AECOM Style; consolidated portions of the contents from the following retired documents: Safe Work Practices Roadway Workers – Americas S3AM-306-ATT3 and Safe Work Practices Night Work – Americas S3AM-306-ATT4.	All

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Heavy Equipment and Machines

S3AM-309-PR2

1. Purpose and Scope

a. This procedure establishes safety requirements for heavy equipment activities and working near heavy equipment and machines, including but not limited to excavating equipment, cranes, powered industrial trucks, other lifting equipment, and concrete pump trucks and parts (i.e., pump, boom, piping, and hoses).

b. For the purposes of this procedure, unmanned aircraft systems (UAS) are considered machines and managed UAS operations must be completed under a UAS plan approved by the UAS Working Group (UASWG) – refer to the UAS Ecosystem page.

c. This procedure applies to all AECOM Americas-based employees and operations, as well as contracted personnel required to comply with this document's content.

2. Procedure

2.1 Critical Controls

The following is a list of the minimum required critical controls to be implemented by the Project Manager or Designee to prevent high potential and/or significant incidents:

a. For all field work:

   i. Implement control measures to allow Ground Personnel and third parties to move safely around heavy equipment activities.

   ii. Establish and maintain controlled access into designated areas of heavy equipment activity.

b. For AECOM-managed sites, the Project Manager must confirm the following:

   i. A task hazard assessment (THA – e.g., field level risk assessment [FLRA] in Canada) or equivalent hazard analysis has identified the heavy equipment activity hazards associated with the equipment.

   ii. Lifting operations are planned and executed by Competent Persons.

   iii. Operators may only operate heavy equipment if they are trained, qualified, and authorized for the specific heavy equipment they intend to operate.

   iv. Rigging is certified and inspected by a Competent Person.

   v. The rated load and all required information for equipment used for lifting or hoisting must be legible, clearly visible to the Operator, and on the lifting devices.

   vi. Operator has completed required heavy equipment inspections.

   vii. Stability and ground bearing pressure is for equipment setup and operation has been verified where risk of overturn or damage to services exists.

c. Those involved in any type of heavy equipment activity must follow applicable manufacturer's specifications, technical standards, and regulatory requirements. When the manufacturer's specifications are more stringent than the requirements of this procedure and local law, the manufacturer's instructions or recommendations must apply.

d. Cranes, hoists or other lifting appliances used for lifting or suspending a load must not be loaded beyond their established load limit and the load must be secured for safe transport.

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e. If safety is being compromised during any heavy equipment activity, all employees have the authority and responsibility to stop work without fear of reprisal or retribution. Please refer to Safety Tenets and Stopping Work – Americas.

f. Competent Person(s) completing a lift must:

   i. Properly classify and plan the lift by completing Lift Classification – Americas or equivalent for every lift or series of lifts to determine the type of lift to be conducted.

   ii. When the lift is classified as a critical lift, complete Critical Lift Plan – Americas, or equivalent.

   iii. Complete Personnel Platform Lifting – Americas or equivalent when the lift involves lifting of personnel.

   iv. Supervise the crane, hoist, or lifting device operation within the vicinity of the work area safely distanced from the operation.

g. Operators must be fit for duty and remain distraction free when operating heavy equipment. Refer to Fitness for Duty – Americas.

   Note: Mobile phone use is not permitted when operating or supporting the operation of equipment. Where fitted, seatbelts must be worn.

h. The Project Manager must confirm a diligent approach to planning is implemented and all requirements in this procedure are followed for all managed work involving heavy equipment and lifting operations. Refer to Safety, Health, and Environment (SH&E) Risk Assessment and Planning – Americas for more general planning requirements.

2.2 Heavy Equipment General Requirements

Where AECOM is the controlling entity or directly managing heavy equipment contractors on a project, the Project Manager or qualified designee must confirm the following:

a. The presence and functionality of critical safety devices, such as Roll-Over Protective Structures (ROPS), Falling Object Protective Structures (FOPS), guarding, edge protection, noise attenuation, hose burst protection valves, operational controls, emergency stops, etc.

b. The hazards associated with simultaneous operations have been addressed.

c. The risk of fall from height during heavy equipment activities has been reviewed. Refer to Work at Height – Americas procedure for work at height requirements.

d. Ground disturbance activity with heavy equipment is conducted according to the Ground Disturbance – Americas.

e. Employees keep all extremities, hair, tools, and loose clothing away from pinch points and other moving parts on heavy equipment.

f. Emissions, such as noise and exhaust fumes, have been managed to prevent/minimize harm to people and the environment and to prevent equipment or machines from acting as an ignition.

g. Rubber/pneumatic-tired earthmoving haulage equipment is equipped with fenders on all wheels. Mud flaps may be used in lieu of fenders whenever motor vehicle equipment is not designed for fenders.

h. Steering or spinner knobs are not attached to steering wheels.

i. Operational controls can be locked in an off position to prevent inadvertent energization during cleaning, maintenance, and repair. Refer to Hazardous Energy Control – Americas.

j. The operating zone of heavy equipment was considered with regards to contact with underground and overhead services such as power lines. Appropriate risk control measures must be adopted to protect against inadvertent contact with services. Refer to the Hazardous Energy Control – Americas for further guidance on identifying underground and above ground services.

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k. Operation manuals and other relevant instructions are readily available to operators and any person requiring information on the equipment. Operators must be familiar with the manual(s) and the safe and efficient operation of the heavy equipment.

l. Heavy equipment has required safety equipment such as serviced and inspected fire extinguishers.

2.3 Heavy Equipment Exclusion Zones

a. Heavy Equipment Exclusion Zones (HEEZ) must be implemented on managed sites by the Project Manager or qualified designee AND the Operator with due consideration to operating zones (e.g. swing radius of excavator or crane) and equipment operator blind spots.

b. HEEZ must be implemented such that they eliminate or minimize the likelihood of any inadvertent access to the immediate area where equipment is operating.

c. Where practicable, HEEZ should be physically demarcated using items such as safety cones, caution tape/flagging, rigid barriers, temporary fencing, etc.

d. Ground Personnel are not allowed to enter HEEZ until given permission by the Operator and the equipment has come to a complete stop and/or has been made safe. Employees must never work or pass under the buckets or booms of heavy equipment in operation.

e. When operating conditions are such that the boom of a crane or load swings over facility equipment, trailers, public roads, sidewalks, property lines or operating transportation systems, the owners of adjacent properties or systems must be consulted. A diagram should be prepared detailing the proposed swing paths for the crane.

2.4 Communication and Spotting

a. A reliable means of communication must be established between the Operator and Ground Personnel. The following general principles must be followed:

   i. Maintain constant visual or audio communication between the Operator and any support personnel.

   ii. Identify operator line of sight limitations (blind spots) of the heavy equipment and establish optimal line of sight locations when the equipment is stationary and in-motion.

   iii. Voice communication equipment must be used if line of sight with spotters or signal persons is not possible.

   iv. If communication is interrupted or lost, the Operator must stop moving immediately until re-established.

   v. During any lifting activity with multiple personnel involved, there can be only one designated signal person.

b. Spotters must:

   i. Be used based on risk assessment of the task and the working environment.

   ii. Remain in a position clearly visible to the Operator and establish an agreed-upon means of communication.

   iii. Be properly trained and dedicated to effectively perform their task, especially during set-up and movement of heavy equipment.

c. Equipment Operators and Ground Personnel must be trained on the radio instructions and/or hand signals used to communicate between Operators and Ground Personnel.

d. All heavy equipment with limited visibility operated around people or on a construction site must meet the following requirements:

   i. The operator must warn personnel in the vicinity of the start-up of the equipment using an alarm audible above the existing operations, or other suitable method providing sufficient warning

   ii. Have an audible back-up alarm that functions automatically when the vehicle or equipment is put into rear motion. The alarm must be clearly heard over equipment and other background noise. Reverse signaling lights must be in working order.

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iii. If it is bi-directional equipment, it must be equipped with a horn, distinguishable from the surrounding noise level, which must be operated as needed when the machine is moving in either direction.

iv. If alarms or horns are not feasible, backing up or movement in both directions for bidirectional equipment must occur only when a signal person communicates it is safe to do so.

2.5 Heavy Equipment Inspection, Testing, and Maintenance

a. The Project Manager must request and confirm that equipment inspections and maintenance records are documented, compliant with manufacturers' specifications and regulatory requirements, and readily available for review by the Operator or any person requiring this information.

b. All equipment must be inspected at defined frequencies, with commissioning inspections completed prior to use on the project.

c. A thorough and detailed inspection and assessment is required prior to initial use of equipment assembled or commissioned on-site.

d. The Operator assigned to a specific piece of equipment must carry out daily pre-start inspections as per the equipment's manual.

e. Any deficiencies found during inspection must be corrected, repaired, or mitigated by a qualified person before the item is placed into service. The Operator should approve and sign off on the repairs and mitigating actions prior to use.

f. A logbook must be completed for each piece of equipment or machine and reflect any inspections, repairs, testing, and maintenance completed. The logbook is to remain with the equipment.

g. Cranes must be inspected:

   i. Prior to using a crane for the first time

   ii. At least every 12 months thereafter

   iii. At the start of each shift

   iv. Each month the crane is in service

   v. When the crane has been idle for 3 months or more

h. Wire ropes and hooks of cranes must be inspected:

   i. Visually prior to each shift.

   ii. Monthly.

   iii. At least every 12 months by a Qualified Person.

i. For powered industrial trucks, use the Pre-Operation Powered Industrial Truck Checklist – Americas or equivalent.

j. Mobile elevated working platforms (MEWPs) must be inspected:

   i. Prior to using the MEWP and be documented using the Mobile Elevating Work Platforms (MEWP) Pre-Operation Checklist – Americas, Under Bridge Inspection Unit Pre-Operation Checklist – Americas, and/or equivalent;

   ii. In accordance with the manufacturer's specifications initially and when:

      1. The MEWP has been in service for 3 months or 150 hours, whichever comes first; or

      2. The MEWP has been out of service for more than 3 months, or if environmental conditions require a shorter period; and

   iii. Annually no more than 13 months from the date of the prior annual inspection;

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k. The inspection will be made in person by a person qualified as a mechanic on the specific type of MEWP or one having similar design characteristics.

l. For hoists, a qualified person must make a thorough, annual inspection of all hoisting machinery. Additionally, the Operator must test control and safety devices daily before operations commence.

m. Prior to operating heavy equipment, ground conditions and weather conditions must be inspected and assessed.

n. Where applicable, an equipment inventory must be established and maintained.

2.6 Guarding

a. Exposed moving parts on equipment or machines that are a hazard to either the Operator or other employees must be guarded to protect them from the hazard, when possible. Moving parts include belts, gears, shafts, pulleys, sprockets, spindles, drums, fan belts, flywheels, and chains.

b. Platforms, foot walks, steps, handholds, guardrails, and toe boards must be present on machinery and equipment to provide safe footing and access ways.

c. If specific guidance on guard design is available in American National Standards Institute (ANSI) / Canadian Standards Association (CSA) standards and applicable regulations, compliance with the guidance is highly recommended. Commercially available guards should be used when feasible.

d. If possible, a machine guard covering rotating parts should be interlocked with the machine itself so the machine cannot be operated unless the machine guard is in place.

e. If a part will be exposed during proper function it must be guarded as much as is practicable consistent with the intended function of the component.

f. All hot surfaces of equipment, including exhaust pipes or other lines, presenting a possible injury or fire hazard, must be guarded or insulated when possible.

g. All equipment having a charging skip must be provided with guards on both sides and the open end of the skip area to prevent persons from walking under the skip while it is elevated.

h. All haulage equipment/trucks whose payload is loaded by means of cranes, power shovels, loaders, or similar equipment, must be adequately shielded (i.e., with a cable shield and/or canopy) to protect the Operator from shifting or falling material. If protection is not available for the Operator, the Operator must leave the vehicle and wait in a designated safe location until it is loaded.

2.6.1 Ground Personnel Requirements

Ground Personnel must:

a. Keep clear of the designated work and travel areas of all heavy equipment and yield to active heavy equipment.

b. Maintain eye contact with operators to the greatest extent possible (always face equipment). Never approach equipment from a blind spot or angle.

c. Only enter a designated area of any operating equipment such as a HEEZ when:

   i. They have attracted the Operator’s attention and established eye contact; and,

   ii. The Operator has idled the equipment down, placed it in neutral, grounded engaging tools, set brakes and communicated entry is permitted.

d. Never stand below buckets or booms or between two pieces of operating heavy equipment or other objects (e.g., steel support beams, trees, buildings, etc.) where a caught-between hazard exists.

e. Stay clear of blind spots around heavy equipment and never assume that the operators are aware of any Ground Personnel nearby. Maintain a distance of at least 2 feet (60 centimeters) between the counterweight of swing machines and the nearest obstacle. If this distance cannot be maintained, a spotter must observe and be in constant communication with the Operator to prevent contact.

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f. Stay away from stacked material that may be knocked over by a swinging load.

g. Never stand directly below heavy equipment located on higher ground.

2.7 Crane and Lifting Device Requirements

2.7.1 General Requirements

When using any type of lifting equipment, the Project Manager must confirm the following:

a. All lifts must be planned and managed under a documented risk assessment.

b. Cranes and lifting devices must not be operated without direct approval from the Project Manager and SH&E Manager.

c. Tag lines are the preferred method to control the load. Evaluate the need for tag lines, and where determined not to be necessary, the Project Manager or qualified designee will approve the decision to omit tag lines. Any additional risks associated with handling a load without tag lines will be addressed in the lift plan. Loads are not permitted to be manipulated by hand.

d. Suspended loads must not be passed over employees, and all parties on site must not work or walk under a suspended load.

e. Workers must never ride on loads being moved by cranes or derricks.

f. Suspended loads must be attended unless they are physically secured to prevent unintended movement.

g. The Operator must not leave the controls when the load is suspended.

h. When loading or unloading trucks, confirm the truck's cab is unoccupied when the crane is lifting loads over it.

i. Any safety devices installed on lifting equipment must be operational.

2.7.2 Critical Lift Operations

a. A lift is critical if it has one or more of the following conditions present:

   i. Lifts made when the load is greater than 75 percent of the rated capacity of the crane in the configuration that the lift will be made;

   ii. Lifts that require the load to be lifted, swung, or placed out of the Operator's view;

   iii. Lifts made with more than one crane or hoisting device;

   iv. Lifts involving non-routine or technically difficult rigging arrangements;

   v. Lifts of long lead time permanent materials;

   vi. Lifts that involve lifting loads over structures or equipment;

   vii. Lifts taking place in a confined or limited access area;

   viii. Hoisting personnel with a crane or derrick; or

   ix. Any lift which the lift Supervisor, Operator, or other management personnel believes should be considered critical.

b. The Project Manager or their delegate must designate lifts meeting any of the conditions that define it as a critical lift. The Project Manager may also designate other lifts that do not meet these conditions as critical, based on consideration of lift sensitivity, risk and/or cost.

c. Preparation for critical lifts must include completing Critical Lift Plan – Americas or equivalent.

d. If the critical lift involves lifting of personnel, Personnel Platform Lifting – Americas or equivalent must be completed.

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2.7.3 Lifting Appliances Other Than Cranes – Incidental Lifts

a. Incidental lifts can present as many, if not more, hazards than critical lifts because they often do not receive the same level of attention. Earthmoving equipment (excavators, backhoes, front-end loaders, etc.), crane trucks (HIABs), overhead gantry hoists, forklifts, telehandlers, piling rigs, etc. must only be used for incidental lifting as they are designed.

b. Where machines require the use of outriggers, they must be always used when lifting.

2.7.4 Lifting and Rigging Equipment

a. The Project Manager must request and confirm that records on all approved lifting and rigging equipment are retained by a Qualified Rigger, compliant with applicable manufacturers' specifications and local law, and readily available for review by the Operator or any person requiring this information.

b. Lifting and rigging equipment must be inspected before use and includes slings, hooks, spreader bars, and all other specialty equipment designated for each lifting apparatus.

c. Hooks, clamps, or other lifting accessories custom designed for hoisting modular structures, panels or other similar materials shall be proof-tested to 125 percent of the rated load and marked with the safe working capacity prior to use.

d. Chain or wire rope slings shall not be shortened with knots or bolts or other makeshift devices. Slings must not be kinked or knotted. Hooks must have safety latches.

e. Lifting and rigging equipment records include the following:

    i. A register of all lifting and rigging equipment that is maintained at each workplace to keep a log of all particulars associated with various gear including serial numbers, manufacturer details, certifications, ratings and inspection history.

    ii. Lifting and rigging equipment inspections

    iii. Copies of the designs and seals of custom lifting devices (including spreader bars and eye pads) which must be on site prior to use and engineered.

    iv. Manufacturer's specifications sheets for each specific lifting device that must be on site.

f. Any defective lifting and rigging equipment must be removed from service immediately and made permanently unusable. Refer to the manufacturer's specifications for determining when lifting and rigging equipment is defective, such as a sling missing a legible load rating. Damaged or defective rigging equipment must be tagged "Out of Service: Do Not Use", rendered unusable and removed from site as soon as practicable.

2.7.5 Modified Equipment

a. Lifting devices and cranes that have modifications or additions that affect the safe operation of the equipment or capacity must be inspected by a Qualified Person after such modifications/additions have been completed and prior to initial use.

b. Prior to initial use, a Qualified Person or a Competent Person who is under the direction of a Qualified Person, must load-test all lifting devices and cranes in which load-sustaining parts have been altered, replaced, or repaired. The replacement of wire rope is specifically excluded from this requirement; however, a functional test of the crane under a normal operating load will be made prior to putting a crane back into service.

c. Modifications or additions that affect the capacity or safe operation of the equipment are prohibited except where the requirements listed below apply.

    i. Manufacturer's review and approval

    ii. The manufacturer approves the modifications/additions in writing.

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iii. The load charts, procedures, instruction manuals, and instruction plates/tags/decals are modified as necessary to accord with the modification/addition.

iv. The original safety factor of the equipment is not reduced.

2.8 Personal Protective Equipment (PPE)

At a minimum, all Ground Personnel and Operators outside of heavy equipment must wear the following:

a. High visibility safety vest (fluorescent background material and retro-reflective striping) visible from all angles and meeting jurisdictional requirements.

b. Hazards may require high visibility garments that cover torso, legs and arms.

c. American National Standards Institute/Canadian Standards Association (ANSI/CSA) - approved hard hat

d. ANSI/CSA-approved safety glasses with side shields

e. Canadian Standards Association or American Society for Testing and Materials (CSA or ASTM) - approved, high-cut (min. 6") impact and compression resistant footwear.

f. ANSI/CSA-approved hearing protection, as needed

g. Appropriate work clothes.

h. Refer to Safety Gear – Americas for any other PPE requirements.

3. Training

Refer to SH&E Training – Americas and its associated Assessment of SH&E Training Requirements – Americas for additional training requirements.

4. Terms and Definitions

a.	ANSI	American National Standards Institute.
b.	Competent Person	A person capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.
c.	Controlling entity	A prime contractor, general contractor, or construction manager, or any other legal entity having the overall planning, quality, and completion responsibility for the construction of the project.
d.	CSA	Canadian Standards Association.
e.	Ground personnel	Personnel performing work around heavy equipment (note: operators are considered ground personnel when outside of the equipment cab).
f.	Guard	A barrier or enclosure that prevents any body part from reaching over, under, around, through, or entry into the point of operation.
g.	Heavy equipment	All excavating equipment, cranes, lift trucks, drills, etc. This includes off-highway trucks.
h.	HEEZ	Heavy Equipment Exclusion Zones.
i.	Machine safeguarding	Employing guards, devices, distance, location, and limited opening to protect employees who may be exposed to moving parts of equipment or machines.
j.	Operator	A person who operates the controls while the heavy equipment is in motion or the engine is running.
k.	Point of operation	That point at which cutting, shaping, boring, or forming is accomplished upon the stock.

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l.	Powered Industrial Truck	A mobile, power-propelled truck used to carry, push, pull, lift, stack, or tier materials. Forklifts, pallet trucks, rider trucks, fork trucks, lift trucks, pallet jacks, motorized hand trucks, and skid steer loaders are all types of powered industrial trucks.
m.	Qualified Person	is a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, successfully demonstrated the ability to solve/resolve problems relating to the subject matter, the work, or the project.
n.	UAS	Unmanned Aircraft System - Aircraft without a human pilot aboard. Unmanned aircraft are commonly referred to as a UAS, Unmanned Aerial Vehicle (UAV) or drone. UAS vehicles may be either fixed wing or rotorcraft.
o.	UASWG	Unmanned Aircraft System Working Group - A group of AECOM employees who are responsible for the development of standard procedures, oversight and support for all AECOM UAS operations. The UASWG is comprised of employees from Operations, Insurance, Legal, Safety, Health and Environment, and UAS pilots and aviation pilots.

5. References

a. Safety Tenets and Stopping Work – Americas S3AM-001-PR2

b. SH&E Training – Americas S3AM-003-PR2

c. Fitness for Duty – Americas S3AM-008-PR2

d. Safety Gear – Americas S3AM-208-PR2

e. SH&E Risk Assessment and Planning– Americas S3AM-209-PR2

f. Hazardous Energy Control – Americas S3AM-302-PR2

g. Ground Disturbance – Americas S3AM-303-PR2

h. Work at Height – Americas S3AM-304-PR2

i. Unmanned Aircraft Systems – Ecosystem page

6. Records

a. Project Managers must confirm the following:

   i. Maintenance records are maintained and available on all heavy equipment, or onsite if unfeasible to keep on equipment. Maintenance records should be maintained for at minimum the duration of the project and in accordance with manufacturer and client requirements.

   ii. Records of all heavy equipment inspections and rigging inspections are retained and are readily available upon request. Documented inspections must be maintained for at minimum the duration of the project and in accordance with manufacturer and client requirements.

   iii. Records of Operator and Qualified Rigger qualifications and training must be provided to the Project Manager upon initiation of the project and maintained for the duration of the project.

b. Equipment manuals must be provided to the Project Manager upon equipment use and onboarding.

c. Training records must be maintained according to SH&E Training – Americas.

d. Records include the following:

   i. Lift Classification – Americas S3AM-309-FM14

   ii. Critical Lift Plan – Americas S3AM-309-FM15

   iii. Personnel Platform Lifting – Americas S3AM-309-FM16

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iv. Pre-Operation Powered Industrial Truck Checklist – Americas S3AM-309-FM17

v. Mobile Elevating Work Platforms (MEWP) Pre-Operation Checklist – Americas S3AM-309-FM18

vi. Under Bridge Inspection Unit Pre-Operation Checklist – Americas S3AM-309-FM19

vii. Assessment of SH&E Training Requirements – Americas S3AM-003-FM1

7. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Dec-2025	Initial release as S3AM-309-PR2; consolidated portions of the contents from the following retired documents: Heavy Equipment – Americas S3AM-309-PR1; Cranes & Lifting Devices – Americas S3AM-310-PR1; Definitions – Americas S3AM-310-ATT1; Rigging – Americas S3AM-310-ATT3; Powered Industrial Trucks – Americas S3AM-324-PR1; Machine Guarding – Americas S3AM-326-PR1; Hoists, Elevators, and Conveyors – Americas S3AM-343-PR1; and Mobile Elevated Work Platforms – Americas S3AM-323-PR1.	All

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Biological Hazards

S3AM-313-PR2

1. Purpose and Scope

a. This procedure communicates the requirements and precautions to be taken by AECOM employees to protect against bloodborne pathogens, insects, arachnids, snakes, poisonous plants, feral animals, and other wildlife referred to herein collectively as “biological hazards.”

b. This procedure applies to all AECOM Americas employees and operations, as well as its contracted personnel required to comply with this document’s content.

2. Procedure

2.1 Critical Controls

a. The project team should identify potential biological hazard encounters during field work and develop a location-specific Safety, Health, and Environment (SH&E) plan and related task hazard assessments (THAs; e.g., field level risk assessments [FLRAs]) prescribing precautions to mitigate exposures and eliminate or reduce the severity of resulting illnesses. Refer to SH&E Risk Assessment and Planning – Americas.

b. The precautions to be taken by employees to decrease the risk of exposure to biological hazards can often directly increase the risk of heat-related illness due to thermal stresses. Refer to Heat and Cold Stress – Americas.

c. Employees must immediately notify their Project Manager or Supervisor of any biological hazard-related incident (e.g., imbedded tick, insect sting, animal bite, rash, abnormal reaction, or bloodborne pathogen-related exposure) and follow the reporting requirements found in SH&E Incident Response and Investigation – Americas. The Occupational Health Manager must be consulted in the event of any exposure incident.

d. Employees must be given information on how to respond to the applicable biological hazard-related incidents in their emergency response plan. Refer to SH&E Risk Assessment and Planning – Americas.

e. Employees with a history of severe allergic reactions to insect bites or stings should undertake work in areas infested with the allergens only after all required precautions are met. Specifically, such employees are encouraged to inform their project team of their allergies, avoid working alone, carry medications (e.g., Epi-pen) on them, and wear a medical identification bracelet or necklace.

2.2 Animals of Concern – General Requirements

a. Working in the field with or around small mammals, larger carnivores, and reptiles has inherent risks of injury or exposure to infectious diseases transmitted from animals to humans.

b. Wild animals can carry a variety of diseases that humans can contract i.e., viral, parasitic, bacterial, and protozoal. The risks can be either because of direct contact with a wild animal (i.e., break in the skin, or contact with the animal’s blood, saliva, or excrement) or through airborne diseases (e.g., hantavirus, histoplasmosis).

c. Full-length clothing, gloves, and a respiratory mask can greatly reduce the risk of exposure. Refer to Safety Gear – Americas and Respiratory Protection – Americas.

d. Wildlife biologists directly handling wildlife, dead or alive, or working with wildlife feces or in enclosed habitats (such as caves), have an increased risk of exposure to a wider range of zoonotic diseases and should take extra precautions. Any staff handling wildlife must be adequately trained and/or supervised by a wildlife biologist experienced in the task.

e. Employees must not work alone in areas where the risk of encounter with dangerous wildlife is high.

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2.2.1 Dogs

a. Treat unknown dogs encountered in field activities in the same manner as a wild animal.

b. Be conscious of behaviors indicating anxiety (e.g., tail under the belly), defensiveness, or aggressiveness, and attempt to leave the area if identified.

c. Gloves, catch sticks, caging, and other appropriate equipment should be considered and may be necessary.

2.2.2 Rodents

a. Rodents can carry a variety of diseases (e.g., hantavirus and bubonic plague). Although infections are rare, they can be fatal. Infection can be spread to humans when they:

   i. Breathe air contaminated by rodent saliva, urine, or feces containing infectious materials; or

   ii. Accidentally rub eyes, mouth, or broken skin with infected rodent mouse saliva, urine, or feces.

b. Rodent control measures must be employed at AECOM locations where there is a potential or evidence of rodent infestation. In these situations, the following precautions should be taken during field operations:

   i. Limit exposure to soil handling and use gloves where appropriate.

   ii. Wash or sanitize hands often throughout the day and before meals.

   iii. Equipment bags, storage areas, and vehicles should be frequently inspected for signs of mouse infestation.

   iv. Rodent-proof storage containers should be used when practical.

   v. Do not enter buildings infested with mice without adequate respiratory protection.

   vi. Droppings should never be removed by vacuuming or sweeping. Wetting down an area with a mixture of 1:9 household bleach and water solution will reduce risk of airborne exposure.

   vii. Repellent (i.e., DEET applied to skin or permethrin to clothing) should be used if there is potential exposure to rodent fleas.

2.2.3 Large Mammals – General Requirements

Most negative encounters with large mammals (e.g., bears, carnivores, and ungulates) can be avoided with a few key preventive measures:

a. When working in wilderness isolation, always travel in pairs and make lots of noise.

b. Always store food in air-tight containers away from sleeping areas (if camping), and never carry strong-smelling foods, which could attract animals.

c. Keep your eyes open for fresh animal signs that may indicate a dangerous situation.

d. Maintaining a distance of at least 100 feet (30 meters) allows large animals an escape route. If you notice any signs of aggression or behavioral changes, move away to a safe location. Wildlife should not be enticed by reaching out or simulating calls.

2.2.4 Bears

a. An encounter with a bear of any species can have a wide variety of outcomes, ranging from a simple sighting to a false charge, to a serious mauling or even death. Consequently, the risk of a bear encounter must be taken very seriously and can vary significantly depending on the location.

b. It is important to research the project area before field work commences to determine the expected probability of encountering bears and what type. Remoteness from urbanized areas should not be a criterion, as bears have been encountered within city limits, especially near landfills. The risk associated with a bear encounter also varies with the species of bear, the season, and the circumstances under which the bear is encountered.

c. The best defense against bears is to actively practice bear avoidance techniques when working in the field.

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2.2.5 Carnivores

a. Most wild carnivores in the feline family (cougars, lynx, and bobcat) or the canine family (wolves and coyotes) are more predictable than bears and are not predatory toward humans. However, all wild animals can be dangerous if they feel threatened or if they are sick or starving.

b. A fresh kill or carcass might indicate the presence of a carnivore that may become aggressive to defend its food.

2.2.6 Ungulates

a. Most ungulates (deer, moose, elk, and caribou) will avoid humans and will flee as soon as a human is sighted. However, females with young (during May and June) and males during mating season (September to November) can be very aggressive, especially if provoked.

b. Extensive fresh rubbing on branches in the fall might indicate the presence of a rutting male ungulate that may become aggressive to defend a potential mate.

2.2.7 Snakes

a. Staff working in areas known to be inhabited by venomous reptiles should take extra precautions, be able to identify the local species, and understand the best practices for administering first aid. Most venomous reptiles are non-aggressive and will only attack humans if immediately threatened.

b. The following precautions should be taken when there is a risk of a snake encounter:

   i. Be careful near heavy vegetation in or near the water's edge. This is where reptiles like to reside during the daylight hours.

   ii. Stay on trails where possible, and watch where you place your hands and feet, especially when climbing or stepping over fences, large rocks, and logs.

   iii. Take care when overturning any objects on the ground.

   iv. If you see a hazardous reptile, give it as much room as possible. Most snakes have a strike distance only half the length of their body.

   v. If venomous snakes are a risk, staff should contact local hospitals to determine availability of appropriate anti-venom and include all snakebite emergency response guidance in the applicable SH&E plan and THA.

2.2.8 Alligators

a. The chance of encountering an alligator is greatest during the animal's courtship and mating season (March to September). Also, July to September is when mother alligators are guarding their nests.

b. When trying to get past an alligator, do not walk between the alligator and the water in case the alligator gets frightened and runs toward the water. The alligator is not a natural runner and can tire out in a relatively short time. An alligator will often give up a chase when it sees the runner is moving away and too much effort is required.

2.3 Insects of Concern

Employees working outdoors may be exposed to a variety of insects, including but not limited to, ticks, mosquitos, spiders, and scorpions. Bites or stings from these insects may result in outcomes ranging from minor irritations to serious allergic reactions and/or illnesses.

2.3.1 Flying Insects

Outdoor workers are at risk of being stung by flying insects (mosquitos, bees, wasps, and hornets). While most stings cause only mild discomfort, some may result in severe allergic reactions requiring immediate medical care and may cause death. As such, employees must take the following precautionary measures when working in habitat areas for flying insects:

a. Wear light-colored, smooth-finished clothing.

b. Avoid wearing perfume and cologne and strong-smelling deodorants, lotions, soaps, and shampoos.

c. Wear clean clothing and bath daily.

d. Wear clothing to cover as much of the body as possible.

e. Avoid flowering plants when possible.

f. Keep work areas clean. Some insects are attracted to discarded food.

g. Remain calm and still if a single stinging insect is flying around.

h. If an insect is inside your vehicle, stop slowly, and open all the windows.

i. Mosquitoes are known to breed in standing water; therefore, when standing water is found at a job site, actions should be taken to drain the water.

2.3.2 Ticks

a. The Centers for Disease Control and Prevention works with states, health authorities, and other experts on research to define and monitor the occurrence of disease-carrying ticks. See cdc.gov/ticks for additional information.

b. Employees working in or adjacent to areas where there are established tick populations must take the precautionary measures below.

   i. Before you go outdoors:

      1. Know where to expect ticks. Ticks live in grassy, brushy, or wooded areas, or even on animals. Avoid wooded and brushy areas with high grass and leaf litter and walk in the center of trails when possible.

      2. Treat clothing and gear with products containing 0.5% permethrin. Permethrin can be used to treat boots, clothing, and gear and remain protective through several washings. Alternatively, you can buy permethrin-treated clothing and gear.

      3. Tuck loose-cuff trousers into socks, wrap with duct tape completely around the cuff of the sock up to the surface of the pant leg to prevent entry of insects between the sock and pants, and preferably reverse wrap the tape with the sticky side out.

      4. Use government-approved repellants containing DEET, picaridin, IR3535, Oil of Lemon Eucalyptus (OLE), para-menthane-diol (PMD), or 2-undecanone. Always follow product instructions.

   ii. After you come indoors:

      1. Check your clothing for ticks. Ticks may be carried into the house on clothing. Turn clothing inside out and shake them at the end of day. Any ticks found should be removed. Tumble dry clothes in a dryer on high heat for 10 minutes to kill ticks on dry clothing after you come indoors. If the clothes are damp, additional time may be needed. If the clothes require washing first, hot water is recommended. Cold and medium temperature water will not kill ticks.

      2. Examine gear and pets. Ticks can ride into the home on clothing and pets, then attach to a person or pet later, so carefully examine pets, coats, and daypacks.

      3. Shower within 2 hours of coming indoors. Showering may help wash off unattached ticks and it is a good opportunity to do a tick check.

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4. Check your body for ticks. Conduct a full body check upon return from potentially tick-infested areas. Use a hand-held or full-length mirror to view all parts of your body. Check these parts of your body and your child's body for ticks:
    - Under the arms
    - In and around the ears
    - Inside belly button
    - Back of the knees
    - In and around the hair
    - Between the legs
    - Around the waist

    Note: Tick testing is not recommended because results are unreliable for treatment decisions, may give false reassurance, and symptoms typically appear before results are available.

2.3.3 Spiders

a. The most common venomous spiders are the black widow and the brown recluse. Venomous spiders can be dangerous to outdoor workers. Spiders are not usually aggressive, and most bites occur because a spider is trapped or unintentionally contacted. It's important to know the risk of exposure to venomous spiders and how to protect yourself and what to do if you are bitten.

b. Workers can take the following preventive steps:

    i. Inspect or shake out any clothing, shoes, towels, or equipment before use.

    ii. Wear protective clothing such as a long-sleeved shirt and long pants, hat, gloves, and boots when handling stacked or undisturbed piles of materials.

    iii. Minimize the empty spaces between stacked materials.

    iv. Remove and reduce debris and rubble from around the outdoor work areas.

    v. Trim or eliminate tall grasses from around outdoor work areas.

    vi. Store apparel and outdoor equipment in tightly closed plastic bags.

    vii. Keep your tetanus boosters up to date (every 10 years). Spider bites can become infected with tetanus spores.

2.3.4 Scorpions

a. Scorpions usually hide during the day and are active at night. They may be hiding under rocks, wood, or anything else lying on the ground. Some species may also burrow into the ground. Most scorpions live in dry, desert areas. However, some species can be found in grasslands, forests, and inside caves.

b. Workers can take the following preventive steps:

    i. Wear long sleeves and pants.

    ii. Wear leather gloves.

    iii. Shake out clothing or shoes before putting them on.

2.4 Plants of Concern

a. Employees working outdoors may be exposed to a variety of plants of concern, including but not limited to, poison ivy, poison oak, poison sumac, giant hogweed (giant cow parsnip), wild parsnip, devils club, and stinging nettle. This hazard still exists in the fall and winter in the form of stubble and roots.

b. Many plants are not harmful to the touch but may contain poisonous berries or foliage that could cause serious complications or death if they are ingested. Never eat any plants or berries, even if you are sure of their identity.

c. Workers should take the following preventive steps:

   i. Beware of your surroundings and the potential irritants in your work area.

   ii. Identify and avoid areas of poisonous plants.

   iii. Use skin guards to prevent the transfer of oils from clothes or equipment to skin.

   iv. If areas of poisonous plants need to be entered, consider clearing the area, when feasible, and wear protective clothing such as Tyvek.

2.5 Bloodborne Pathogens

There are a few activities for which potential occupational exposures to blood or other potentially infectious materials are of concern. These activities may include:

a. Investigations of properties receiving regulated wastes.

b. Site visits or audits at treatment, storage, and disposal facilities where wastewater or medical waste is handled.

c. Site visits or audits at medical or health care facilities.

d. Site work in areas where there is a potential risk for the presence of used hypodermic needles.

e. The provision of first aid or cardiopulmonary resuscitation (CPR).

   Note: First aid and CPR training is often on a voluntary basis and not directed by AECOM. As such, potential exposures may not be considered occupational exposures within the context of the OSHA Bloodborne Pathogens Standard.

f. Occasionally, potentially infectious material is encountered during an activity where none was expected. When this occurs, the work must be stopped, employee training conducted, and an exposure control plan prepared prior to resuming activities with potential exposures.

2.6 Exposure Control Plan for Bloodborne Pathogens

a. A site-specific exposure control plan (ECP) must be established for employees at risk for exposure to and possible transmission of infectious diseases from bloodborne pathogen sources. The ECPs must describe how employees are effectively informed of potential workplace health hazards, and the protective measures necessary to eliminate or effectively minimize the risk of bloodborne exposure incidents. ECPs for projects or programs extending over 1 year must be reviewed annually by the SH&E Manager and affected employees.

b. Sections 2.6.1 to 2.6.5 summarize key elements to be included in the ECP.

2.6.1 Potential Exposure Determination

Employees must consult with the Occupational Health Manager to determine if a Hepatitis A or B vaccination is appropriate given the site conditions and the proposed scope of work. These determinations should differentiate voluntary first-aid duties from occupational exposures as a component of the exposure determination.

2.6.2 Training

Refer to Section 3.

2.6.3 Hepatitis B Vaccination

a. Employees will be offered the Hepatitis B vaccination, at no cost to the employee, when assigned to tasks with potential occupational exposure to bloodborne pathogens or if incidental contact with potential sources of bloodborne pathogens occurs.

b. Employees choosing to take the vaccination series must sign a consent form. Employees who decline the Hepatitis B vaccine must sign a copy of a waiver form. All forms are to be stored by the Occupational Health Manager.

2.6.4 Engineering and Work Practice Controls

a. “Universal precautions” are a required method of control to prevent exposure to blood and body fluids. This term refers to the concept that all human blood and certain human body fluids are treated as if known to be infectious for human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), and other bloodborne pathogens, regardless of the perceived risk status of another individual. Universal precautions apply to blood, and other body fluids containing visible blood. Universal precautions do not apply to feces, nasal secretions, saliva, sweat, tears, sputum, urine, and vomitus unless they contain visible blood.

b. Special provisions should be made so hand washing facilities are available on sites where bloodborne pathogens are suspected or present. If soap and running water are not available, an antiseptic hand cleaner in conjunction with clean paper towels or antiseptic towelettes are acceptable temporary alternatives to running water. When this alternative method is used, employees must wash their hands with soap and running water as soon as feasible.

c. Eating, drinking, smoking, applying cosmetics, and handling of contact lenses is prohibited in work areas where there is a reasonable likelihood of occupational exposure.

d. Fluorescent red or orange-red warning labels bearing the universal biohazard symbol and the legend BIOHAZARD must be firmly affixed to all containers (e.g., waste cans, sharps containers, and refrigerators) used for the storage or shipment of blood or other potentially infectious materials. Disposal manifests must be maintained in accordance with local law.

e. Any areas or equipment that are contaminated by potentially infectious material will be decontaminated using a 10% solution of household bleach. Utilize appropriate personal protective equipment to control exposure to the bleach (e.g. safety goggles, and gloves). Refer to Section 2.6.5.

2.6.5 Personal Protective Equipment

a. Personal protective equipment (PPE) will be provided at no cost to the employee and will be chosen based on the anticipated exposure to blood. PPE is considered appropriate if it does not permit blood or other potentially infectious materials to reach or pass through clothes, skin, or mucous membranes of the eyes or mouth under normal conditions of use, and for the duration of time the equipment is used.

b. Disposable single-use gloves must be used as a protective barrier in all situations in which contact with body fluids is anticipated. Gloves of the correct size will be provided. Disposable gloves must not be washed or disinfected for reuse and must be replaced between employees and if they become torn or punctured. Gloves are especially important if the Employee has cuts, abraded skin, chapped hands, or dermatitis.

c. Liquid-impermeable gowns, boots, and masks, in combination with eye-protective devices such as goggles and shatterproof glasses with solid-side shields or chin-length face shields, must be worn whenever splashing, spraying, or spattering of blood droplets or body fluids can be reasonably anticipated.

d. Disposable pocket mask ventilation devices must be provided in all first aid kits and used to avoid mouth-to-mouth contact during emergency cardiopulmonary resuscitation.

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e. Examples of recommended PPE include the following listed in Table 1 (depending on task, more PPE may be needed):

Table 1. PPE by Task

Task	Gloves	Gown	Mask	Goggles
Bleeding control w/ minimal bleeding	Yes	No	No	No
Bleeding control w/ spurting blood	Yes	Yes	Yes	Yes
Cardiopulmonary resuscitation	No	No	Yes	No
Decontamination/cleanup	Yes	No	No	No
Medical laboratory activities	Yes	Yes	Yes	Yes

2.6.6 Incident Response

a. All incidents in which an employee has been exposed to blood or other potentially infectious materials must be reported to the Employee's Supervisor and to the SH&E Manager immediately. The Occupational Health Manager must be consulted in the event of an exposure incident.

b. Post-exposure hepatitis vaccination will be offered to employees involved in an occupational exposure incident within 24 hours of possible exposure at no cost if required by the exposure determination.

3. Training

a. Employes must take appropriate training from AECOM University and third-party vendors to assist in the identification and control of biological hazards. Refer to SH&E Training – Americas and its associated Assessment of SH&E Training Requirements – Americas.

b. All personnel who will work on projects or programs that involve potential contact with bloodborne pathogens are required to attend a training class prior to the start of the project or program and annually for continuing projects or programs. Refer to SH&E Training – Americas.

c. The specific requirements and provisions of the written ECP will be provided to each employee and any managed subcontractor assigned to work at the program/project site.

4. Terms and Definitions

a.	Bloodborne Pathogen Exposure	Exposure to blood containing pathogens including, but not limited to, HBV, HIV, hepatitis C, malaria, syphilis, babesiosis, brucellosis, leptospirosis, arboviral infections, relapsing fever, human T-lymphotropic virus Type I, and viral hemorrhagic fever (Ebola).
b.	CPR	Cardiopulmonary resuscitation.
c.	ECP	Exposure Control Plan – A plan addressing the requirements applicable to specific AECOM projects and activities designed to eliminate or minimize employee exposure. The ECP must be incorporated into the location-specific SH&E Plan and must be accessible to all employees.
d.	Field Work	Any activity conducted in outdoor settings; or at a site containing brush, overgrown grass, leaf litter, or poisonous plants; or located near mosquito breeding areas, including work in structures where animals harboring fleas or ticks might exist or where spiders and mites could be present.
e.	HBV	Hepatitis B virus.
f.	HCV	Hepatitis C virus.
g.	HIV	Human immunodeficiency virus.

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h.	Occupational Exposure (Exposed)	Reasonably anticipated skin, eye mucous membrane, or parenteral contact with blood or other potentially infectious materials resulting from the performance of an employee's duties. Employees are considered to be potentially exposed, even if they are using the universal precautions specified for the project or program.
i.	Poisonous	Capable of harming or killing by poison; toxic or venomous.
j.	PPE	Personal Protective Equipment.
k.	SH&E	Safety, Health, and Environment.
l.	Universal Precautions	All body fluids and materials potentially contaminated by body fluids will be considered to be infectious unless the fluids were from the person performing the cleanup or decontamination activities. All employees coming in contact with another person's body fluids must assume that the fluids are infectious and must wear prescribed personal protective equipment.

5. References

a. SH&E Training – Americas S3AM-003-PR2

b. SH&E Incident Response and Investigation – Americas S3AM-004-PR2

c. Heat and Cold Stress – Americas S3AM-112-PR2

d. Safety Gear – Americas S3AM-208-PR2

e. SH&E Risk Assessment and Planning – Americas S3AM-209-PR2

f. Respiratory Protection – Americas S3AM-123-PR1

6. Records

a. Bloodborne pathogens training class records must be maintained for at least 3 years from the date of training. The records will include the date of the training class, a summary of the class contents, the names of the qualified instructors, and the names and job titles of personnel attending the training.

b. Assessment of SH&E Training Requirements – Americas S3AM-003-FM1

7. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	01-Dec-2025	Initial release as S3AM-302-PR2; consolidated portions of the contents from the following retired documents: Wildlife, Plants & Insects – Americas S3AM-313-PR1, Biological Hazard Assessment Decision Flowchart – Americas, S3AM-313-ATT01 , Ticks – Americas S3AM-313-ATT02, Poisonous Spider Identification – Americas S3AM-313-ATT03, Mosquito-Borne Diseases – Americas S3AM-313-ATT04, Plants of Concern – Americas S3AM-313-ATT05, Wild Parsnip Identification – Americas S3AM-313-ATT06, Alligators – Americas S3AM-313-ATT07, Bird Droppings Safe Practices – Americas S3AM-313-ATT08, Large Carnivores & Ungulates – Americas S3AM-313-ATT09, Bear Safety – Americas S3AM-313-ATT10, Small Mammals – Americas S3AM-313-ATT11, Snakes & Scorpions – Americas S3AM-313-ATT12, Bloodborne Pathogens – Americas S3AM-111-PR1, and Bloodborne Pathogens Exposure Control Plan – Americas S3AM-111-ATT1.	All

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Appendix B – Field Activities Plan (FAP)

AECOM

Field Activities Plan (FAP)

Site Characterization
Off-Site 91 Leighton Avenue (Site No. C828231A)
Work Assignment D009803.64

August 2026

Prepared for:

New York State Department of Environmental Conservation
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1.0 Introduction

The purpose of this Field Activities Plan (FAP) is to document planned investigative activities and establish the criteria for performing these activities at a predetermined quality for the work conducted by AECOM USA, Inc. (AECOM) under NYSDEC Standby Engineering Contract D009803.

The data gathering effort outlined in this FAP includes advancement of boreholes, installation of monitoring wells, installation of soil vapor monitoring pins, and analysis of groundwater, soil vapor, and air samples. This information will be necessary to assess the presence or absence of subsurface impacts, and provide data related to Site conditions. All data collected will be compiled into a RI Report in response to the request from NYSDEC.

This FAP is designed to provide typical procedures for the field activities on work assignments (WAs) issued under NYSDEC Contract D009803. It will serve as the field procedures manual for all AECOM personnel. Adherence to these procedures will ensure the quality and defensibility of the field data collected. In addition to the field procedures outlined in this document, all personnel performing field activities must do so in compliance with: (1) the quality assurance/quality control (QA/QC) measures outlined in the Quality Assurance Project Plan (QAPP); (2) the appropriate health and safety guidelines found in the Health and Safety Plan (HASP); (3) the scope of work outlined in the Site Characterization Work Plan (SCWP) and WA; and (4) the time schedule outlined in the SCWP and WA.

The FAP is intended to be a companion document to the site-specific Work Plan prepared for each work assignment. This FAP was prepared as an Appendix to the SCWP for Work Assignment #64 to address site-specific conditions and project-specific requirements.

1.1 Work Assignment Objectives

Field activities are planned and conducted in general accordance with NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation (NYSDEC, 2010), NYSDEC DER-31: Green Remediation (2010b) the United States Environmental Protection Agency (USEPA) Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988), and New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, 2006).

The FAP is intended to be a companion document to the site-specific SCWP. This site-specific FAP has been prepared using the NYSDEC Generic FAP and included as Appendix B to the SCWP to address site-specific conditions and project-specific requirements for Work Assignment #64.

1.2 Site Description and Background Information

The Site comprises the downgradient areas adjoining 91 Leighton Avenue in the City of Rochester, Monroe County, New York. The Site boundary is not currently defined but includes the City-owned roadways and right-of-ways (ROWs) for Leighton Avenue to the north and Greenleaf Street to the west, followed by select medium density residential properties. Previous investigations at 91 Leighton Avenue identified solvents (e.g., trichloroethene [TCE], etc.) in the groundwater and soil vapor, which may have migrated off-site to the north and west.

Available site information is presented in the SCWP.

2.0 General and Preparatory Field Activities

The scope of work has been established in the work assignment as documented in the site-specific SCWP.

The work assignment includes a variety of field activities intended to obtain site-specific data pertaining to the extent of contamination and the extent to which releases or potential releases from the site pose a threat to human health and the environment. Typical project objectives include:

- Assess site geology;
- Assess site hydrogeology;
- Evaluate areal and vertical extent of contamination, including transport mechanisms;
- Determine if the source(s) has impacted off-site properties; and
- Collect additional data to support the design and implementation of remedial actions.

To accomplish these objectives, the field subtasks described in this FAP will be utilized. Additional methodology information is provided in the QAPP. Unless otherwise noted, it is assumed that all field work will be completed at Level D personal protection in accordance with the HASP. Field activities will be monitored by a qualified AECOM representative(s).

2.1 Mobilization

Following authorization to proceed with the field investigation from NYSDEC, AECOM and its subcontractors will mobilize necessary materials and equipment to the site. Due to the intrusive nature of the work being performed, Atlantic Testing Laboratories, Limited (ATL), as the subcontractor performing the work, will call UDig New York for a utility markout. Utility clearance is detailed in Section 2.3.

The site-specific SCWP describes the provisions made for providing all necessary facilities and material, independent of the site owners/occupants. Site preparation will be performed by AECOM's drilling subcontractor, ATL, under direction of AECOM. Site preparation will include construction of a temporary decontamination pad for decontamination of tools and equipment and obtaining necessary City of Rochester work permits. The temporary decontamination pad will be lined with plastic sheeting for purposes of collecting, containerizing, and properly disposing of decontamination water. Following field work, the temporary decontamination pad will be disassembled and removed from the Site.

A drum storage area will also be established on the site property for the temporary storage of investigation derived waste (IDW), including soil cuttings, monitoring well development water, decontamination fluids and purge water from groundwater sampling. Necessary materials will be stored in a vehicle (e.g., box truck).

A project kick-off meeting will be held prior to initiating field work to orient field team members and subcontractors with the site and to familiarize all site workers with site background, potential dangers, health and safety requirements and emergency contingencies and other field procedures.

2.2 Health and Safety

It is anticipated that the work to be completed will be performed in Level D personal protection with the potential to upgrade to Level C. Field workers will be instructed to keep Level C equipment available should it be needed. Should health and safety monitoring during field activities indicate a threat to field personnel or warrant an upgrade beyond Level C protection, work will stop, and site conditions will be re-evaluated by NYSDEC and AECOM. An upgrade to Level B protection will require modification of the HASP and review by AECOM's regional safety manager.

The site-specific HASP is included in the SCWP as Appendix A and submitted concurrently with the site-specific FAP (Appendix B), and site-specific QAPP (Appendix B).

2.3 Utility Clearance: Callout

Intrusive activities will include monitoring well installations. Prior to the start of intrusive activities, a call will be placed by ATL, the drilling subcontractor, to UDig New York CALL CENTER at Dig Safely New York (for all areas north of New York City) 811 (http://www.digsafelynewyork.com) or 1-800 272-4480 for utility markouts to minimize the risk of encountering subsurface utilities. Site personnel will be contacted to determine if detailed utility plans are available for the Site.

2.4 Geophysical Surveys

Following public utility clearances, a geophysical survey will be conducted by Matrix Environmental Technologies Inc. (Matrix) to screen for and identify the presence of underground utilities or any anomalies (e.g., underground storage tanks) within the work areas where drilling will be conducted. The subcontractor will use both ground penetrating radar (GPR) and electromagnetic conductivity (EMC) methods necessary to confirm utility clearance. Subsurface utilities and/or anomalies shall be identified and marked in the field with spray paint as they are located and a report that summarizes the findings of the survey shall be submitted seven calendar days of completion of the survey.

2.5 Utility Clearance: Hand Clearing

Excavation with hand tools allows for excavation near subsurface utilities with reduced chance of impacting the utilities. Hand clearing will be conducted for all boring/well locations by AECOM's drilling subcontractor, ATL, under direction by AECOM.

Procedure:

1. Excavate a two-foot square by approximately five-foot deep area manually using post-hole diggers, pry bars, and/or hand digging. An air knife or Vac-Tron® can be used as contingency if needed to advance through areas of dense overburden.
2. After the location is cleared for drilling, the hole will be backfilled flush with the ground surface using the excavated spoils (small rocks and debris removed).
3. Excavated material not returned to the hole will be drummed for proper disposal.

2.6 Community Air Monitoring

Community air monitoring will be performed as outlined in the NYSDOH Generic Community Air Monitoring Plan (CAMP). AECOM's approach to implementing CAMP is provided in Section 8.0 of this FAP.

2.7 Site Survey

Project surveying will be performed by qualified AECOM staff and will provide data necessary to plot groundwater monitoring wells on the existing base map. All surveying will be performed by a New York State licensed land surveyor, following the requirements of the Scope of Work and HASP.

The horizontal positions will be tied into the North American Datum 1983 and UTM Zone 18N coordinate system. The vertical positions will be tied to the North American Vertical Datum 1988 (NAVD88). The measuring point associated with the existing monitoring wells or other site reference features will be recorded to a vertical accuracy of 0.01 ft. The final survey will be supplied in a digital CAD format (i.e., .dwg or .dxf files in the cited coordinate systems).

2.8 Green and Sustainable Remediation

The work to be completed will comply with NYSDEC guidance documents including DER-31: Green Remediation (2010b). To ensure compliance with DER-31, the work will be completed using the best management practices (BMPs) and techniques described below. In addition to the items discussed in Section 10.0 – Field Records and Documentation, specific reporting methods relative to DER-31 are further described in the following subsection.

2.8.1 Best Practices and Techniques

DER-31 provides some examples of BMPs that could be applied during all phases of remediation (see Attachment 1 of the DER-31 policy). Additional resources to identify potential BMPs and techniques applicable to this work include:

- United States Environmental Protection Agency CLU-IN Green Remediation (www.clu-in.org/greenremediation/);
- Interstate Technology & Regulatory Council Green and Sustainable Remediation (www.itrcweb.org/teampublic_GSR.asp);
- NAVFAC Green and Sustainable Remediation (www.ert2.org/t2gsrportal/);
- Air Force Center for Engineering and the Environment Sustainable Remediation (www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/sustainableremediation/index.asp); and
- Sustainable Remediation Forum (www.sustainableremediation.org).

Lastly, NYSDEC expects that the BMPs identified below will be implemented at sites unless a site-specific evaluation demonstrates impracticability or favors an alternative green approach:

- Use of battery powered pumps.
- Reduce vehicle idling. All vehicles, both on and off road (including construction equipment) will be shut off when not in use for more than 5 minutes, consistent with 6 NYCRR Part 217 Motor Vehicle Emissions, Subpart 217-3 Idling Prohibition For Heavy Duty Vehicles.
- Use of Ultra Low Sulfur Diesel (ULSD) for drilling rigs.
- Use of low-flow sampling techniques to limit waste generation.
- Segregating recyclables from disposable waste material.
- Use phosphate-free detergents in place of organic solvents or acids.
- Use local staff (including subcontractors) when possible, to limit travel and petroleum fuel consumption.
- Contract a laboratory that uses green practices and/or chemicals.
- Use of newer equipment models meeting higher energy conservation standards.
- Source newer and lower-emission Tier 4 diesel equipment for pumps and drilling/ direct push equipment where possible.
- Use appropriately sized construction equipment, and pumps for each task.
- Use lower emission vehicles such as electric vehicles or small trucks or SUVs rather than full-size, where appropriate.
- GPR will be used as a non-invasive method, in lieu of excavating, to clear for utilities as well as identify any potential previously unidentified underground structures.
- IDW drums will be grouped and stored in a secure location throughout field activities and removed from the Site in a single event at the end of each field mobilization as applicable, rather than daily pickups.
- When applicable, visits to stores to purchase field supplies, etc., and trips to the laboratory to drop off sample coolers will be limited or combined to save energy, reduce emissions, reduce localized noise, vibration, and wear and tear on roads.

The Project Manager has identified applicable BMPs to be used, as presented in the site-specific SCWP as Appendix D. The NYSDEC Form A: Summary of Green Remediation Metrics tracking form will also be utilized during the RI, and has been included in the site-specific SCWP as Appendix D.

2.8.2 Reporting

All Green and Sustainable BMPs employed during field activities will be discussed within the field logbooks described in Section 9.0 – Field Records and Documentation. Specifically, the field logbooks will acknowledge that the practices and techniques identified for the site work were taken each day (if applicable). In addition, the following information will be recorded within the field logbooks at the close of each day:

- Estimated quantity of fuel consumed by onsite vehicles and equipment;
- Estimated distance traveled by trucks and equipment delivering goods or removing waste; and
- Estimated water used during onsite activities.

The information will be compiled in a form suitable to the site-specific work completed.

3.0 Drilling / Coring and Well Installation Procedures

Drilling activities will comprise of four (4) soil borings, of which two (2) will be overburden monitoring wells, and two (2) will be bedrock monitoring wells according to the SCWP and will utilize a combination of direct push technology (DPT) drilling, hollow-stem auger (HSA) drilling and NX-Rock coring.

Procedures for specific sampling activities are described below. The procedures proposed for this investigation are discussed in this section and will be implemented by a subcontractor under the direct supervision of an AECOM employee.

3.1 Hollow-Stem Auger Drilling Procedures

A standard method of subsurface drilling which enables the recovery of representative subsurface samples for identification and laboratory testing.

Procedure:

1. HSAs, drill rods, and the drill rig will be thoroughly decontaminated prior to initial borehole installation and between each borehole at the centralized decontamination area. All decontamination liquids will be collected and placed in DOT-approved 55-gallon drums.
2. The drill rig will be inspected for oil leaks and any leaks reported prior to starting drilling operations.
3. Advance the boring by rotating and advancing the HSAs to the desired depth. The borings will be advanced incrementally to permit continuous or intermittent subsurface soil sampling, as required.
4. Remove center plug from the HSAs and collect a split spoon sample per the method stipulated by the project geologist or hydrogeologist.

References: American Society for Testing and Materials (ASTM) D1452/D1452M-16.

3.2 NX-Rock Coring Procedures

NX-Coring is a standard method of subsurface drilling which enables the recovery of bedrock cores for identification.

Procedure:

1. Advance the boring into the bedrock by core drilling using an NX-size, double-tube, swivel-type core barrel. Continue drilling until core blockage occurs or until the net length of the core barrel has been drilled.
2. Remove the core barrel from the hole and disassemble it as necessary to remove the core. Reassemble the core barrel and return it to the hole. Resume coring.
3. Place recovered core in the core box with the upper (surface) end of the core at the upper-left corner of the core box. Fit fractured, bedded, or jointed pieces of core together as they naturally occurred.
4. Label core box with borehole ID, date, time, and depth interval of core.
5. The following observations will be recorded from the rock core:
    a. Core recovery percent
    b. Color
    c. Rock classification
    d. Rock hardness
    e. Rock fractures, including descriptions of natural breaks
    f. Rock Quality Designation (RQD)

RQD = Sum of core lengths > 4" × 100%

Total length of core run

Reference: ASTM D2113-14.

3.3 Monitoring Well Installation

The default method for advancing borings in overburden will be using 4¼-inch HSAs with a center plug. The HSAs will be advanced to bedrock. If difficulties with running sands are encountered which hinder drilling, potable water may be introduced into the HSAs to maintain a positive hydrostatic head. NX-Rock coring will be implemented for advancing in bedrock.

Monitoring well borings will be advanced to the target depths listed in the site-specific SCWP. Soil samples will be obtained in accordance with Section 5. Soil cuttings will be screened for organic vapors using a PID.

3.3.1 Overburden Monitoring Well Construction Procedures

The overburden groundwater monitoring wells that will be installed during this investigation will use the procedures described below.

Procedure:

1. Advance subsurface boring to the desired depth by means of hollow-stem auger drilling.
2. While boring, collect split spoon samples on a continuous basis to geologically log the boring.
3. Remove center plug from augers and verify borehole depth using weighted measuring tape.
4. Add washed and graded medium sand as needed to base of borehole.
5. Insert 10 feet of 2-inch ID #10 slot PVC screen attached to a 2-inch ID, Schedule 40 PVC riser to the ground surface and cap the riser to prevent well construction materials from entering the well.
6. Add sand to screen section of well while slowly removing augers. Sand pack should extend at least two feet above the top of the screen section. Measure with a tape.
7. Slowly add bentonite pellet seal to borehole as augers are slowly removed. The bentonite seal should extend at least two feet above the top of the sand pack section. Measure with tape.
8. Note: The rate of removal of the auger from the borehole should closely follow the rate that the sand pack and bentonite pellets fill the borehole.
9. If bentonite seal is placed above the groundwater level within the borehole, add water to the borehole to hydrate the bentonite pellets. Allow pellets to hydrate for at least 30 minutes.
10. Mix cement/bentonite grout per manufacturer's specifications.
11. Add grout to borehole through tremie pipe or hose from the top of the bentonite seal to the ground surface.
12. Remove remaining augers from the borehole.
13. Top off grout in borehole. Grout should extend to approximately two feet below ground surface.
14. Cut well-riser pipe to about three feet above the ground surface for stickup type wells. Flush-mount well risers should be cut off just below surface grade.
15. Backfill the remaining two feet of the borehole with concrete.
16. Install a protective casing over the well riser pipe and set it into the concrete backfill.
17. Lock the protective casing cover.
18. Document well construction in the field notebook and on a Well Construction Detail diagram (**Appendix A**).

Reference: ASTM D5092/D5092M-16.

3.3.2 Bedrock Monitoring Well Construction Procedures

The bedrock groundwater monitoring wells that will be installed during this investigation will use the procedures described below.

Procedure:

1. Collect soil samples while advancing to the top of bedrock. Follow the procedures in Section 5 as applicable for field conditions.
2. Measure the depth to the top of bedrock from the ground surface using a weighted measuring tape.
3. Upon reaching the bedrock surface, the augers will be removed, and a temporary 6-inch diameter casing will be installed.
4. Bedrock will be cored using an NX core bit to approximately 3 feet into bedrock. The bedrock core will be examined by the AECOM geologist to confirm bedrock. After bedrock is confirmed, the drilling rig will be re-tooled to ream the core hole using a 5-7/8 – inch roller bit to construct a rock socket. A nominal 4-inch ID carbon steel casing will be installed to grade and grouted into the rock socket.
5. Bedrock will then be continuously cored at least 24-hours after the grout and steel permanent casing is installed using an NX core bit up to a target depth (i.e., approximately 10-15 feet into bedrock).
6. Insert a riser cap (J-plug) into the well riser. Install an 8-inch curb box around the well casing by cementing the protective curb box around the well casing. Install lock on J-plug and seal the curb box.
7. Document well construction details in the field notebook and transfer the data onto the Bedrock Monitoring Well Construction Detail form (**Appendix A**).

Reference: ASTM D5092/D5092M-16.

4.0 Groundwater Investigation Tasks

A groundwater investigation will be conducted as part of the RI. Field activities implemented as part of a groundwater investigation include (but are not limited to) the following:

- Monitoring Well Development
- Groundwater Elevation Survey
- Groundwater Sampling from Monitoring Wells

4.1 Well Development

Following completion of groundwater monitoring well installation, at least 24 hours after installation, each newly installed monitoring well will be developed by pumping until the discharged water is relatively sediment free and the indicator parameters (pH, temperature, and specific conductivity) have reached steady state. Developing the monitoring well removes sediment and may improve the hydraulic properties of the formation.

The effectiveness of the development measures will be closely monitored in order to keep the volume of discharged water to the minimum necessary to obtain sediment-free samples. A portable turbidimeter will be used to monitor effectiveness of development. A turbidity reading of < 50 Nephelometric Turbidity Units (NTU) and steady-state pH, temperature, and specific conductivity readings will be used as a guide for discontinuing well development.

Procedure:

1. An appropriate monitoring well development method should be selected, depending on water level depth, well productivity, and sediment content of water. Monitoring well development options include: (a) manual pumping; and (b) powered suction-lift or hydrolift pumping.
2. Equipment should be assembled, decontaminated (if necessary), and installed in the well. Care should be taken not to introduce contaminants to the equipment during installation.
3. Monitoring well development should proceed by repeated removal of water from the well until the discharged water is relatively sediment-free. All development waters will be containerized in New York State Department of Transportation (NYSDOT) 55-gallon drums. Effectiveness of development should be monitored at regular intervals using a portable turbidimeter and water quality meter. Volume of water removed, and turbidity, pH, temperature, and conductivity measurements will be recorded on a Well Development/Purging Log form (**Appendix A**).
4. Monitoring well development will be discontinued when the turbidity of the discharged water is below 50 NTU and the other indicator parameters have stabilized.

Reference: ASTM D5092/D5092M-16.

4.2 Groundwater Elevation Survey

To better understand the hydrogeologic conditions, synoptic water level readings will be collected by AECOM prior to each groundwater sampling event.

Water levels in monitoring wells scheduled to be sampled during the field work will be measured using an electronic water level indicator. Initially, measurements will be taken following well development once the well has recovered to anticipate d static conditions. Water level measurement procedures are presented below.

Procedure:

1. Clean the water level probe and the lower portion of cable following standard decontamination procedures (Section 7.1) and test water level meter to ensure that the batteries are charged.
2. Lower the probe slowly into the monitoring well until the audible alarm indicates water.

3. Read the depth to the nearest hundredth of a foot from the graduated cable using the V-notch on the riser pipe as a reference point.
4. Repeat the measurement for confirmation and record the water level.
5. Remove the probe from the well slowly, drying the cable and probe with a clean "Chem Wipe" or paper towel.
6. Replace the well cap and lock protective cap in place.
7. Decontaminate the water level meter (Section 7.0) if additional measurements are to be taken.

Reference: ASTM D4750-87(2001).

4.3 Groundwater Sampling from Monitoring Wells

Groundwater sampling will be performed to evaluate the presence or absence of groundwater contamination. All newly installed monitoring wells will be sampled for chemical analysis. The analytical program is presented in the SCWP and QAPP.

The locations and well identifications are presented in the SCWP.

4.3.1 Low-Flow Sampling Technique

Groundwater sampling will be done in accordance with *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers* (USEPA OSWER 542-S-02-001). The default groundwater sampling method will be in accordance with EPA's low stress (often referred to as low flow) sampling technique (EPA, 1998).

Monitoring well purging will be completed using the low-flow purging technique as follows:

1. The well cover will be unlocked and carefully removed to avoid having any foreign material enter the well. The interior of the riser pipe will be monitored for organic vapors using PID. If a reading of greater than 5 ppm is recorded, the well will be vented until levels are below 5 ppm before purging begins.
2. Using an electronic interface probe/water level detector, the water level below top of casing will be measured. The depth of the well will be measured to determine the volume of water in the well. The bottom of the well will also be checked for DNAPL using the interface probe/water level indicator. The end of the probe will be decontaminated between wells.
3. Calibrate field instruments (e.g., pH, specific conductance, PID, turbidity).
4. Purge the required water volume (i.e., until stabilization of pH, temperature, specific conductivity, and turbidity) using a low-flow pump (e.g., Solinst or Geopump) and dedicated HDPE tubing. New dedicated tubing will be used for each well.
5. Purge the well until the water quality parameters have stabilized. The stabilization criteria are: specific conductivity - 3% full-scale range; pH - 0.10 pH unit; dissolved oxygen – 10%, Turbidity – 10% and oxidation/reduction (redox) potential - +/- 10 units.
6. Purging of three well volumes is not necessary if the indicator parameters are stable. However, at least one (1) well volume must be purged before sampling can begin. During purging, it is permissible to by-pass the flow cell until the groundwater has cleared.
7. Indicator parameters of pH, conductivity, dissolved oxygen, oxidation/reduction (redox) potential, turbidity, and temperature must be measured continuously using the flow cell.
8. Well purging data are to be recorded in the field notebook and on the Low Flow Purge Log (**Appendix A**).

4.3.2 Sample Collection Procedures

Procedure:

1. After well purging is completed, a sample will be collected into the appropriate containers.

2. Direct water flow toward the inside wall of the sample container to minimize volatilization. Fill volatile sample containers so no headspace (air bubbles) is present. If containers are pre-preserved, do not overfill sample containers. Note if effervescence is observed.
3. All sample bottles will be labeled in the field using a waterproof permanent marker (Section 9.4).
4. Samples will be collected into sample bottles (containing required preservatives) and placed on ice in coolers for processing (preservation and packing) prior to shipment to the analytical laboratory. A chain-of-custody record will be initiated. The analytical laboratory will certify that the sample bottles are analyte-free prior to shipping.
5. Remove pump and disconnect valves and tubing, as necessary. If a submersible pump was used, it must be decontaminated prior to and between each use. Clean pump by flushing 10 gallons of potable water through the pump. Rinse with deionized water after flushing the pump.
6. Well sampling data are to be recorded in the field notebook and on the Well Purging Log (**Appendix A**).

4.4 Monitoring Well Decommissioning

If necessary, and after NYSDEC authorization, monitoring well decommissioning will be performed in accordance with NYSDEC Policy CP-43, using the following steps:

1. Each well will be tremie-grouted from the bottom of the well to within five feet of the ground surface to ensure a continuous grout column. Grout slurry composition should be the following:
    a. 1.5 to 3.0 percent by weight - Bentonite (Quick Gel)
    b. 40 to 60 percent by weight - Cement (Portland Type I)
    c. 40 to 60 percent by weight - Water
2. The well casing will be removed at a depth of five feet below grade (if possible) and the outer protective casing "stick-up" and/or flush-mount curb box will be removed only after the well has been properly filled with grout.
3. A metal marker (PK Survey Spike) will be embedded in the top of the grout to indicate the location of the former monitoring well.
4. The uppermost five feet of the borehole will be filled with approved/clean backfill or topsoil.
5. The surface of the borehole will be restored to the condition of the area surrounding the borehole (crushed stone, asphalt, etc.). If the surrounding surface is a concrete sidewalk flag, that flag will be replaced in accordance with applicable regulations/standards.
6. The solid waste should be handled in accordance with Section 7.2 of this plan.
7. Document well construction details in the field notebook and transfer the data onto the Well Decommissioning Record form (**Appendix A**).

Reference: ASTM D5299/D5299M-18; NYSDEC CP-43: Groundwater Monitoring Well Decommissioning Policy, November 3, 2009.

5.0 Soil Sampling Activities

Soil sampling will only be conducted for soil classification purposes. No soil sampling for chemical analysis will be conducted. Procedures for these activities are described below.

5.1 Unified Soil Classification System

Soils will be classified according to the Unified Soil Classification System (USCS) adopted by the U.S. Army Corps of Engineers and U.S. Department of the Interior Bureau of Reclamation. Soil properties that form the basis for the USCS are:

- Percentage of gravel, sand, and fines;
- Shape of the grain-size distribution curve; and
- Plasticity and compressibility characteristics.

According to this system, all soils are divided into three major groups: coarse-grained, fine-grained, and highly-organic (peaty). The boundary between coarse-grained and fine-grained soils is taken to be the 200-mesh sieve (0.074 mm). In the field the distinction is based on whether the individual particles can be seen with the unaided eye. If more than 50% of the soil by weight is judged to consist of grains that can be distinguished separately, the soil is considered to be coarse-grained.

The coarse-grained soils are divided into gravelly (G) or sandy (S) soils, depending on whether more or less than 50% of the visible grains are larger than the No. 4 sieve (3/16 inch). They are each divided further into four groups:

W: Well graded; fairly clean (<5% finer than 0.074 mm)

P: Poorly graded (gap-graded); fairly clean (<5% finer than 0.074mm)

C: Clayey (>12% finer than 0.074mm); plastic (clayey) fines. Fine fraction above the A- line with plasticity index above 7.

M: Silty (>12% finer than 0.074 mm); non-plastic or silty fines. Fine fraction below the A- line and plasticity index below 4.

The soils are represented by symbols such as GW or SP. Borderline materials are represented by a double symbol, as GW-GC.

The fine-grained soils are divided into three groups: inorganic silts (M), inorganic clays (C), and organic silts and clays (O). The soils are further divided into those having liquid limits lower than 50% (L), or higher than 50% (H).

The distinction between the inorganic clays (C), the inorganic silts (M), and organic soils (O) is made on the basis of a modified plasticity chart. Soils CH and CL are represented by points above the A-line, whereas soils OH, OL, and MH correspond to positions below the A-line. Soils ML, except for a few clayey fine sands, are also represented by points below the A-line. The organic soils O are distinguished from the inorganic soils M and C by their characteristic odor and dark color.

Reference: ASTM D2487-17.

5.2 Visual Identification

Soil samples collected during boring advancement will be visually identified. Soil properties required to define the USCS classification of a soil and other observed characteristics normally identified in describing a soil are defined below:

a. Color

b. Moisture conditions

c. Grain size

    i. Estimated maximum grain size

ii. Estimated percent by weight of fines (material passing No. 200 sieve)

d. Gradation

e. Grain shape

f. Plasticity

g. Predominant soil type

h. Secondary components of soil

i. Classification symbol

j. Other features such as:

i. organic, chemical, or metallic content;

ii. compactness;

iii. consistency;

iv. cohesiveness near plastic limit;

v. dry strength; and

vi. source - residual, or transported (aeolian, water borne, glacial deposit, etc.)

Reference: ASTM D2488-17.

6.0 Soil Vapor Intrusion Sampling

Soil vapor intrusion sampling will be conducted during the heating season, which runs from November 15 to March 31. Air and vapor samples will be collected using a 6-liter (L) Summa® canister over a 24-hour period at each location. Indoor and outdoor air sampling will be conducted prior to the sub-slab vapor sampling. Ideally, residences will be sampled on the same day if schedules permit. Details of the typical field activities associated with SVI studies are presented in this section.

The objective of the SVI sampling is to evaluate whether vapor intrusion of compounds related to the source property is occurring near structures within vicinity of the site, and whether vapor hazards as a result of the soil or groundwater contamination may exist for receptors associated the existing structures in the vicinity of the site. The SVI sampling results may be used to identify the structures within vicinity of the site that require further investigation or mitigation/remediation.

The following tasks will typically be performed:

- Indoor and Outdoor Ambient Air Sampling
- Location Mark-Out and Utility Clearance Activity
- Sub-Slab Soil Vapor Pin Installation and Leak Testing
- Sample Collection and Analysis
- Data Evaluation and Report Preparation

This section outlines the procedures that will be used in the collection of soil vapor and air samples.

6.1 Indoor and Outdoor Ambient Air Sampling

Indoor air samples will be collected from the basement and from the lowest living space level of each residence, where vapor infiltration is suspected, such as near sump pumps or indoor wells, or in a central location. Indoor air samples will be collected at approximately 3 feet above ground to represent a height at which occupants normally are seated or sleeping. A representative outdoor ambient air sample will be collected from a localized area that is not accessible to the public and is at an upwind location during the day of sampling. Indoor and outdoor air sampling will be conducted prior to the sub-slab vapor sampling.

As specified in the SVI Guidance (NYSDOH, 2006, attached in **Appendix B** of this FAP), to reduce the potential for interference and dilution effects, the occupants of the buildings to be sampled will be requested to refrain from the activities listed below for the 24-hour period prior to and during the ambient air sampling collection:

- Opening any windows, fireplace dampers, openings or vents;
- Operating any ventilation fans unless special arrangements are made;
- Smoking in the building;
- Painting;
- Using a wood stove, fireplace, or other auxiliary heating equipment (e.g., kerosene heater);
- Operating or storing an automobile in the building or an attached garage;
- Allowing containers of gasoline or oil to remain within the building or garage area, except for fuel oil tanks;
- Cleaning, waxing or polishing furniture, floors or other woodwork with petroleum or oil-based products;
- Using air fresheners, scented candles or odor eliminators;
- Engaging in any hobbies that use materials containing volatile chemicals;

- Using cosmetics including hairspray, nail polish, nail polish removers, perfume/cologne, etc.;
- Lawn mowing, paving with asphalt, or snow blowing;
- Applying pesticides; and,
- Using building repair or maintenance products, such as caulk or roofing tar.

Canisters of indoor air and outdoor ambient air samples will be deployed using the procedure outlined in Section 6.4.1 below.

For outdoor ambient samples, a piece of Teflon tubing will be connected to the inlet of the regulator and positioned with its opening facing downward to minimize moisture from entering the canister. If the outdoor air sample is located in a public area, security measures such as a chain and lock shall be considered.

6.2 Location Mark-Out and Utility Clearance Activity

Prior to commencement of the soil vapor monitoring pin installation, Matrix will delineate potential subsurface utilities at the structures using electromagnetic utility locating instruments. Any information provided by the building occupants will be considered when locating the soil vapor pin locations in the field.

6.3 Sub-Slab Soil Vapor Pin Installation and Leak Testing

Sub-slab soil vapor monitoring pins will be installed in a central location within the lowest level of each residence, away from foundation footings and from the soil or aggregate directly below the basement slab or slab on-grade if possible, depending on building and floor construction. A permanent sub-slab vapor pin will be installed by AECOM staff prior to sampling. Each vapor pin will be constructed with a stainless-steel sampling device and a flush mount steel protective casing. Dedicated sampling equipment will be used at each vapor pin. Each vapor sampling location will be leak tested prior to sampling.

The following steps will be taken to collect sub-slab soil vapor samples:

1. Select and prepare the sample location. Observe the slab condition for floor cracks, drains, or other direct access to the subsurface.
2. Check for utility at the sampling location, first drill a one-inch (1”) deep hole with a 5/8-inch drill bit, then use a ½-inch drill bit to fully drill through the slab. Confirm the thickness of the slab once the drill bit reaches soil. Thicker slabs may require a pilot hole or over-drilling. Remove concrete debris and dust as needed.
3. Extend the drilled hole about three inches (3”) into the soil.
4. Insert a 5/8-inch outside diameter (OD) by ¼-inch inside diameter (ID) rubber stopper onto and three-inches beyond the end of a 1/4-inch OD by 1/8-inch ID Teflon tube. Insert the Teflon tube into the 5/8-inch hole so the stopper is seated into the top of the ½-inch drilled hole.
5. Seal the annular space between the 5/8-inch hole and the Teflon tubing with white Sculpey Brand modeling clay (or equivalent). The top of the clay should form a mound around the tubing.
6. If the slab is covered (tiles or carpet), with the Owner’s agreement, drill a small hole through the tile and slab. The hole should be just big enough for the Teflon tubing. Seal the top of the hole around the tubing with modeling clay.
7. Place a 2-quart (or similar size) bucket over the floor seal after threading the Teflon sample tube through a hole in the top of the bucket. Seal the tube to the bucket with clay.
8. The bucket should also have a hole in the top for the injection of helium gas. An additional hole should be present in the side, near the bottom, to measure the concentration of helium gas in the bucket.
9. Connect helium (99.999%) cylinder tubing to the top port of bucket enclosure and seal with clay or other sealing material. Insert a helium detector probe to the bottom port of the bucket.

10. Release enough helium to displace any ambient air in the bucket until the concentration of helium reaches a minimum of 90%. Maintain this minimum concentration by testing with a helium detector. The helium cylinder should be open during the purge time to cause a slight positive pressure within the enclosure.
11. Connect the sample tubing to a GilAir vacuum pump or equivalent using 3/8-inch O.D. silicone tubing. Connect a 1-liter Tedlar bag to the outlet of the pump using silicone tubing and collect a 1-liter sample. Analyze the Tedlar bag for helium using a helium detector and record the results on the Summa® Canister Sampling Field Data Sheet. Also analyze the Tedlar bag for the presence of methane, H2S, CO2 and O2 and record the result on the Summa® Canister Sampling Field Data Sheet. A concentration of helium 10% or greater indicates a poor seal of the sample tubing to the basement floor. The tubing must be resealed to the floor and another helium test conducted.
12. Purging flow rates must not exceed 0.2 L/min. After purging, remove the bucket enclosure.
13. Shortly after the installation of the vapor pins, one to three pin volumes (i.e., the volume of the sample pin and tube) should be purged prior to collecting the samples. Flow rates for both purging and collecting should not exceed 200 mL/min to minimize outdoor air infiltration during sampling.

6.3.1 Site Restoration

As necessary, upon completion of sub-slab soil vapor sampling, AECOM will repair the carpet/floor tile/floor to restore the area to its previous conditions. The nature and extent of site restoration that will be required upon completion of the SVI sampling will be determined on a case-by-case basis.

6.4 Sample Collection and Analysis

Procedures for collection of soil vapor and air samples are provided below.

6.4.1 Summa Canister Sampling

To obtain representative samples and to minimize possible discrepancies, sub-slab soil vapor, indoor air, and outdoor (ambient) air samples should be collected in the following manner at all locations:

1. Assign sample identification to the Summa® canister identification tag and record on the COC, and the Summa® Canister Sampling Field Data Sheet. Also record the Summa® canister's serial number on the Summa® Canister Sampling Field Data Sheet.
2. Connect the 1/4-inch Teflon OD sample tubing to the Summa® canister regulator (24 hours for residential properties, 8 hours for commercial properties, and 1 hour for permanent monitoring points – prepared by the laboratory) inlet using a ¼-inch Swagelok® nut with appropriate ferrules. Open the canister valve to initiate sample collection and record the start time and date and beginning vacuum on the canister identification tag and on the Summa® Canister Sampling Field Data Sheet. If the canister does not show sufficient vacuum (generally less than 25" Hg), do not use.
3. Take a digital photograph of canister setup and surrounding area.
4. After the sampling duration has lapsed, record sample end time and final vacuum on the Summa® Canister Sampling Field Data Sheet and close the valve.
5. Disconnect the Teflon tubing from the Summa® canister and remove the flow controller / particulate-filter assembly from canister. Seal canister with brass plug.
6. Remove the sample tubing, stopper and clay from the hole in the basement slab and seal with hydraulic cement patch.

In some cases, weather conditions may present certain limitations on SVI sampling. For example, condensation in the sample tubing may be encountered during winter sampling due to low outdoor air temperatures. Devices, such as tube warmers, may be used to address these conditions. AECOM will discuss anticipated limitations to the sampling with NYSDEC prior to the sampling event so appropriate measures to address these difficulties are established in the site-specific FAP. When soil

vapor samples are collected, the following actions should be taken to document local conditions during sampling that may influence interpretation of the results:

- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified;
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (north);
- Weather conditions (e.g., precipitation and outdoor temperature) should be noted for the past 24 to 48 hours; and
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

Additional information that could be gathered to assist in the interpretation of the results includes barometric pressure, wind speed and wind direction. The field sampling team should maintain a sample log sheet summarizing the following:

- sample identification;
- date and time of sample collection;
- sampling depth;
- identity of samplers;
- sampling methods and devices;
- purge volumes;
- volume of soil vapor extracted;
- if Summa® canisters are used, note the vacuum before and after samples were collected;
    - The February 2008 update to the 2005 NYSDEC ASP (NYSDEC, 2008) specifies allowable pressures (vacuum) for canisters. The initial canister vacuum must be 28 inches Hg ± 2-inch Hg. The final canister pressure vacuum should be 5 inches Hg ± 1-inch Hg. If final canister pressures are not within this range, contact the NYSDEC project manager before instructing the laboratory to analyze the canisters.
- apparent moisture content (dry, moist, saturated, etc.) of the sampling zone; and,
- chain of custody protocols and records used to track samples from sampling point to analysis.

6.4.2 Analytical Requirements

AECOM will use a NYSDOH Environmental Laboratory Accreditation Program (ELAP) laboratory certified for the air and emissions category. The Summa® canisters will be certified clean (batch certification) by the laboratory. Air samples are typically analyzed for VOCs by USEPA Method TO-15. The laboratory-specific detection limits and quantitation limits for TO-15 analytes are included in the site-specific QAPP.

6.4.3 Decontamination Procedures

Only dedicated equipment (canisters, tubing, etc.) will be used during sampling. All non-dedicated equipment (i.e. flow meters, etc.) will be purged with air prior to sampling. As such, no field decontamination is necessary for vapor sampling. Summa canisters will be decontaminated by the analytical laboratory and certification of cleanliness will be included in the analytical data report.

7.0 Decontamination and Management of Investigation Derived Waste

7.1 Equipment Decontamination

To avoid cross contamination, sampling equipment (defined as any piece of equipment which may contact a sample) will be decontaminated according to the following procedures. Field equipment rinsate blanks are generated and analyzed to monitor the effective of field decontamination procedures.

Cross contamination is minimized by the use of vendor-decontaminated, dedicated, disposable equipment to the extent practical.

7.1.1 Decontamination Procedures

A decontamination pad will be constructed on the site by AECOM's drilling subcontractor.

The pad will be sized to be large enough to handle the equipment used on site (e.g., drill rig). Additionally, the pad will be used for small equipment decontamination as well as personnel decontamination.

7.1.2 Small Equipment Decontamination

Small equipment decontamination for non-disposable equipment such as Geoprobe® HydroPunch® samplers, transducer probes and cables, will be accomplished using the following procedures:

- Alconox (or equivalent) and potable water wash;
- Potable water rinse;
- Distilled/deionized water rinse;

Solvents will not be used in the field decontamination of such equipment. Decontamination will include scrubbing/washing with a laboratory grade detergent (e.g. Alconox) to remove visible contamination, followed by potable (tap) water and analyte-free water rinses. Tap water may be used from any treated municipal water system; the use of an untreated potable water supply is not an acceptable substitute.

Equipment should be allowed to dry prior to use. Steam cleaning or high-pressure hot water cleaning may be used in the initial removal of gross, visible contamination.

Electric submersible pumps (such as a Grundfos Redi-Flow II) will be decontaminated using the above steps followed by running a large volume (several gallons) of potable water through the pump, followed by an analyte-free water rinse. Tubing will not be re-used (new tubing will be used for each well). Submersible pumps and supporting lines and cables will be placed in a plastic bucket filled with Liquinox and potable water and then run for several minutes (to decontaminate both exterior and interior parts). The process will be repeated with potable water. Submersible pumps will also be given a final analyte-free water rinse of both interior and exterior parts.

If bladder pumps are used, the pump will be disassembled and cleaned after each used. A new bladder will be used for each sample. Small parts, such as screens and gaskets will be replaced after each use. Dedicated airline tubing and Teflon sample tubing will be used at each monitoring well. The pump will be cleaned using the following steps:

- Alconox (or equivalent) and potable water wash;
- Potable water rinse;
- Distilled/deionized water rinse;
- Solvent (reagent or pesticide grade) rinse if samples are collected for organic analysis;
- Dilute (10%) nitric acid rinse if samples are collected for metals analysis; and

- Distilled/deionized rinse, air dry.

7.1.3 Heavy Equipment Decontamination

Drilling equipment will be decontaminated before the first use, between boreholes and prior to demobilization using high-pressure steam. Decontamination will be conducted at a dedicated decontamination pad constructed for the project or at an alternate location as indicated in the site-specific SCWP. Decontamination fluids will be containerized (drummed) for subsequent characterization or disposal, unless other arrangements are made on a project-specific basis and as indicated in the site-specific SCWP.

7.1.4 Personnel Decontamination

Wash buckets and potable water will be set up at the decontamination pad or alternate location as indicated in the site-specific SCWP. This includes washing hands and a boot wash. Details of the personnel decontamination procedures are provided in the HASP.

7.2 Management of Investigation Derived Waste

IDW management will be in accordance with section 3.3(3e) of DER-10 (NYSDEC, 2010). The sampling methods and equipment will be selected to limit both the need for decontamination and the volume of IDW.

IDW generated during field activities include, but is not limited to, the following:

- Purge water;
- Poly sheeting;
- Spent macrocore liners;
- PPE; and
- Drill cutting and soil boring spoils.

This IDW must be placed in 1A2 open head 55-gallon steel drums pending shipment off site for disposal.

Segregation

Drummed IDW is to be divided into the following categories:

- Drill cuttings and soil boring spoils (see Section 3.0);
- Purge water from monitoring well development/sampling and DNAPL/LNAPL product; and,
- Solid waste other than drill cuttings and boring spoils (i.e., spent poly tubing, PPE, etc.).

Generator ID

Any IDW generated will be assigned a USEPA Generator ID Number.

Hazardous/Non-Hazardous Classification

AECOM will collect characterization samples to classify the IDW as either hazardous or non-hazardous.

Shipment/Disposal

Drummed IDW will be staged in a designated and secured area until it can be shipped off site at a later date.

All IDW will be shipped off site by a permitted contractor, Momentum Environmental (Momentum), to a permitted facility and may be disposed of at a facility licensed to accept hazardous waste, if necessary.

Manifests

Waste manifests must accompany the IDW during shipment off site for disposal. For non-hazardous waste, a non-hazardous waste manifest must be completed. For hazardous waste, a Uniform Hazardous Waste Manifest (USEPA Form 8700-22) must be completed, along with a Land Disposal Restriction Notification Form 1. IDW manifests can be signed by AECOM personnel as agents for the generator (NYSDEC).

8.0 Community Air Monitoring Program

CAMP is used to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities.

The protocols cited below are based on the NYSDOH Generic CAMP (May, 2010; Appendix 1A to DER-10 [NYSDEC, 2010]) which is typically utilized by NYSDEC as guidance for work conducted under these contracts.

8.1 Monitoring

Real-time air monitoring for VOCs and/or particulate levels at the perimeter and surrounding community of the work area are necessary during intrusive drilling activities. Monitoring activities will consist of a combination of continuous and periodic monitoring, which will be performed dependent upon the type of activity being conducted at the site, as discussed below.

8.1.1 Continuous Air Monitoring

Continuous monitoring for VOCs and particulates is required for ground intrusive activities associated with the site, including, but not limited to, hand digs, the installation of soil borings and groundwater monitoring wells. A total of two (2) CAMP units will be present; one (1) in a down-wind location, and one (1) in an up-wind location.

VOC monitoring will be conducted continuously at each CAMP. VOC monitoring will be performed using a MiniRAE 2000 or equivalent, which is appropriate to detect a wide range of contaminants typically encountered. The MiniRAE 2000 will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The MiniRAE 2000 is capable of calculating 15-minute running average concentrations, which will be compared to the action levels specified below.

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the work area at temporary particulate monitoring stations. The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) such as a Thermo MIE pDR-4000 DataRam or equivalent. The Thermo MIE pDR-4000 DataRam is a real-time monitoring equipment capable of measuring particulate matter less than 10 microns (µm) in size [PM-10] and capable of integrating over a period of 15 minutes for comparison to the airborne particulate action level. The Thermo MIE pDR is equipped with an audible alarm to indicate exceedance of the action level. In addition to using the Thermo MIE pDR-4000 DataRam, fugitive dust migration will be visually assessed during work activities. If particulate concentrations at the upwind station are higher or equivalent to concentrations at or downwind of work areas, then continuous air monitoring may be discontinued, as approved by NYSDEC.

8.1.2 Periodic (As-Needed) Air Monitoring

Periodic or as-needed air monitoring for VOCs may be required during non-intrusive activities associated with the site-specific Work Plan. Non-intrusive activities may include the collection of soil samples, the collection of groundwater samples from existing monitoring wells, and the collection of indoor air and soil vapor samples. Periodic air monitoring during sample collection will consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well bailing/purging, and taking a reading prior to leaving a sample location.

8.2 Action Levels and Response

This subsection identifies the action levels and corresponding responses for concentrations of VOCs and particulates detected during the field activities associated with a site.

8.2.1 Volatile Organic Compounds

If the ambient air concentration of total organic vapors at the downwind perimeter of the work area exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be

temporarily halted, and monitoring will continue. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

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

If the organic vapor level is above 25 ppm at the perimeter of the work area, field activities will be shut down.

All 15-minute readings will be recorded and be available for NYSDEC and NYSDOH personnel to review. Instantaneous readings (if any) used for decision purposes will also be recorded.

8.2.2 Particulates

If the downwind PM-10 particulate level is 100 µg/m^3 greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 µg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, the downwind PM-10 particulate levels are greater than 150 µg/m^3 above the upwind level, work will be stopped, and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 µg/m^3 of the upwind level and in preventing visible dust migration.

Similar to the VOC readings, particulate readings will be recorded and be available for state (NYSDEC and NYSDOH) and county health personnel to review.

9.0 Field Records and Documentation

The objective of this subsection is to provide consistent procedures and formats by which field records will be kept and activities documented, and a methodology by which field records will be managed. Field records and documentation to be used during field activities include Field Log Books and Standard Forms. Standard Forms are provided in **Appendix A**.

9.1 Field Logbooks

Field logbooks will be prepared and maintained throughout the course of the investigation**.** Only bound, weatherproof field logbooks will be used by personnel working on NYSDEC projects. The logbooks will be turned in for copying/filing/tracking when complete.

Each logbook will be labeled on the front cover in indelible ink with the following designation: “Site Name/Project Type, NYSDEC Work Assignment D009803-64, AECOM Project Number 60788778.”

Logbook entries will be recorded in indelible, waterproof ink. If errors are made in any field logbook, field record (form), Chain-of-Custody Record, or any other field record document, corrections will be made by crossing a single line through the error, entering the correct information, and initialing and dating the correction.

Standard Forms have been adopted in this FAP to facilitate the collection of consistent data (see **Appendix A**). This will preclude detailed documentation of, for example, lithologic descriptions in the field logbook. A reference, however, to use of each specific form must be made in the logbook.

The date will be placed at the top of every page in the left-hand corner of the right page. The time of entry recordings will be in columnar form down the left-hand side of the right page. If an entry is made in a non-dedicated logbook, then the date, project name, and project number will be entered left to right, respectively, along the top of the right page. Entries should be dated, and time of entry recorded. At the beginning of each day, the first two entries will be “Personnel/Contractors On Site” and “Weather.” At the end of each day's entry or particular event, if appropriate, the person entering the field notes should draw a diagonal line originating from the bottom left corner of the page to the conclusion of the entry and sign along the line indicating the conclusion of the entry or the day's activity.

Entries in field logbooks will be legible (printing is preferable) and will contain accurate and inclusive documentation of project activities (investigation, monitoring remediation, closure, maintenance, etc.). Information pertaining to health and safety aspects, personnel on site, visitor’s names, association, and time of arrival/departure, etc., should also be recorded. Language should be objective, factual, and free of personal feelings or other terminology that might prove inappropriate, since field records are the basis for later written reports. Once completed, these field logbooks become accountable documents and must be maintained as part of the project files.

Sample collection and handling activities, as well as visual observations, will be documented in the field logbooks. The sample collection equipment (where appropriate), field analytical equipment, and equipment used to make physical measurements will be identified in the field logbooks. Calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment will also be recorded in the field logbooks, except where these are referenced as being recorded on approved field forms. Field analyses and measurements must be traceable to the specific piece of field equipment utilized and to the field investigator collecting the sample, making the measurement, or conducting analyses. Logbooks will be updated as field work progresses.

On a periodic basis (i.e., daily, weekly, etc.), or at the end of each field event, the pages of the field logbook that were filled out during that time will be scanned into PDF format. The resulting PDF files will then be uploaded to the project folder located on the office server.

When an individual logbook is full, the logbook will be submitted to the AECOM project manager for final cataloging and filing. The logbooks will be stored in the Project File. Copies of specific sections will be made available to personnel upon request.

9.2 Standard Forms

All non-bound field records (e.g., drilling logs, well construction forms, sampling logs, etc.) will be completed the day the associated activity occurs. Field data collected using electronic data loggers or computer entry forms, will be downloaded as soon as practical onto CDs and/or uploaded to office servers. If possible, the person collecting the data will download electronic data on a daily basis. This person will be responsible for verifying that the data collected are adequately represented in electronic media and in the file. Examples of forms typically used are provided in **Appendix A** of this FAP.

On a periodic basis (i.e., daily, weekly, etc.), or at the end of each field event, the field forms that were completed during that time will be scanned into PDF format. The resulting PDF files will then be uploaded to the project folder located on the office server.

Daily inspection reports will be completed by field personnel for every day they are in the field. The daily inspection report to be used is provided in **Appendix A** of this FAP. AECOM will provide the daily inspection report to the NYSDEC PM by 12pm the day following the completion of the field day.

9.3 Sample Identification

During this project, a unique sample identifier will designate each sample collected. The following system may be used to assign unique sample identification numbers; however, modifications should be made as needed to clearly and appropriate identify samples for each site or project. Each sample will be identified by an alphanumeric character identifier, as described below.

The following codes will be used for identifying other sample types:

CODE	Sample Type
MW	Monitoring well
SB	Soil boring
SW	Surface water
SD	Sediment
IA	Indoor air
OA (or AA)	Outdoor (or ambient) air
SV	Soil vapor
FB	Field (Rinsate) Blank
N + 50	Field Duplicate (e.g., field duplicate of MW-3S will be MW-53S)
TB	Trip Blank
MS/MSD	Matrix Spike/ Matrix Spike Duplicate

Field blanks and tip blanks will be labeled for the day of collection. For MS/MSD samples, the MS/MSD will be added to the sample ID and included on the COC as a note.

An example of the sample numbering system is provided below.

Sample Identifier	Description
MW-1S	Shallow well MW-1S
MW-101D	Deep monitoring well MW-101D
SB-02-0406	Soil sample from 4 to 6 ft interval from boring SB-02.
SS-01	Surface soil sample from location SS-01.
FBW-110502	Field blank associated with water samples collected on 5/2/11
TB-110503	Trip blank associated with samples shipped 5/3/11.

9.4 Sample Labeling

A non-removable label will be affixed to each sample container. Labels will be marked with permanent marker pens. The following information will be contained on each label:

Project name;

Sample identifier;

Company (AECOM);

Sample date and time;

Sampler's initials;

Sample preservation; and

Analysis required.

9.5 Sample Shipping

Proper documentation of sample collection and the methods used to control these documents are referred to as chain-of-custody procedures. Chain-of-custody procedures are essential for presentation of sample analytical chemistry results as evidence in litigation or at administrative hearings held by regulatory agencies. Chain-of-custody procedures also serve to minimize loss or misidentification of samples and to ensure that unauthorized persons do not tamper with collected samples.

The procedures should follow the chain-of-custody guidelines outlined in NEIC Policies and Procedures, prepared by the National Enforcement Investigations Center (NEIC) of the U.S. Environmental Protection Agency Office of Enforcement.

Procedure:

1. The chain-of-custody (COC) record (provided by the analytical laboratory) should be completely filled out, with all relevant information.
2. The original COC goes with the samples. It should be placed in a Ziploc bag and taped inside the sample cooler. The sampler should retain a copy of the COC.
3. Place inert cushioning material such as vermiculite or bubble-wrap in the bottom of the cooler.
4. Place the bottles in the cooler in such a way that they do not touch (use cardboard dividers or bubble-wrap).
5. Wrap VOA vials securely in bubble-wrap and tape. Place them in the center of the cooler.
6. With the exception of Summa® canisters, pack the cooler with ice in doubled Ziploc plastic bags.
7. Pack the cooler with cushioning material.
8. Tape the drain shut.
9. Wrap the cooler completely with strapping tape at two locations securing the lid. Do not cover any labels.
10. Place the lab address on top of cooler. For out-of-town laboratory, add the following: Put "This side up" labels on all four sides and "Fragile" labels on at least two sides. Affix numbered custody seals on front right and left of cooler. Cover seals with wide, clear tape.
11. Summa® canisters are shipped in the same boxes the laboratory used for shipping.
12. Ship samples via overnight carrier the same day that they are collected. Samples (except Summa® canisters) must be maintained at 4 degrees Celsius (C) ± 2ºC throughout the shipping duration.

10.0 References

American Society for Testing and Materials (ASTM) D1452/D1452M-16, Standard Practice for Soil Exploration and Sampling by Auger Borings

ASTM D1586/ D1586M-18. Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.

ASTM D1587/D1587M-15. Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes.

ASTM D2113-14. Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration.

ASTM D2487-17. Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

ASTM D2488-17. Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

ASTM D4750-87(2001). Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well).

ASTM D5092/D5092M-16. Standard Practice for Design and Installation of Groundwater Monitoring Wells.

ASTM D5299/D5299M-18. Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities.

ASTM D5782-95. Standard Guide for Use of Direct Air-Rotary Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices.

ASTM D5783-18. Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices.

ASTM D6001-05(2012). Standard Guide for Direct-Push Groundwater Sampling for Environmental Site Characterization.

ASTM D6282/D6282M-14. Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations.

ASTM D6907-05(2016). Standard Practice for Sampling Soils and Contaminated Media with Hand-Operated Bucket Augers.

ASTM D6914/D6914M-16. Standard Practice for Sonic Drilling for Site Characterization and the Installation of Subsurface Monitoring Devices.

ASTM D7663-12(2018). Standard Practice for Active Soil Gas Sampling in the Vadose Zone for Vapor Intrusion Evaluations.

New York State Department of Environmental Conservation (NYSDEC), 2008. NYSDEC Modifications to EPA Region 9 TO-15 QA/QC Criteria. February 2008.

NYSDEC, 2009. CP-43 Groundwater Monitoring Well Decommissioning Policy. November 3, 2009.

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

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

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

USEPA, 1998. Region II Sampling SOP - Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling. March 16, 1998.

USEPA, 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. OSWER. Douglas Yeskis and Bernard Zavala. EPA 542-S-02-001. May 2002.

Appendix A – Field Activity Forms

DAILY INSPECTION REPORT - No. XX

Off-Site 91 Leighton Avenue (Site No. C828231A) **Date: XX**

NYSDEC **Division of Environmental Remediation**					**Contract No. D009803-64** **DEC PM –** Makaila Adair **AECOM PM –** Michael Gutmann **AECOM Task Leads –** Edyta Chorostkowska / Ernie Thalhamer **AECOM Field Lead –**
Site Location: Leighton Avenue and Greenleaf Street, Rochester, Monroe County, NY					
Weather Conditions					
General Description		AM		PM	
Temperature		AM		PM	
Wind		AM		PM	

Health & Safety **If any box below is checked "Yes", provide explanation under "Health & Safety Comments".**			
Were there any changes to the Health & Safety Plan?	*Yes ☐	No ☐	NA ☐
Were there any exceedances of the perimeter air monitoring reported on this date?	*Yes ☐	No ☐	NA ☐
Were there any nuisance issues reported/observed on this date?	*Yes ☐	No ☐	NA ☐
Health & Safety Comments			

Summary of Work Performed	Arrived at site:		Departed Site:	

DAILY INSPECTION REPORT - No. XX

Off-Site 91 Leighton Avenue (Site No. C828231A) **Date: XX**

Equipment/Material Tracking **If any box below is checked "Yes", provide explanation under "Material Tracking Comments".**			
Were there any vehicles which did not display proper D.O.T numbers and placards?	*Yes ☐	No ☐	NA ☐
Were there any vehicles which were not tarped?	* Yes ☐	No ☐	NA ☐
Were there any vehicles which were not decontaminated prior to exiting the work site?	* Yes ☐	No ☐	NA ☐

Personnel and Equipment

Individual	Company	Trade	Total Hours

Equipment Description	Contractor/Vendor	Quantity	Used

Material Description	Imported/ Delivered to Site	Exported off Site	Waste Profile (If Applicable)	Source or Disposal Facility (If Applicable)	Daily Loads	Daily Weight (tons)*

*On-Site scale for off-site shipment, delivery ticket for material received

Equipment/Material Tracking Comments:

DAILY INSPECTION REPORT - No. XX

Off-Site 91 Leighton Avenue (Site No. C828231A) **Date: XX**

Visitors to Site

Name	Representing	Entered Exclusion/CRZ Zone	
		Yes	No
		Yes	No
		Yes	No
		Yes	No
		Yes	No
		Yes	No
		Yes	No
		Yes	No
		Yes	No
		Yes	No

Site Representatives

Name	Representing

Project Schedule Comments

Issues Pending

Interaction with Public, Property Owners, Media, etc.

DAILY INSPECTION REPORT - No. XX
Off-Site 91 Leighton Avenue (Site No. C828231A) **Date: XX**

Include (insert) figures with markups showing location of work and job progress

Site Photographs (Descriptions Below)	
Insert Photo	Insert Photo
Add Description	Add Description
Insert Photo	Insert Photo
Add Description	Add Description
Insert Photo	Insert Photo
Add Description	Add Description

Comments	
Site Inspector(s):	**Date:**

Videos of discreet operations have been provided to the DEC Project Manager to facilitate understanding of the ongoing work? Yes ☐ No ☐ N/A ☐

ON-SITE WASTE STORAGE (including IDW)

Drums, roll offs and piles are staged in secure areas?	Yes ☐	No ☐	N/A☐
Liners and berms have been installed if necessary to prevent cross contamination of clean areas?	Yes ☐	No ☐	N/A☐
Containers are in good condition or properly overpacked?	Yes ☐	No ☐	N/A☐
Waste materials are scheduled to be properly characterized and disposed of prior to demobilization?	Yes ☐	No ☐	N/A☐
Complying with RCRA 90 day storage limitation for hazardous waste?	Yes ☐	No ☐	N/A☐
Piles are securely covered when not in use?	Yes ☐	No ☐	N/A☐
Containers are closed when not in use?	Yes ☐	No ☐	N/A☐
Staging areas should be inspected periodically and any issues addressed immediately?	Yes ☐	No ☐	N/A☐
Signage and labeling comply with RCRA requirements for all staging areas and containers?	Yes ☐	No ☐	N/A☐
If any issues noted, has Contractor been notified?	Yes ☐	No ☐	N/A☐
Comments:			

NUISANCE CHECKLIST

Were there any community complaints related to work on this date?	Yes ☐	No ☐	N/A☐
Were there any odors detected on this date?	Yes ☐	No ☐	N/A☐
Was noise outside specification and/or above background on this date?	Yes ☐	No ☐	N/A☐
Were vibration readings outside specification and/or above background on this date?	Yes ☐	No ☐	N/A☐
Any visible dust observed beyond the work perimeter on this date?	Yes ☐	No ☐	N/A☐
Any visible contrast (turbidity) beyond engineering controls observed on this date?	Yes ☐	No ☐	N/A☐
Was turbidity checked at the outfall(s)?	AM ☐	PM ☐	N/A☐
Were any property owners NOT provided advance notice for work performed on this property on this date?	Yes ☐	No ☐	N/A☐
Was the temporary fabric structure closed at the end of the day?	Yes ☐	No ☐	N/A☐
Has Contractor failed to protect all foundations and structures adjacent to and adjoining the site which are affected by the excavations or other operations connected with performance of the Work?	Yes ☐	No ☐	N/A☐
If yes, has Contractor been notified?	Yes ☐	No ☐	N/A☐
Comments:			

DAILY INSPECTION REPORT - No. XX
Off-Site 91 Leighton Avenue (Site No. C828231A) **Date: XX**

RESILIENCE/GREEN REMEDIATION CHECKLIST

Is site power procured from renewable energy sources (e.g., solar, wind, geothermal, biomass and biogas)?	Yes ☐	No ☐	N/A☐
Is the Contractor employing 2007 or newer or retrofitted (BART*) diesel on-road trucks and non-road equipment?	Yes ☐	No ☐	N/A☐
Is vehicle idling adequately reduced per 6NYCRR Part 217-3?	Yes ☐	No ☐	N/A☐
Have equipment operators been trained in the idling requirements of 6NYCRR Part 217-3?	Yes ☐	No ☐	N/A☐
Is BART-equipped equipment properly maintained and working?	Yes ☐	No ☐	N/A☐
Is work being sequenced to avoid double handling?	Yes ☐	No ☐	N/A☐
Is there an onsite recycling program for CONTRACTOR-generated wastes and is it complied with?	Yes ☐	No ☐	N/A☐
Are office trailer heating and cooling systems maintained at efficient set points, have programable thermostats been installed?	Yes ☐	No ☐	N/A☐
Are installed and consumable materials appropriately selected to meet the Department's green and sustainable remediation goals embodied in DER-31, (e.g., LEED, Energy Star, Sustainable Forestry Initiative®, etc.)?	Yes ☐	No ☐	N/A☐
Are resiliency features included in the design, or completed remedy properly installed and/or maintained (flood control, storm water controls, erosion measures, etc.)?	Yes ☐	No ☐	N/A☐
Are green remediation elements included in the design, or completed remedy properly installed and/or maintained (e.g., porous pavement, geothermal, variable speed drives, native plantings, natural stream bank restoration, etc.)?	Yes ☐	No ☐	N/A☐
Has Contractor been notified of any deficiencies?	Yes ☐	No ☐	N/A☐
Are remote/call in job meetings being held in lieu of meeting in person where possible?	Yes ☐	No ☐	N/A☐
Comments:			

* BART – Best Available Retrofit Technology

ANCILLARY REMEDIAL COMPONENTS

[DEC desires efficiency during site visits to ensure any issues or concerns are evaluated promptly]

Institutional/Engineering Controls for all operable units appear to be in place and effective?	Yes ☐	No ☐	N/A☐
Occupancy/Ownership appears unchanged?	Yes ☐	No ☐	N/A☐
Signage (e.g., fish advisory) is in place and legible?	Yes ☐	No ☐	N/A☐
Confirm no apparent erosion, deposition of other impacts from any storm events?	Yes ☐	No ☐	N/A☐
Monitoring wells remain in place, undamaged and accessible?	Yes ☐	No ☐	N/A☐
Fencing remains in place, undamaged and secure?	Yes ☐	No ☐	N/A☐
Stormwater infrastructure and any discharge conveyance/outfall from onsite treatment remains in place, undamaged and effective?	Yes ☐	No ☐	N/A☐
Wetland mitigation work appears to be successful with no major issues apparent?	Yes ☐	No ☐	N/A☐
Any modifications to buildings, utilities or other infrastructure apparent?	Yes ☐	No ☐	N/A☐
All other site-specific elements in place and effective?	Yes ☐	No ☐	N/A☐
Has DEC PM been notified of any deficiencies?	Yes ☐	No ☐	N/A☐
Comments:			

DAILY DRILLING RECORD

AECOM

PROJECT TITLE: _____ DATE: _____

CLIENT: _____ CONTRACTOR: _____

FROM	TO	PRODUCTIVE HOURS	ACTIVITIES/COMMENTS
TOTAL PRODUCTIVE HOURS			LEVEL B / LEVEL C / LEVEL D (CIRCLE ONE SELCTION)

LABOR:		MATERIALS / SUPPLIES:	
UNITS		UNITS	

WEATHER:

_____ AECOM ONSITE COORDINATOR	_____ CONTRACTOR REPRESENTATIVE

AECOM

TEST BORING LOG

									BORING NO:
PROJECT:									SHEET: 1 of 1
CLIENT:									JOB NO.:
BORING CONTRACTOR:									BORING LOCATION:
GROUNDWATER:					CAS.	SAMPLER	CORE	TUBE	GROUND ELEVATION:
DATE	TIME	LEVEL	TYPE	TYPE		Macrocore			DATE STARTED:
				DIA.		2"			DATE FINISHED:
				WT.		--			DRILLER:
				FALL		--			GEOLOGIST:
				* POCKET PENETROMETER READING					REVIEWED BY:

DEPTH	SAMPLE			BLOWS		REC%	DESCRIPTION				REMARKS	
FEET	STRATA	NO.	TYPE	PER 6"		ROD%	COLOR	CONSIST HARD	MATERIAL DESCRIPTION	USCS	PID	Moist
5												
10												
15												
20												
25												
30												

COMMENTS:	PROJECT NO.
	BORING NO.

AECOM

TEST BORING LOG

									BORING NO:
PROJECT:									SHEET: 1 of 1
CLIENT:									JOB NO.:
BORING CONTRACTOR:									BORING LOCATION:
GROUNDWATER:					CAS.	SAMPLER	CORE	TUBE	GROUND ELEVATION:
DATE	TIME	LEVEL	TYPE	TYPE					DATE STARTED:
				DIA.					DATE FINISHED:
				WT.					DRILLER:
				FALL					GEOLOGIST:
				* POCKET PENETROMETER READING					REVIEWED BY:

DEPTH FEET	SAMPLE TIME	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6"		ROD%	DESCRIPTION COLOR	DESCRIPTION CONSISTENCY HARDNESS	DESCRIPTION MATERIAL DESCRIPTION	REMARKS
5										
10										
15										
20										
25										
30										

COMMENTS:	PROJECT NO.
	BORING NO.

AECOM

MONITORING WELL CONSTRUCTION DETAILS

PROJECT: _____ WELL ID: _____

CLIENT: _____ DATE: _____

DRILLING SUMMARY

Geologist:

Drilling Company:

Driller:

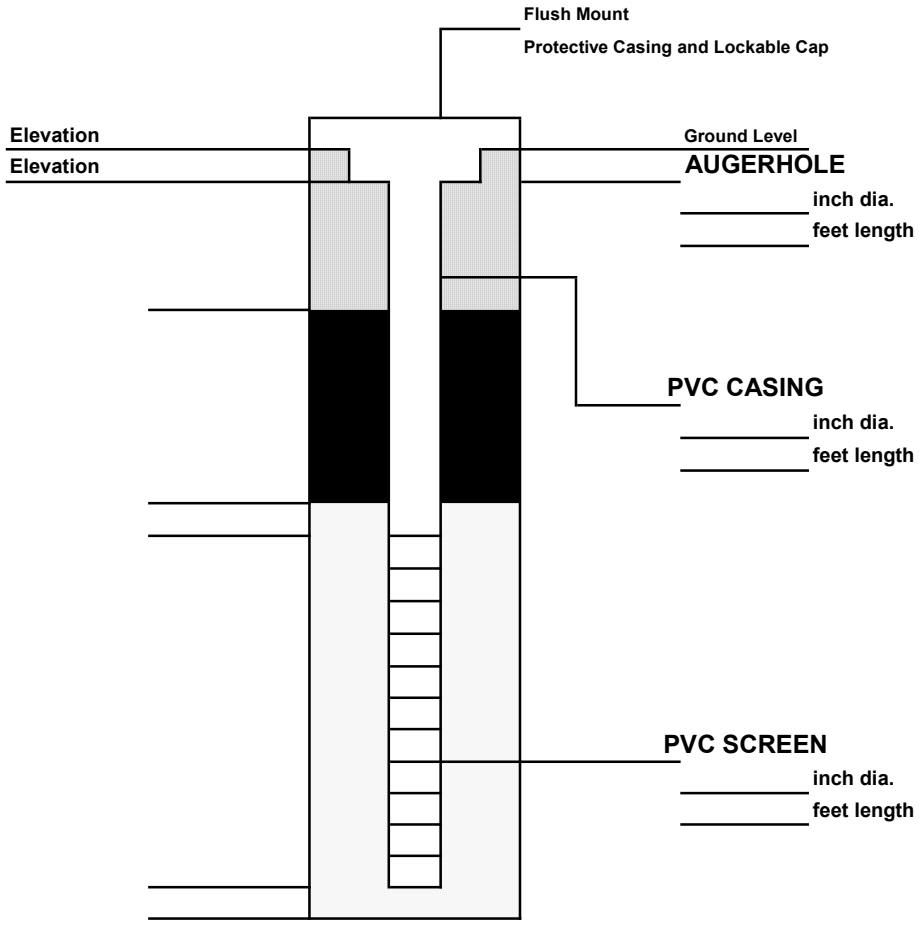
Rig Make/Model:

Date:

GEOLOGIC LOG

Depth(ft.)	Description

DEPTH



WELL DESIGN

CASING MATERIAL	*SCREEN MATERIAL*	*FILTER MATERIAL*
Surface: Steel grade box	**Type:** 4" PVC	**Type:** #2 Sand **Setting:**
Monitor: 4" PVC	**Slot Size:** .020"	***SEAL MATERIAL***
		Type: Bentonite **Setting:**

COMMENTS:

LEGEND

- Cement/Bentonite Grout
- Bentonite Seal
- Silica Sandpack

AECOM

BEDROCK MONITORING WELL CONSTRUCTION DETAILS

PROJECT: _____ WELL ID: _____

CLIENT: _____ DATE: _____

DRILLING SUMMARY

Geologist:

Drilling Company:

Driller:

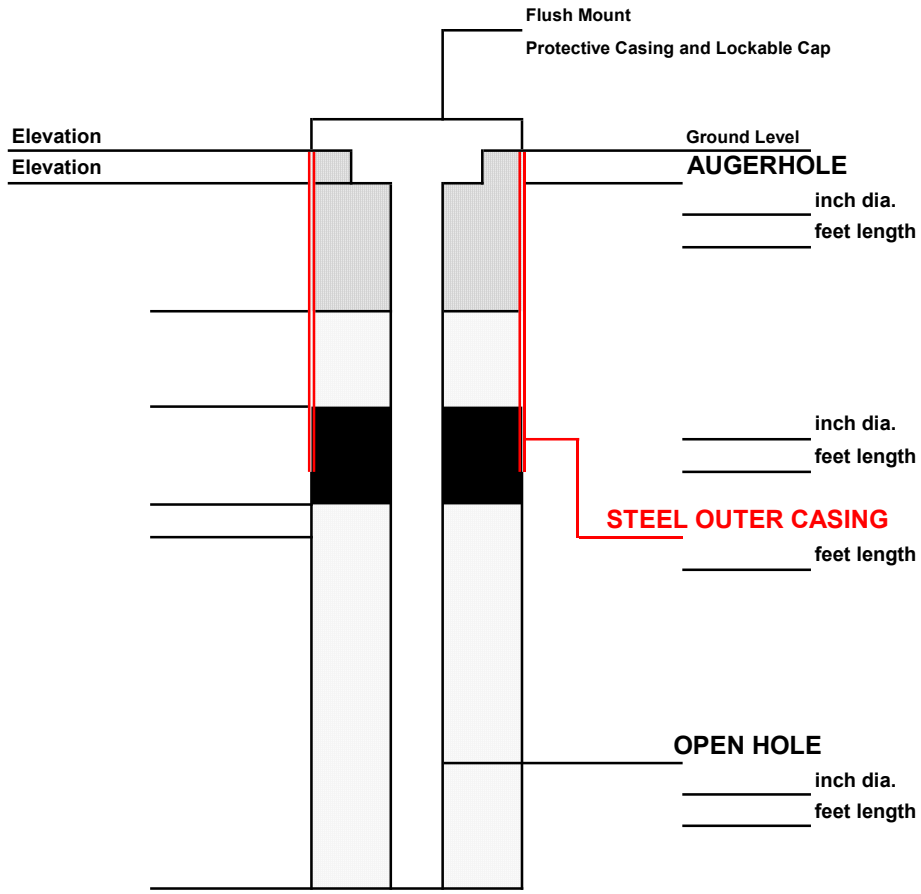
Rig Make/Model:

Date:

GEOLOGIC LOG

Depth(ft.)	Description
	See boring log for lithologic description.

WELL DESIGN



CASING MATERIAL	*SCREEN MATERIAL*	*FILTER MATERIAL*
Surface:	**Type:**	**Type:** **Setting:**
Monitor:	**Slot Size:**	***SEAL MATERIAL*** **Type:** Bentonite **Setting:**

COMMENTS:

LEGEND

- Cement/Bentonite Grout
- Bentonite Seal
- Silica Sandpack

AECOM

WELL DEVELOPMENT LOG

PROJECT TITLE: _____ WELL NO.: _____

PROJECT NO.: _____

STAFF: _____

DATE(S): _____

			WELL ID.	VOL. (GAL/FT)
1. TOTAL CASING AND SCREEN LENGTH (FT.)	=		1"	0.04
2. WATER LEVEL BELOW TOP OF CASING (FT.)	=		2"	0.17
3. NUMBER OF FEET STANDING WATER (#1 - #2)	=	0.0	3"	0.38
4. VOLUME OF WATER/FOOT OF CASING (GAL.)	=	0.02	4"	0.66
5. VOLUME OF WATER IN CASING (GAL.)(#3 x #4)	=	0.0	5"	1.04
6. VOLUME OF WATER TO REMOVE (GAL.)(#5 x ___)	=	0	6"	1.50
7. VOLUME OF WATER ACTUALLY REMOVED (GAL.)	=		0.75"	0.02

OR

$V=0.0408 \times (\text{CASING DIAMETER})^2$

	ACCUMULATED VOLUME PURGED (GALLONS)										
PARAMETERS											
pH											
SPEC. COND. (umhos)											
APPEARANCE											
TEMPERATURE (°C)											

COMMENTS:

AECOM

LOW FLOW GROUNDWATER PURGING/SAMPLING LOG

PROJECT TITLE: _____ WELL ID: _____

CLIENT: _____ SAMPLING PERSONNEL: _____

DATE: _____

Purging/ Sampling Device: _____ Tubing Type: _____ Pump/Tubing Inlet Location: _____

Measuring Point: _____ Initial Depth to Water: _____ Depth to Well Bottom: _____ Well Diameter: _____ Screen Length: _____

Casing Type: PVC Volume in 1 Well Casing (liters): _____ Estimated Purge Volume (liters): _____

Sample ID: _____ Sample Time: _____ QA/QC: --

Sample Parameters: _____

PURGE PARAMETERS

TIME	pH	TEMP (^{0}C)	COND. (mS/cm)	DISS. O_2 (mg/l)	TURB. (NTU)	Eh (mV)	FLOW RATE (ml/min.)	DEPTH TO WATER (btor)
Tolerance:	0.1	---	3%	10%	10%	+ or - 10	---	

Remarks:

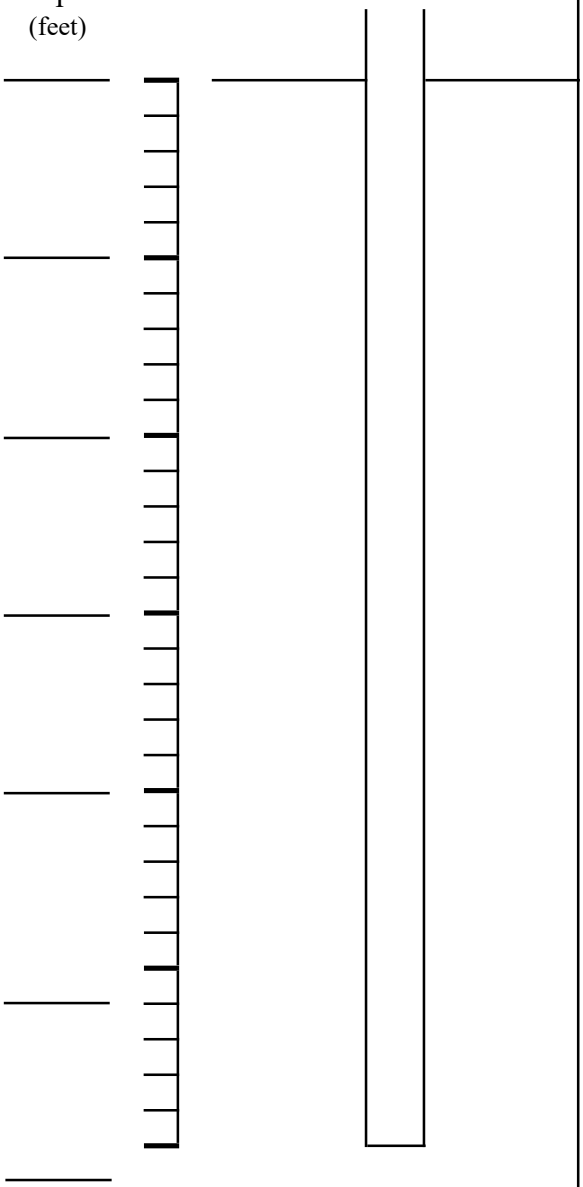
WELL DECOMMISSIONING RECORD

Site Name:	Well I.D.:
Site Location:	Driller:
Drilling Co.:	Inspector:
	Date:

DECOMMISSIONING DATA
(Fill in all that apply)

OVERDRILLING	
Interval Drilled	
Drilling Method(s)	
Borehole Dia. (in.)	
Temporary Casing Installed? (y/n)	
Depth temporary casing installed	
Casing type/dia. (in.)	
Method of installing	
CASING PULLING	
Method employed	
Casing retrieved (feet)	
Casing type/dia. (in)	
CASING PERFORATING	
Equipment used	
Number of perforations/foot	
Size of perforations	
Interval perforated	
GROUTING	
Interval grouted (FBLS)	
# of batches prepared	
For each batch record:	
Quantity of water used (gal.)	
Quantity of cement used (lbs.)	
Cement type	
Quantity of bentonite used (lbs.)	
Quantity of calcium chloride used (lbs.)	
Volume of grout prepared (gal.)	
Volume of grout used (gal.)	

WELL SCHEMATIC*



COMMENTS:

* Sketch in all relevant decommissioning data, including: interval overdrilled, interval grouted, casing left in hole, well stickup, etc.

Drilling Contractor

Department Representative

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_____

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	Other: _____

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_____

If multiple units, how many? _____

If the property is commercial, type?

Business Type(s) _____

Does it include residences (i.e., multi-use)? Y / N If yes, how many? _____

Other characteristics:

Number of floors_____ Building age_____

Is the building insulated? Y / N How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and 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
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 / not applicable			

Basement/Lowest level depth below grade: _____(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

_____

_____

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	Steam radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other _____

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: _____

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other_____
Air conditioning:	Central Air	Window units	Open Windows	None

Are there air distribution ducts present? 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., familyroom, 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) 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? Y / N If yes, where vented?_____

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type?_____

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: _____

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: _____

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

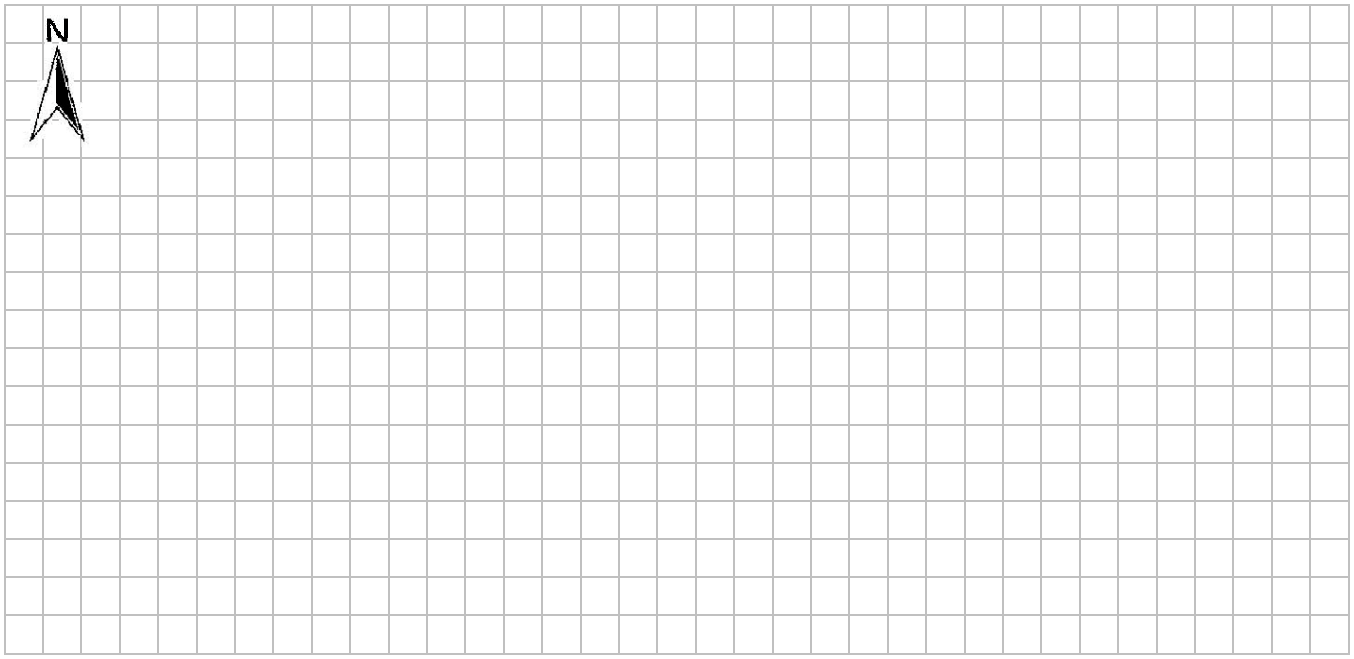
c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

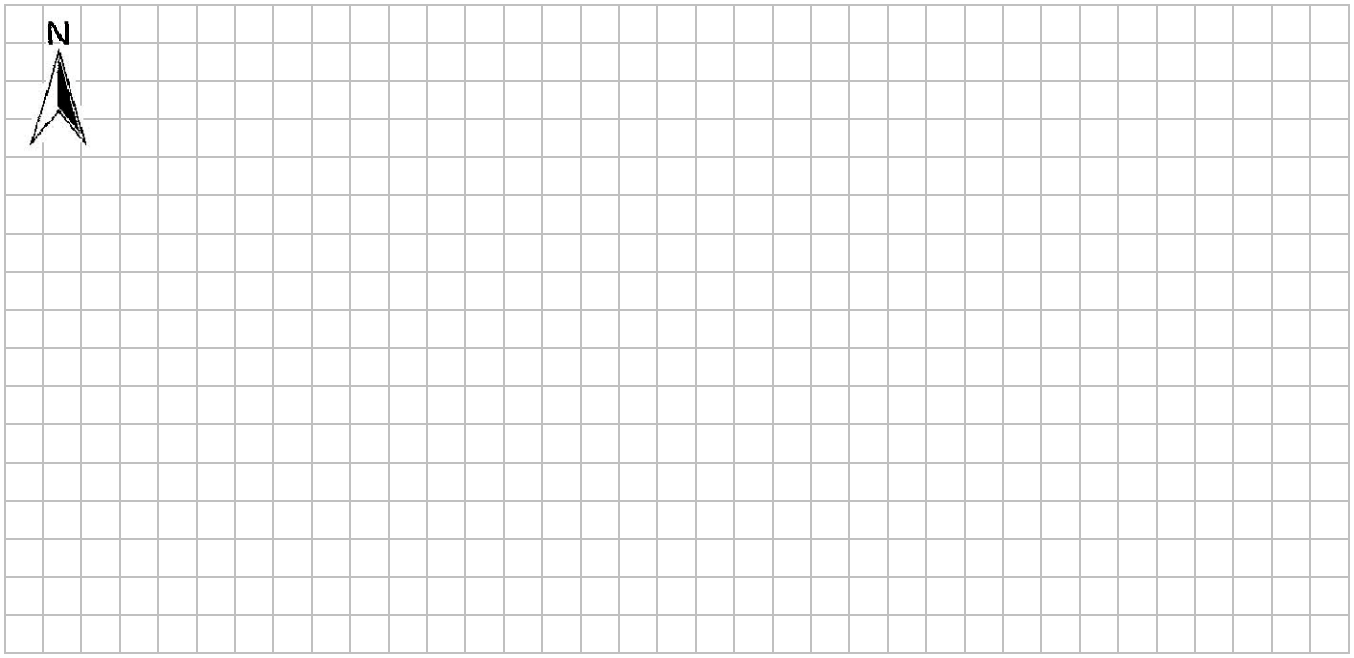
11. FLOOR PLANS

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.

Basement:



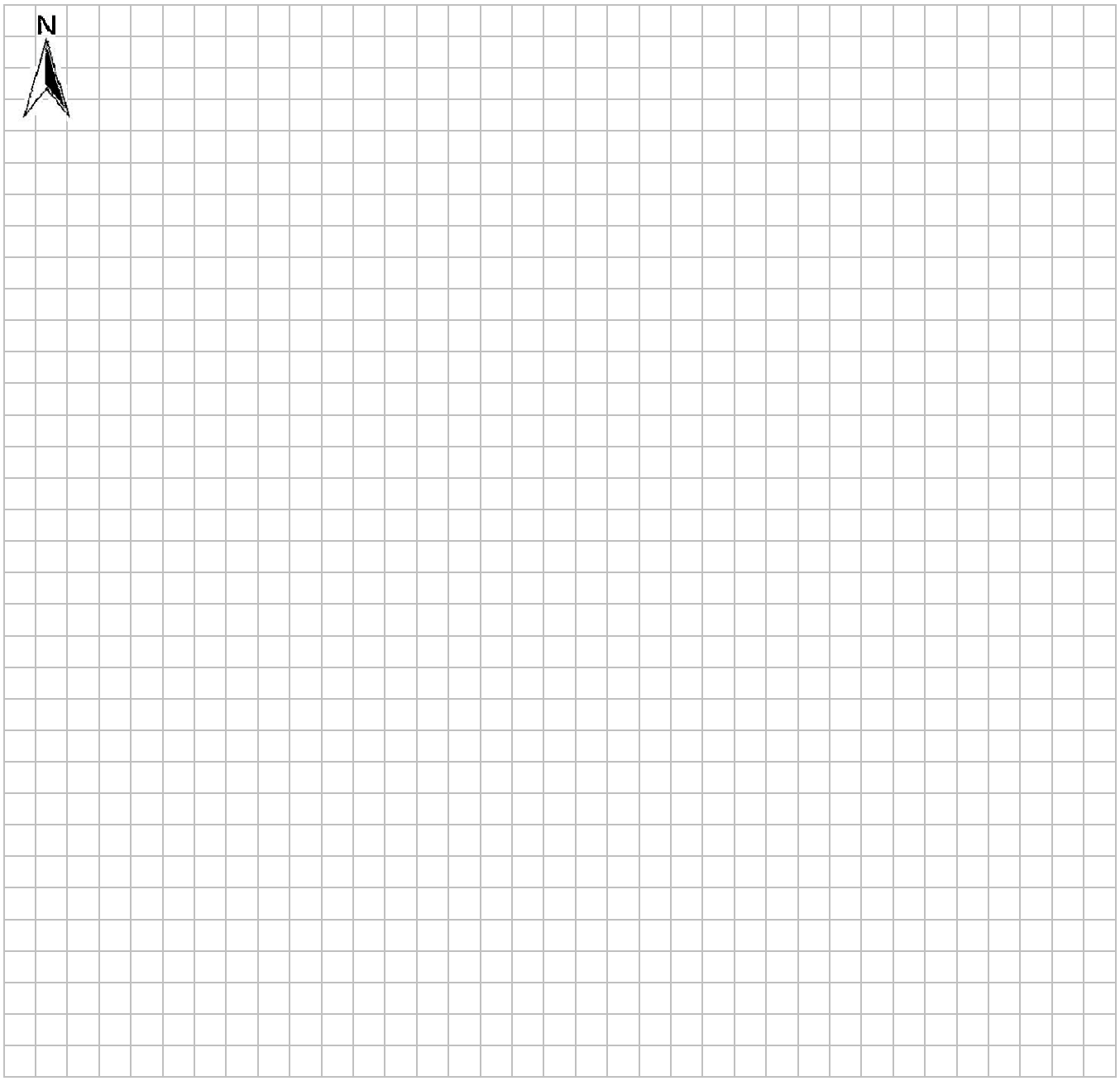
First Floor:



12. 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.



13. PRODUCT INVENTORY FORM

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.

Soil Vapor Intrusion - Structure Sampling Building Questionnaire **Structure ID :** _____

Site No. : _____ **Site Name** : _____

Date: _____ **Time:** _____

Structure Address : _____

Preparer's Name & Affiliation : _____

Residential ? ☐ **Yes** ☐ **No** **Owner Occupied ?** ☐ **Yes** ☐ **No** **Owner Interviewed ?** ☐ **Yes** ☐ **No**

Commercial ? ☐ **Yes** ☐ **No** **Industrial ?** ☐ **Yes** ☐ **No** **Mixed Uses ?** ☐ **Yes** ☐ **No**

Identify all non-residential use(s) : _____

Owner Name : _____ **Owner Phone** : ( ) _____ - _____

Secondary Owner Phone : ( ) _____ - _____

Owner Address (if different) : _____

Occupant Name : _____ **Occupant Phone** : ( ) _____ - _____

Secondary Occupant Phone : ( ) _____ - _____

Number & Age of All Persons Residing at this Location : _____

Additional Owner/Occupant Information : _____

Describe Structure (style, number floors, size) : _____

_____

Approximate **Year Built** : _____ Is the building **Insulated**? ☐ Yes ☐ No

Lowest level : ☐ Slab-on-grade ☐ Basement ☐ Crawlspace

Describe Lowest Level (finishing, use, time spent in space) : _____

_____

Floor Type: ☐ Concrete Slab ☐ Dirt ☐ Mixed : _____

Floor Condition : ☐ Good (few or no cracks) ☐ Average (some cracks) ☐ Poor (broken concrete or dirt)

Sumps/Drains? ☐ Yes ☐ No Describe : _____

Identify other floor penetrations & details : _____

_____

Wall Construction : ☐ Concrete Block ☐ Poured Concrete ☐ Laid-Up Stone

Identify any wall penetrations : _____

_____

Identify water, moisture, or seepage: location & severity (sump, cracks, stains, etc) : _____

_____

Heating Fuel : ☐ Oil ☐ Gas ☐ Wood ☐ Electric ☐ Other : _____

Heating System : ☐ Forced Air ☐ Hot Water ☐ Other : _____

Hot Water System : ☐ Combustion ☐ Electric ☐ Boilermate ☐ Other: _____

Clothes Dryer : ☐ Electric ☐ Gas Where is dryer **vented** to? _____

If combustion occurs, describe where air is drawn from (cold air return, basement, external air, etc.) : _____

_____

Fans & Vents (identify where fans/vents pull air from and where they vent/exhaust to) : _____

_____

Describe factors that may affect indoor air quality (chemical use/storage, unvented heaters, smoking, workshop):

Attached garage ? ☐ Yes ☐ No Air fresheners ? ☐ Yes ☐ No

New carpet or furniture ? ☐ Yes ☐ No What/Where ? _____

Recent **painting** or **staining** ? ☐ Yes ☐ No Where ? : _____

Any **solvent** or **chemical-like** odors ? ☐ Yes ☐ No Describe : _____

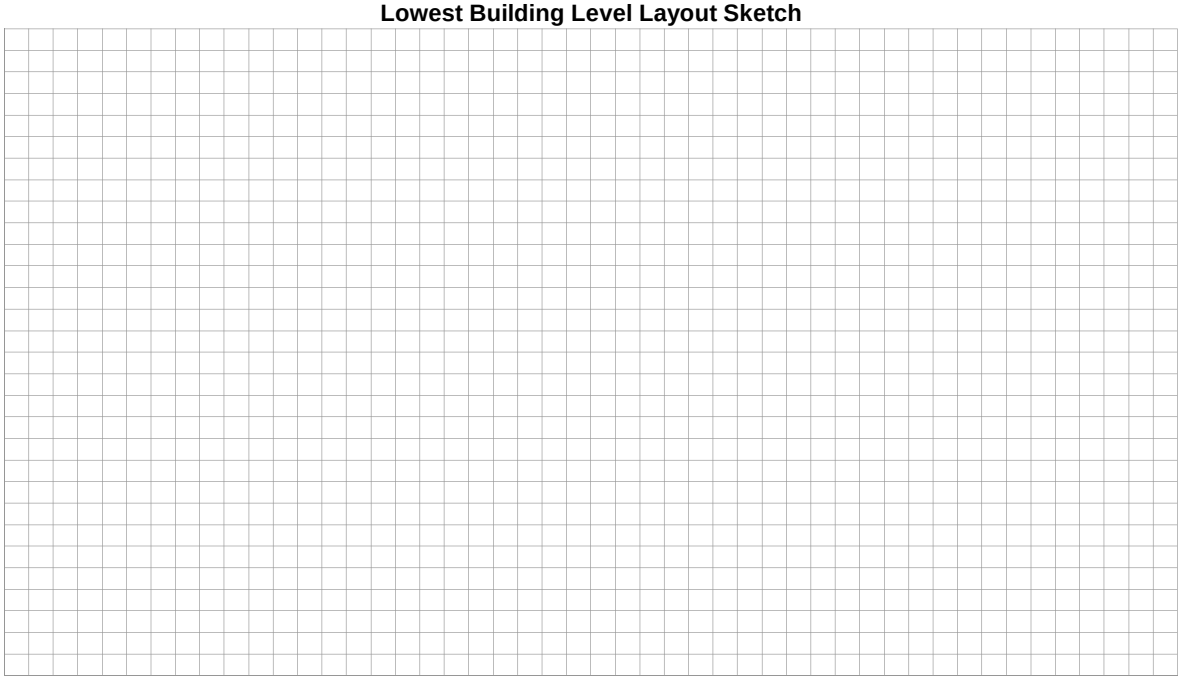
Last time **Dry Cleaned** fabrics brought in ? _____ What / Where ? _____

Do any building occupants use solvents at work ? ☐ Yes ☐ No Describe : _____

Any testing for Radon ? ☐ Yes ☐ No Results : _____

Radon System/Soil Vapor Intrusion Mitigation System present ? ☐ Yes ☐ No If yes, describe below

Lowest Building Level Layout Sketch



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

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

Structure Sampling - Product Inventory

Homeowner Name & Address: _____ **Date:** _____

Samplers & Company: _____ **Structure ID:** _____

Site Number & Name: _____ **Phone Number:** _____

Make & Model of PID: _____ **Date of PID Calibration:** _____

Identify any Changes from Original Building Questionnaire : _____

Product Name/Description	Quantity	Chemical Ingredients	PID Reading	Location

SOIL VAPOR IMPLANT CONSTRUCTION DETAILS

AECOM

PROJECT: _____ VAPOR IMPLANT ID: _____

CLIENT: _____ DATE: _____

DRILLING SUMMARY

Geologist:

Drilling Company:

Driller:

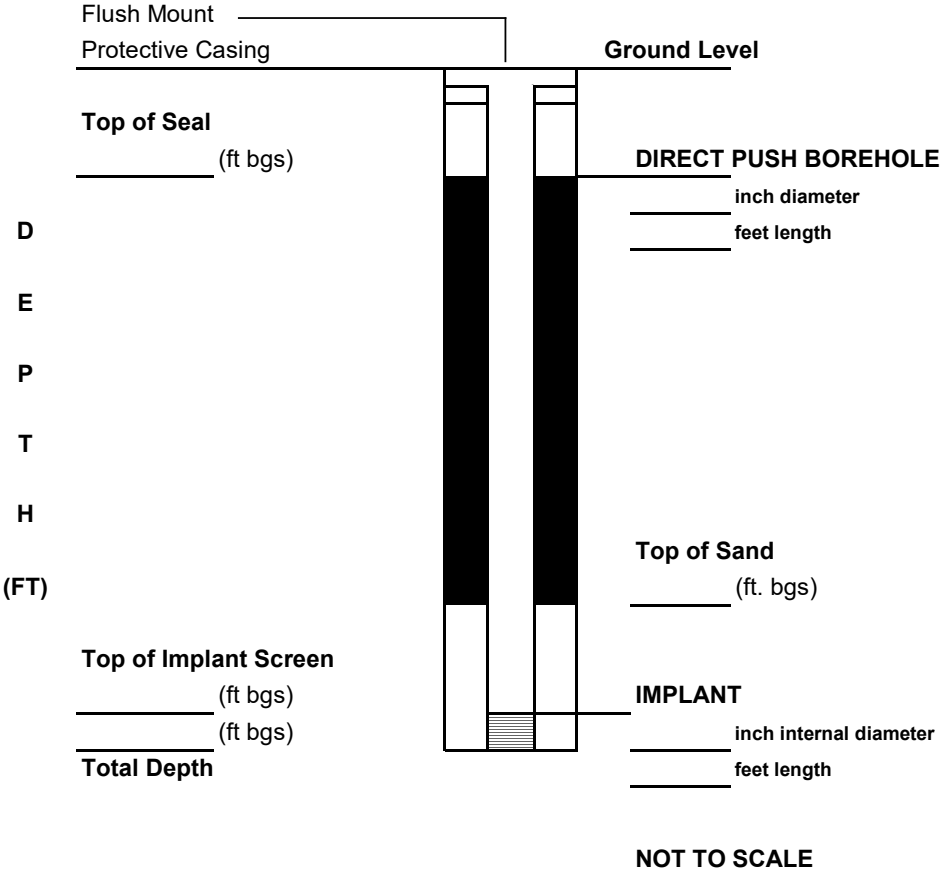
Rig Make/Model:

Date:

GEOLOGIC LOG

Depth(ft.)	Description

WELL DESIGN



CASING MATERIAL	*SCREEN MATERIAL*	*FILTER MATERIAL*
Surface:	**Type:**	**Type**
		SEAL MATERIAL
Riser:	**Pore Diameter:**	**Type:**

COMMENTS:

LEGEND

- Cement/Bentonite Grout
- Bentonite Seal
- Silica Sandpack

SUMMA CANISTER SAMPLING FIELD SHEET

AECOM

PROJECT: _____ DATE: _____

CLIENT: _____

Sample #					
Location					
Summa Canister ID					
Flow Controller ID					
Additional Tubing Added					
Purge Time (Start)					
Purge Time (Stop)					
Total Purge Time (min)					
Purge Volume (L)					
PID Test of Purge Air (ppm)					
Initial Tracer Gas Results (ppm)					
Pressure Gauge - before sampling					
Sample Time (Start)					
Sample Time (Stop)					
Total Sample Time (min)					
Pressure Gauge - after sampling					
Sample Volume (L)					
Canister Pressure Went To Ambient Pressure?					
Associated Ambient Air Sample Number					

General Comments:

Appendix B – NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York

FINAL

Guidance for Evaluating Soil Vapor Intrusion in the State of New York

October 2006

NOTE: Updates to this final guidance are available at
health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Prepared by:



NEW YORK STATE DEPARTMENT OF HEALTH
Center for Environmental Health
Bureau of Environmental Exposure Investigation

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Telephone: 1-800-458-1158, extension 27850

New York State Departments of Health and Environmental Conservation — Web Sites on Soil Vapor Intrusion

This guidance, policy documents, training documents, fact sheets, etc. are available to the public on the following web sites:

New York State Department of Health
http://www.health.state.ny.us/environmental/indoors/vapor_intrusion

New York State Department of Environmental Conservation
http://www.dec.state.ny.us/website/der/guidance/vapor/index.html

As new information becomes available (e.g., revisions or amendments to the guidance, new fact sheets, etc.), these web sites will be updated accordingly.

Preface

This guidance has been prepared by the New York State Department of Health (NYSDOH) in consultation with the New York State Department of Environmental Conservation (NYSDEC) — collectively referred to as "the State" throughout this document. It is intended as general guidance for parties evaluating soil vapor intrusion in the State of New York. The guidance is not a regulation, rule or requirement.

The guidance describes the State's methodology for evaluating soil vapor intrusion at a site. It reflects our experience in conducting soil vapor intrusion investigations and presents a reasonable and practical approach to identifying and addressing current and potential human exposures to contaminated subsurface vapors associated with known or suspected volatile chemical contamination. The approach presented is analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns.

The guidance is organized into five sections:

Section 1 introduces the concept of soil vapor intrusion, associated human exposure issues, factors affecting soil vapor intrusion, factors affecting indoor air quality, and the general approach recommended to evaluating vapor intrusion;

Section 2 provides guidance on collecting appropriate and relevant data that can be used to identify current or potential human exposures;

Section 3 discusses how the investigation data are evaluated, recommends actions based on the evaluation, and presents tools that are used when determining appropriate actions to address exposures;

Section 4 provides an overview of soil vapor intrusion mitigation methods and basic recommendations pertaining to their selection for use, installation and design, post-mitigation testing, operation, maintenance and monitoring, termination of operation, and annual certification; and

Section 5 describes outreach techniques commonly used to inform the community about soil vapor intrusion issues.

The State recommends that the guidance be considered anywhere soil vapor intrusion is evaluated in the State of New York — whether the evaluation is undertaken voluntarily by a corporation, a municipality, or private citizen, or whether it is performed under one of the State's environmental remediation programs.

PLEASE NOTE:

- While soil vapor intrusion can also occur with "naturally-occurring" subsurface gases (e.g., radon, methane and hydrogen sulfide), the document discusses soil vapor intrusion in terms of environmental contamination only.
- The guidance document addresses soil vapor intrusion. However, vapor intrusion can also occur through direct volatilization of contaminants from groundwater into indoor air. This can occur when, for example, a basement slab is in contact with contaminated groundwater, contaminated groundwater enters (floods) a basement or crawl space, or contaminated groundwater enters a sump pit drainage system. In such cases, volatile

chemicals can be transferred directly from groundwater to indoor air without the intervening contamination of soil vapor. Although exposures of this nature are not discussed in this guidance, they should be addressed on a site-specific and building-specific basis.

- Throughout the guidance references are made to specific brands of field equipment. These references are for discussion purposes only and are intended to be illustrative. They should not be interpreted as endorsements by the State of any one company or their products.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

ACRONYMNS and ABBREVIATIONS

ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substance and Disease Registry
BASE	Building Assessment and Survey Evaluation
BTSA	[NYSDOH] Bureau of Toxic Substance Assessment
CME	Continuing Medical Education
CSEMs	Case Studies in Environmental Medicine
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
EPA	United States Environmental Protection Agency
GC	Gas Chromatograph
HEI	Health Effects Institute
HVAC	Heating, Ventilating and Air-conditioning
mcg/m^3	micrograms per cubic meter
MeCl	Methylene Chloride
MEK	Methyl Ethyl Ketone; 2-Butanone
MTBE	Methyl-*tert*-Butyl Ether
NAPL	Non-Aqueous Phase Liquid
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	Operation, Maintenance and Monitoring
OSHA	Occupational Safety and Health Administration
OVM	Organic Vapor Monitor
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene or Perchloroethylene
PID	Photoionization Detector
QA/QC	Quality Assurance/Quality Control
RIOPA	Relationship of Indoor, Outdoor, and Personal Air
SF_6	Sulfur Hexafluoride
SSD	Sub-slab Depressurization System
SIM	Selective Ion Monitoring
SMD	Sub-Membrane Depressurization
SVE	Soil Vapor Extraction
SVOCs	Semi-volatile Organic Compounds
TAL	Target Analyte List
TCA	Trichloroethane
TCDD	Tetrachlorodibenzo-*p*-Dioxin Equivalents
TCE	Trichloroethene
TCL	Target Compound List
VOCs	Volatile Organic Compounds

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NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

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Section 1: Introduction

This section introduces the concept of soil vapor intrusion, associated human exposure issues, factors affecting soil vapor intrusion, factors affecting indoor air quality, and the general approach to evaluating vapor intrusion.

1.1 Soil vapor intrusion

The phrase "soil vapor intrusion" refers to the process by which volatile chemicals migrate from a subsurface source into the indoor air of buildings. Soil vapor, also referred to as soil gas, is the air found in the pore spaces between soil particles (Figure 1.1). Primarily because of a difference between interior and exterior pressures, soil vapor can enter a building through cracks or perforations in slabs or basement floors and walls, and through openings around sump pumps or where pipes and electrical wires go through the foundation. For example, heating, ventilation or air-conditioning (HVAC) systems and/or the operation of large mechanical appliances (e.g., exhaust fans, dryers, etc.) may create a negative pressure that can draw soil vapor into the building. This intrusion is similar to how radon gas enters buildings from the subsurface.

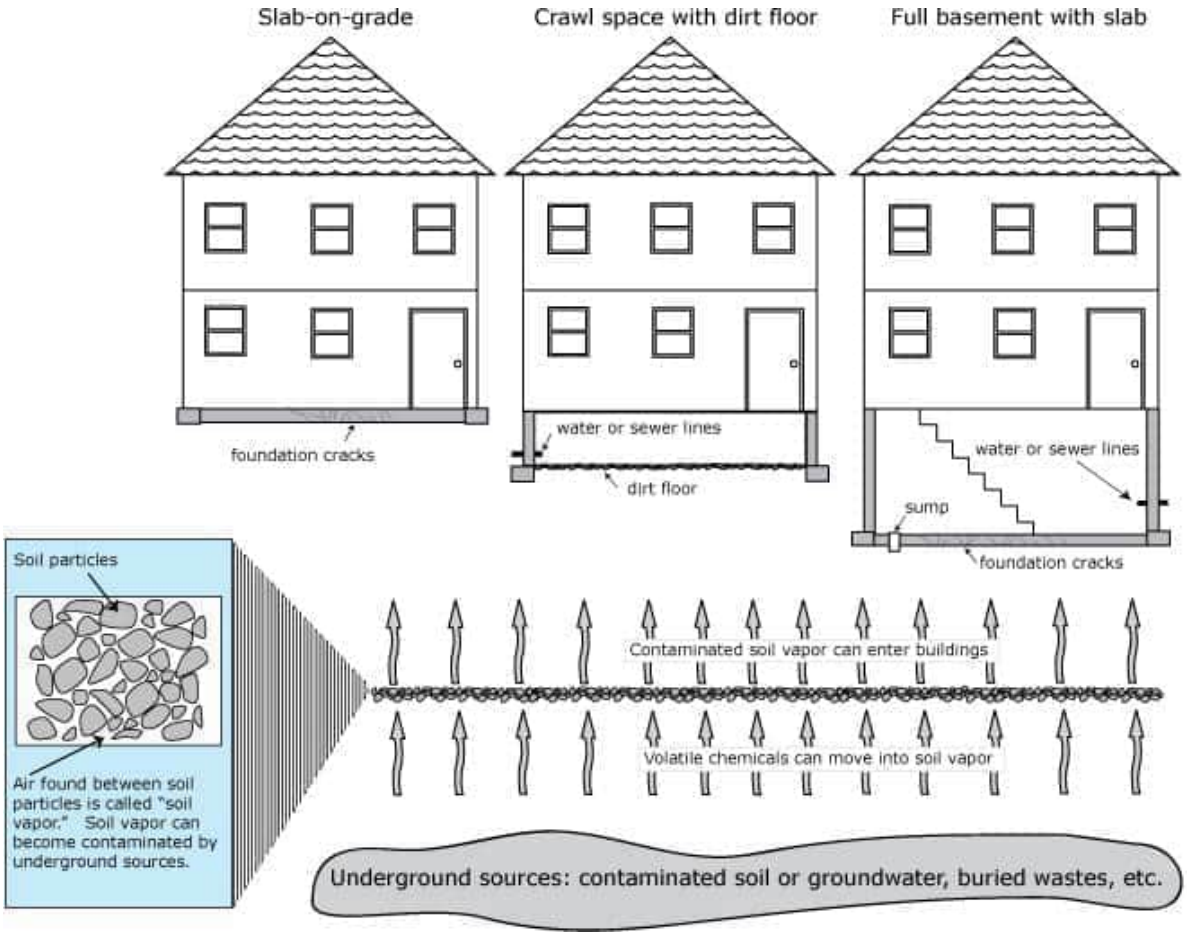


Figure 1.1
Generalized diagram of soil vapor intrusion

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http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Soil vapor can become contaminated when chemicals evaporate from subsurface sources. Chemicals that can emit vapors are called "volatile chemicals." Volatile chemicals include volatile organic compounds (VOCs), some semi-volatile organic compounds (SVOCs), and some inorganic substances such as elemental mercury. Subsurface sources of volatile chemicals can include the following:

a. groundwater or soil that contains volatile chemicals;
b. non-aqueous phase liquid (NAPL);
c. buried wastes; and
d. underground storage tanks or drums.

If soil vapor is contaminated and enters a building, indoor air quality may be affected.

When contaminated vapors are present in the zone directly next to or under the foundation of a building, vapor intrusion is possible. Soil vapor can enter a building whether the building is old or new, or whether it is on a slab or has a crawl space or basement (Figure 1.1). However, the subsurface source of the contaminated vapor (e.g., contaminated soil or groundwater) does not need to be directly beneath a structure to contaminate the vapor immediately beneath the building's foundation (as suggested in Figure 1.1).

1.2 Soil vapor intrusion and human exposure

Humans can be exposed to contaminated soil vapor when the vapor is drawn into the building due to pressure differences [Section 1.1] and mixed with the indoor air. Inhalation is the primary route of exposure, or the manner in which the volatile chemicals, once in the indoor air, actually enter the body.

Both current and potential exposures are considered when evaluating soil vapor intrusion at sites (i.e., locations of suspected or known environmental contamination). *Current* exposures exist when vapor intrusion is documented in an occupied building. *Potential* exposures exist when volatile chemicals are present in the vapor phase beneath a building, but have not affected indoor air quality due to current site conditions. Potential exposures also exist when there is a chance that contaminated soil vapors may move beneath existing buildings not currently affected, when indoor air is affected but the building is currently unoccupied, or when there is a chance that new buildings can be built over existing subsurface vapor contamination.

Exposure to a volatile chemical due to vapor intrusion does not necessarily mean that health effects will occur. Whether or not a person experiences health effects depends on several factors, including the length of exposure (short-term or acute versus long-term or chronic), the amount of exposure (i.e., dose), the frequency of exposure, the toxicity of the volatile chemical and the individual's sensitivity to the chemical.

1.3 Factors affecting soil vapor migration and intrusion

Predicting the extent of soil vapor contamination from soil or groundwater contamination, as well as the potential for human exposure from soil vapor intrusion into buildings, is complicated by factors that can affect soil vapor migration and intrusion. For example, soil vapor contaminant plumes may not mimic groundwater contaminant plumes since different factors affect the migration pattern of each medium. In addition to the operation of HVAC

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systems, the operation of kitchen vents in restaurants or of elevators in office buildings may induce pressure gradients that result in the migration of vapor-phase contaminants away from a groundwater source of vapors and toward these buildings. This is similar to when the pumping of production wells or water supply wells draws contaminated groundwater away from its natural flow path.

Factors that can affect soil vapor migration and intrusion generally fall into two categories: environmental and building factors. Examples of environmental factors are provided in Table 1.1, and examples of building factors in Table 1.2. These factors are considered when conducting an investigation of the soil vapor intrusion pathway [Section 2] and when evaluating the results [Section 3].

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Table 1.1 Environmental factors that may affect soil vapor intrusion

Environmental Factor	Description
Soil conditions	Generally, dry, coarse-grained soils facilitate the migration of subsurface vapors and wet, fine-grained or highly organic soils retard migration.
Volatile chemical concentrations	The potential for vapor intrusion generally increases with increasing concentrations of volatile chemicals in groundwater or subsurface soils, as well as with the presence of NAPL.
Source location	The potential for vapor intrusion generally decreases with increasing distance between the subsurface source of vapor contamination and overlying buildings. For example, the potential for vapor intrusion associated with contaminated groundwater decreases with increasing depth to groundwater.
Groundwater conditions	Volatile chemicals dissolved in groundwater may off-gas to the vadose zone from the surface of the water table. If contaminated groundwater is overlain by clean water (upper versus lower aquifer systems or significant downward groundwater gradients), then vapor phase migration or partitioning of the volatile chemicals is unlikely. Additionally, fluctuations in the groundwater table may results in contaminant smear zones. The "smear zone" is the area of subsurface soil contamination within the range of depths where the water table fluctuates. Chemicals floating on top of the water table, such as petroleum components, can sorb onto soils within this zone as the water table fluctuates. Sorption of chemicals can influence their gaseous and aqueous phase diffusion in the subsurface, and ultimately the rate at which they migrate.
Surface confining layer	A surface confining layer (e.g., frost layer, pavement or buildings) may temporarily or permanently retard the migration of subsurface vapors to outdoor air. Confining layers can also prevent rainfall from reaching subsurface soils, creating relatively dry soils that further increase the potential for soil vapor migration.
Fractures in bedrock and/or tight clay soils	Fractures in bedrock and desiccation fractures in clay can increase the potential for vapor intrusion beyond that expected for the bulk, unfractured bedrock or clay matrix by facilitating vapor migration (in horizontal and vertical directions) and movement of contaminated groundwater along spaces between fractures.
Underground conduits	Underground conduits (e.g., sewer and utility lines, drains or tree roots, septic systems) with highly permeable bedding materials relative to native materials can serve as preferential pathways for vapor migration due to relatively low resistance to flow.
Weather conditions	Wind and barometric pressure changes and thermal differences between air and surrounding soils may induce pressure gradients that affect soil vapor intrusion.
Biodegradation processes	Depending upon environmental conditions (e.g., soil moisture, oxygen levels, pH, mineral nutrients, organic compounds, and temperature), the presence of appropriate microbial populations, and the degradability of the volatile chemical of concern, biodegradation in the subsurface may reduce the potential for vapor intrusion. For example, readily biodegradable chemicals in soil vapor may not migrate a significant distance from a source area while less degradable chemicals may travel farther.

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http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Table 1.2 Building factors that may affect vapor intrusion

Building Factor	Description
Operation of HVAC systems, fireplaces, and mechanical equipment (e.g., clothes dryers or exhaust fans/vents)	Operation may create a pressure differential between the building or indoor air and the surrounding soil that induces or retards the migration of vapor-phase contaminants toward and into the building. Vapor intrusion can be enhanced as the air vented outside is replaced.
Heated building	When buildings are closed up and heated, a difference in temperature between the inside and outdoor air induces a stack effect, venting warm air from higher floors to the outside. Vapor intrusion can be enhanced as the air is replaced in the lower parts of the building.
Air exchange rates	The rate at which outdoor air replenishes indoor air may affect vapor migration into a building as well the indoor air quality. For example, newer construction is typically designed to limit the exchange of air with the outside environment. This may result in the accumulation of vapors within a building.
Foundation type	Earthen floors and fieldstone walls may serve as preferential pathways for vapor intrusion.
Foundation integrity	Expansion joints or cold joints, wall cracks, or block wall cavities may serve as preferential pathways for vapor intrusion.
Subsurface features that penetrate the building's foundation	Foundation perforations for subsurface features (e.g., electrical, gas, sewer or water utility pipes, sumps, and drains) may serve as a preferential pathway for vapor intrusion.

1.4 Factors affecting indoor air quality

Chemicals are a part of our everyday life. They are found in the household products we use and in items we bring into our homes. As such, chemicals are found in indoor air of homes not affected by intrusion of contaminated soil vapor. Examples of alternate sources of volatile chemicals in indoor air are given in Table 1.3. Similarly, volatile chemicals can be in the outdoor air that enters a home or place of business. Certain commercial and industrial facilities, such as gasoline stations and dry cleaners, and vehicle exhaust are examples of possible sources of volatile chemicals in outdoor air.

Commonly found concentrations of these chemicals in indoor and outdoor air are referred to as "background levels." These levels are generally determined from the results of samples collected in homes, offices and outdoor areas not known to be affected by external sources of volatile chemicals (for example, a home not known to be near a chemical spill, a hazardous waste site, a dry-cleaner, or a factory). Background sources of volatile chemicals are considered when conducting an investigation of the soil vapor intrusion pathway [Section 2] and when evaluating the results [Section 3].

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Table 1.3 Alternate sources of volatile chemicals in indoor air

Source	Description
Outdoor air	Outdoor sources of pollution can affect indoor air quality due to the exchange of outdoor and indoor air in buildings through natural ventilation, mechanical ventilation or infiltration. Outdoor sources of volatile compounds include automobiles, lawn mowers, oil storage tanks, dry cleaners, gasoline stations, industrial facilities, etc.
Attached or underground garages	Volatile chemicals from sources stored in the garage (e.g., automobiles, lawn mowers, oil storage tanks, gasoline containers, etc.) can affect indoor air quality due to the exchange of air between the garage and indoor space.
Off-gassing	Volatile chemicals may off-gas from building materials (e.g., adhesives or caulk), furnishings (e.g., new carpets or furniture), recently dry-cleaned clothing, or areas (such as floors or walls) contaminated by historical use of volatile chemicals in a building. Volatile chemicals may also off-gas from contaminated groundwater that infiltrates into the basement (e.g., at a sump) or during the use of contaminated domestic well water (e.g., at a tap or in a shower).
Household products	Household products include, but are not limited to, cleaners, mothballs, cigarette smoke, paints, paint strippers and thinners, air fresheners, lubricants, glues, solvents, pesticides, fuel oil storage, and gasoline storage.
Occupant activities	For example, in non-residential settings, the use of volatile chemicals in industrial or commercial processes or in products used for building maintenance. In residential settings, the use of products containing volatile chemicals for hobbies (e.g., glues, paints, etc.) or home businesses. People working at industrial or commercial facilities where volatile chemicals are used may bring the chemicals into their home on their clothing.
Indoor emissions	These include, but are not limited to, combustion products from gas, oil and wood heating systems that are vented outside improperly, as well as emissions from industrial process equipment and operations.

1.5 General approach to evaluating soil vapor intrusion

Since no two sites are exactly alike, the approach to evaluating soil vapor intrusion is dependent upon site-specific conditions. A thorough understanding of the site, including its history of use, characteristics (e.g., geology, geography, identified environmental contamination, etc.) and potentially exposed populations, is used to develop an investigation plan. Existing information is reviewed to determine what data are available and what additional data should be collected (i.e., to guide the investigation). In addition, factors affecting soil vapor migration and intrusion [Section 1.3] and indoor air quality [Section 1.4] are also considered when both conducting an investigation [Section 2] and evaluating the results [Section 3].

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This data gathering and review process should be repeated until each of the following questions can be answered:

[1] Are subsurface vapors contaminated (i.e., soil vapor as defined in Section 1.1, including vapors located immediately beneath the foundation or slab of a building)? If so, what are the nature and extent of contamination? What is/are the source(s) of the contamination?

[2] What are the current and potential exposures to contaminated subsurface vapors via soil vapor intrusion?

[3] What actions, if any, should be taken to prevent or mitigate exposures related to soil vapor intrusion and to remediate subsurface vapor contamination?

When determining what actions, if any, are appropriate to mitigate current or prevent future human exposures, all information known about a site is considered (i.e., a "whole picture" approach is taken) because each site presents its own unique set of circumstances. This information includes, but is not limited to, the following: nature and extent of contamination in all environmental media, factors affecting vapor migration and intrusion, current and future site uses, off-site land uses, presence of alternate sources of volatile chemicals, and completed or proposed remedial actions.

Actions taken to minimize or prevent exposures typically do not preclude the site from being used for a desired purpose or from being developed. If appropriate, mitigation systems can be installed at existing buildings or installed during the construction of new buildings. In many cases, installation of mitigation systems on new buildings may be a prudent, proactive action. The costs associated with installing a system at the time of a building's construction are often considerably less than the costs associated with retrofitting a system to the building after construction is completed. Furthermore, in many parts of New York State, the mitigation system would also address concerns about human exposures to radon. To learn more about radon in New York State, please refer to the Radon: Frequently Asked Questions Fact Sheet in Appendix H or visit the NYSDOH's web site at http://www.health.state.ny.us/nysdoh/radon/radonhom.htm or contact the NYSDOH's Radon Program at 1-800-458-1158.

1.6 Conceptual site model

In accordance with the NYSDEC's *Draft DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDEC 2002), subsurface vapors and soil vapor intrusion should be included in an overall conceptual model for the site. As described in the NYSDEC's technical guidance, a conceptual site model should be used to develop a general understanding of the site to evaluate potential risks to public health and the environment and to assist in identifying and setting priorities for the activities to be conducted at the site. The conceptual site model also identifies potential sources of contamination, types of contaminants and affected media, release mechanisms and potential contaminant pathways, and actual/potential human and environmental receptors.

The components of a conceptual site model specific to soil vapor intrusion are provided throughout Section 1 of the guidance. The general approach for evaluating soil vapor intrusion described in Section 1.5 is analogous to the development of a conceptual site model specific to soil vapor intrusion. For additional information about the use of conceptual site models in the investigation and remediation of sites or a description of the conceptual site model process, the reader is referred to the NYSDEC's technical guidance.

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http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

1.7 Applicability of guidance

This guidance should be considered anywhere soil vapor intrusion is evaluated in the State of New York, whether the evaluation is being undertaken voluntarily by a corporation, a municipality, or private citizen, or under one of the state's environmental remediation programs.

1.7.1 Residential and non-residential settings

The guidance should be followed in residential and non-residential settings where people may be exposed involuntarily to chemicals from soil vapor intrusion.

1.7.2 Chlorinated and non-chlorinated volatile chemical sites

The guidance should be used when evaluating soil vapor intrusion at chlorinated and non-chlorinated volatile chemical sites, including petroleum hydrocarbon sites and manufactured gas plant sites. While the likelihood for exposures related to soil vapor intrusion may differ between sites due to site-specific conditions and chemical-specific properties, the extent of volatile chemical contamination and the nature of the contamination, these factors should be considered when developing the conceptual site model and implementing an investigation plan (as discussed in Sections 1.5 and 1.6). For example, if the conceptual site model suggests that soil vapor intrusion is not a concern at a petroleum hydrocarbon site due to biodegradation, the work plan might include the measurement of select bioparameters (e.g., oxygen, carbon dioxide, methane, etc.), along with the petroleum hydrocarbons, at varying depths to demonstrate bioattenuation in the vadose. The work plan might include sub-slab vapor sampling as well to demonstrate that conditions beneath nearby buildings are also resulting in bioattenuation of the petroleum hydrocarbons.

1.7.3 Current, new and past remedial sites

As discussed in the NYSDEC's Program Policy *DER-13: Strategy for Prioritizing Vapor Intrusion Evaluations at Remedial Sites in New York* (NYSDEC 2006), the soil vapor intrusion pathway will be evaluated at all completed, current and future remedial sites New York State. This soil vapor intrusion guidance document complements the NYSDEC's policy by providing recommendations on how to evaluate soil vapor intrusion. The combined goal of the policy and guidance documents is to conduct soil vapor intrusion evaluations as efficiently and effectively as possible at all remedial sites in New York.

1.8 Updates to the guidance

The investigation, evaluation, mitigation and remediation of soil vapor are evolving disciplines and this guidance document will be updated periodically, as appropriate. The history of the document's release is provided on the inside of the cover page. In addition, changes to the document are noted in Appendix A. The current version of the document supercedes previous versions. The current version of the guidance is available on the NYSDOH's web site (*http://www.health.state.ny.us/environmental/indoors/vapor_intrusion/*) or by contacting the NYSDOH's Bureau of Environmental Exposure Investigation [see Contact Information on the inside of the cover page]. Revisions or amendments to the guidance will be posted on the NYSDOH's web site.

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Section 2: Investigation of the Soil Vapor Intrusion Pathway

Soil vapor is an environmental medium, like groundwater and soil, that should be characterized during the investigation of a site. This section provides guidance on collecting appropriate and relevant data that can be used to identify current or potential human exposures to contaminated subsurface vapors associated with a site. As discussed in Section 1.5, no two sites are exactly alike. Site-specific and/or building-specific conditions may warrant modifying the recommendations herein. Therefore, guidance provided in this section is presented in terms of general steps and strategies that should be applied when approaching an investigation of soil vapor intrusion.

2.1 Sites at which an investigation is appropriate

Data collected to date do not support the use of pre-determined concentrations of volatile chemicals (i.e., screening criteria) in either groundwater or soil to trigger a soil vapor intrusion investigation. Therefore, although the level of investigation may vary, the pathway should be investigated at any site with the following:

a. an existing subsurface source (e.g., on the basis of preliminary environmental sampling) or likely subsurface source (e.g., on the basis of known previous land uses) of volatile chemicals [Section 1.1]; and

b. existing buildings or the possibility that buildings may be constructed near a subsurface source of volatile chemicals.

2.2 Types of samples

The following are types of samples that are collected to investigate the soil vapor intrusion pathway:

a. subsurface vapor samples:

   1. *soil vapor* samples (i.e., soil vapor samples not beneath the foundation or slab of a building) and

   2. *sub-slab vapor* samples (i.e., soil vapor samples immediately beneath the foundation or slab of a building);

b. crawl space air samples;

c. indoor air samples; and

d. outdoor air samples.

The types of samples that should be collected depend upon the specific objective(s) of the sampling, as described below.

2.2.1 Soil vapor

Soil vapor samples are collected to determine whether this environmental medium is contaminated, characterize the nature and extent of contamination, and identify possible sources of the contamination. Our experience to date indicates soil vapor results alone typically cannot be relied upon to rule out sampling at nearby buildings. For example, concentrations of volatile chemicals in sub-slab vapor samples have been substantially higher (e.g., by a factor of 100 or more) than concentrations found in nearby soil vapor

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samples (e.g., collected at 8 feet below grade near the building). This may be due to differences in factors such as soil moisture content and pressure gradients. Therefore, exposures are evaluated primarily based on sub-slab vapor, indoor air and outdoor air sampling results and soil vapor results are primarily used as a tool to guide these investigations.

Soil vapor sampling results are also used when evaluating the effectiveness of direct or indirect measures to remediate contaminated subsurface vapors. (Soil vapor extraction is an example of a direct remedial measure, and groundwater pumping and treating an indirect measure.)

2.2.2 Sub-slab vapor

Sub-slab vapor samples are collected to characterize the nature and extent of soil vapor contamination immediately beneath a building with a basement foundation and/or a slab-on-grade. Sub-slab vapor sampling results are used in conjunction with indoor air and outdoor air sampling results when evaluating the following:

a. *current* human exposures;
b. the potential for *future* human exposures (e.g., if the structural integrity of the building changes or the use of the building changes); and
c. site-specific attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations).

Sub-slab vapor samples are often collected after soil vapor characterization and/or other environmental sampling (e.g., soil and groundwater characterization) indicate they are warranted. Sub-slab samples are typically collected concurrently with indoor and outdoor air samples. However, outside of the heating season, sub-slab vapor samples may be collected independently depending on the sampling objective (e.g., to characterize the extent of subsurface vapor contamination outside of the heating season to develop a more comprehensive, focused investigation plan for the heating season).

2.2.3 Crawl space air

Similar to sub-slab vapor samples, crawl space air samples are collected to characterize the nature and extent of contamination immediately beneath a building with a crawl space foundation. Crawl space air sampling results are used in conjunction with indoor air and outdoor air sampling results when evaluating the following:

a. *current* human exposures; and
b. the potential for *future* human exposures (e.g., if the structural integrity of the building changes or the use of the building changes).

2.2.4 Indoor air

Indoor air samples are collected to characterize exposures to air within a building, including those with earthen floors. Indoor air sampling results are used when evaluating the following:

a. *current* human exposures;

b. the potential for *future* exposures (e.g., if a currently vacant building should become occupied); and

c. site-specific attenuation factors (e.g., the ratio of indoor air to sub-slab vapor concentrations).

Indoor air samples are often collected after subsurface vapor characterization and other environmental sampling (e.g., soil and groundwater characterization) indicate they are warranted. When indoor air samples are collected, concurrent sub-slab vapor, crawl space air (if applicable) and outdoor air samples are collected to evaluate the indoor air results appropriately. However, indoor air and outdoor air samples, without sub-slab vapor samples, may be collected when confirming the effectiveness of a mitigation system [Section 4].

In addition, site-specific situations may warrant collecting indoor air samples prior to characterizing subsurface vapors and/or without concurrent sub-slab vapor sampling to examine immediate inhalation hazards. Examples of such situations may include, but are not limited to, the following:

a. in response to a spill event to qualitatively and/or quantitatively characterize the contamination;

b. if high readings are obtained in a building when screening with field equipment (e.g., a photoionization detector (PID), an organic vapor analyzer, or an explosimeter) and the source is unknown;

c. if significant odors are present and the source needs to be characterized; or

d. if groundwater beneath the building is contaminated, the building is prone to groundwater intrusion or flooding (e.g., sump pit overflows), and subsurface vapor sampling is not feasible. In these situations, the collection of water samples from the sump may also be appropriate.

2.2.5 Outdoor air

Outdoor air samples are collected to characterize site-specific background outdoor air conditions. Outdoor air samples should be collected simultaneously with indoor air samples to evaluate the potential influence, if any, of outdoor air on the indoor air sampled. Outdoor air samples may also be collected concurrently with soil vapor samples to identify potential outdoor air interferences associated with infiltration of outdoor air into the sampling apparatus while the soil vapor was collected.

2.3 Phase of a site investigation in which to sample

There is no single phase (e.g., preliminary site characterization or remedial investigation) of a site investigation during which sampling to evaluate the soil vapor intrusion pathway is appropriate. Initiation of investigation activities for this specific purpose should be determined on a site-by-site basis. However, if exposures due to soil vapor intrusion appear likely at any point during the investigation, evaluation of this exposure pathway should not be delayed.

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If the locations of likely source areas are reasonably known, sampling earlier during the investigation of a site rather than later is recommended because of the iterative nature of the sampling process [Section 2.5]. However, if current site conditions are not well-defined, then sampling after contamination in other environmental media (e.g., groundwater and soil) has been characterized may be considered. In the latter scenario, groundwater, soil and other site information may be used to guide an investigation of the soil vapor intrusion pathway, such as selecting locations for subsurface vapor samples based on likely migration pathways and source areas [Sections 2.6.1 and 2.6.2]. At a minimum, depth to groundwater and soil stratigraphy should be identified prior to collecting soil vapor samples.

Sampling may be delayed at parcels that are undeveloped or contain unoccupied buildings provided

a. characterization of the parcel is not needed to
    1. address exposures in the surrounding area;
    2. design remedial measures for subsurface vapor contamination; or
    3. monitor or confirm the effectiveness of remedial measures; and
b. measures are in place that assure that the parcel will not be developed, or buildings occupied, without addressing exposure concerns [Section 3.6].

If exposures due to soil vapor intrusion appear likely, and a delay of sampling is contemplated, the State (i.e., the NYSDEC and NYSDOH) should be informed of the contemplated delay and the rationale for the delay. Furthermore, the party contemplating the delay should consider any comments the State may have on the information provided.

2.4 Time of year in which to sample

2.4.1 Soil vapor

Soil vapor samples are collected at any time during the year. Often, sampling is completed during the summer so the results can be used as a tool when selecting buildings to be sampled during the heating season.

2.4.2 Buildings

Sub-slab vapor samples and, unless immediate sampling is appropriate, indoor air samples are typically collected during the heating season because soil vapor intrusion is more likely to occur when a building's heating system is in operation and doors and windows are closed. In New York State, heating systems are generally expected to be operating routinely from November 15th to March 31st. However, these dates are not absolute; the timeframe for sampling may vary depending on factors such as the location of the site (e.g., upstate versus downstate) and the weather conditions for a particular year.

A soil vapor intrusion investigation at a building may be conducted outside of the heating season if the concern for vapor intrusion is greater during another time of year. This may occur at certain industrial buildings, for instance, where HVAC systems are actively managed to control the ratio of recirculated indoor air to make-up air from outside the building. Information about the site and potentially affected structures, including the factors discussed in Section 1.3, should be considered in determining the timing of an investigation.

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Samples may be collected at any time of year if exposures due to soil vapor intrusion appear likely. However, samples collected at times when soil vapor intrusion is not expected to have its greatest effect on indoor air quality (typically, samples collected outside of the heating season) should not be used to rule out exposures. For example, results indicating "no further action" or "monitoring required" should be verified when soil vapor intrusion is believed to be most likely to ensure these actions are protective throughout the year.

2.5 Number of sampling rounds

Investigating the soil vapor intrusion pathway usually involves more than one round of subsurface vapor, indoor air and/or outdoor air sampling, for reasons such as the following:

a. to characterize the nature and extent of subsurface vapor contamination (similar to the delineation of groundwater contamination) and to address corresponding exposure concerns;

b. to evaluate fluctuations in concentrations due to

    1. different weather conditions (e.g., seasonal effects),

    2. changes in building conditions (e.g., various operating conditions of a building's HVAC system),

    3. changes in source strength, or

    4. vapor migration or contaminant biodegradation processes (particularly when degradation products may be more toxic than the parent compounds); or

c. to confirm sampling results or the effectiveness of mitigation or remedial systems.

Overall, as discussed in Section 1.5, successive rounds of sampling should be conducted until the following questions can be answered:

a. Are subsurface vapors contaminated? If so, what are the nature and extent of contamination? What is/are the source(s) of the contamination?

b. What are the current and potential exposures to contaminated subsurface vapors?

c. What actions, if any, are appropriate to prevent or mitigate exposures and to remediate subsurface vapor contamination?

Toward this end, multiple rounds of sampling may be appropriate to characterize the nature and extent of subsurface vapor contamination such that

a. both potential and current exposures are addressed [Section 2.6];

b. measures can be designed to remediate subsurface vapor contamination, either directly (e.g., SVE system) or indirectly (e.g., soil excavation or groundwater remediation), given that monitoring and mitigation are considered temporary measures implemented to address exposures related to vapor intrusion until contaminated environmental media are remediated [Section 3.4]; and

c. the effectiveness of remedial measures can be monitored and confirmed (e.g., endpoint sampling) [Section 4.5].

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2.6 Sampling locations

The general approach for selecting sampling locations as part of a soil vapor intrusion investigation is similar to the approach for the investigation of other environmental media (e.g., soil and groundwater). Sampling locations should be selected with consideration of the conceptual site model [Section 1.6]. These locations should be selected to meet the stated objectives of the sampling program. Additionally, similar to the investigation of soil and groundwater, it is typical to start at a known or suspected source and work outward. The specific approach, however, will be dependent upon site-specific and building-specific conditions.

2.6.1 Soil vapor

If available, existing environmental data (e.g., groundwater and soil data) and site background information should be used to select locations for sampling soil vapor as part of a vapor intrusion investigation. Locations will vary depending upon surface features (e.g., presence or absence of buildings, areas of pavement, or vacant lot) and subsurface characteristics (e.g., soil stratigraphy, buried structures, utility corridors, or clay lenses), as well as the specific purpose of the sampling. Therefore, a figure illustrating proposed sampling locations (with respect to both areal position and depth), actual locations sampled in the field, and relevant on-site and off-site features should be included in all sampling work plans and reports.

Examples of how locations may vary given the specific purpose of the sampling follow. They include general guidelines that should be followed when selecting soil vapor sampling locations:

a. to evaluate the **potential for current on-site or off-site exposures**, samples should be collected
    1. in the vicinity of a building's foundation [see special sampling consideration at the end of Section 2.6.1 if sampling around a building with no surrounding surface confining layer], as well as between the building's foundation and the source (if known and not located beneath the building),
    2. along the site's perimeter, and
    3. at a depth comparable to the depth of foundation footings (determined on a building-specific or site-specific basis) or at least 1 foot above the water table in areas where the groundwater table is less than 6 feet below grade;
b. to evaluate the **potential for future exposures if development** on a known or suspected contaminated area on-site or off-site is possible, representative samples should be collected
    1. in areas with either known or suspected subsurface sources of volatile chemicals, in areas where elevated readings were obtained with field equipment during previous environmental investigations, and in areas of varying concentrations of contamination in the upper groundwater,
    2. in a grid pattern across the area (at an appropriate spacing interval for the size of the area) if information is limited for the area, and
    3. at multiple depths from the suspected subsurface source, or former source, to a depth comparable to the expected depth of foundation footings;

c. to evaluate the **potential for off-site soil vapor contamination**, samples should be collected

   1. along the site's perimeter,
   2. in areas of potential subsurface sources of vapor contamination (e.g., a groundwater plume that has migrated off-site), and
   3. at a depth comparable to the depth of foundation footings (determined on a site-specific basis) or at least 1 foot above the water table in areas where the groundwater table is less than 6 feet below grade;

d. to evaluate on-site and off-site **preferential migration pathways** in areas with low permeability soils, samples should be collected

   1. 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
   2. at depths corresponding to these subsurface features (will depend on site-specific conditions);

e. to characterize on-site or off-site **contamination in the vadose zone**, samples should be collected

   1. in areas with either known or suspected sources of volatile chemicals, in areas where elevated readings were obtained with field equipment (e.g., PID) during previous soil and groundwater investigations, and in areas of varying concentrations of contamination in the upper groundwater regime, and
   2. at appropriate depths associated with these areas (will depend on site-specific conditions); and

f. to investigate the **influence of contaminated groundwater or soil on soil vapor** and to characterize the **vertical profile** of contamination, samples should be collected from clusters of soil vapor probes at varying depths in the vadose zone [Figure 2.2, Section 2.7.1] and preferably in conjunction with the collection of groundwater or soil samples.

Soil vapor samples collected at depths shallower than 5 feet below grade may be prone to negative bias due to infiltration of outdoor air. Therefore, samples from these depths should be collected only if appropriate (based on site-specific conditions), and sampling procedures and results should be reviewed accordingly. The depth of sampling near buildings with slab-on-grade foundations is dependent upon site-specific conditions (e.g., building surrounded by grassy or surface confining layer).

When collecting soil vapor samples around a building 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.

Investigations of soil vapor contamination should proceed outward from known or suspected subsurface sources, as appropriate, on an areal basis until the nature and extent of

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subsurface vapor contamination has been characterized and human exposures have been addressed.

2.6.2 Sub-slab vapor

Existing environmental data (e.g., soil vapor, groundwater and soil data), site background information, and building construction details (e.g., basement, slab-on-grade, or multiple types of foundations, HVAC systems, etc.) should be considered when selecting buildings and locations within buildings for sub-slab vapor sampling.

At a minimum, these general guidelines should be followed when selecting buildings to sample for sub-slab vapors:

a. buildings, including residential dwellings, located above or directly adjacent to known or suspected areas of subsurface volatile chemical contamination should be sampled;

b. buildings in which screening with field equipment (e.g., PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) suggests a completed migration pathway, such as when readings are above background and from unidentified sources or when readings show increasing gradients, should be sampled; and

c. buildings within known or suspected areas of subsurface volatile chemical contamination that are used or occupied by sensitive population groups (e.g., daycare facilities, schools, nursing homes, etc.) should be given special consideration for sampling.

Investigations of sub-slab vapor and/or indoor air contamination should proceed outward from known or suspected sources, as appropriate, on an areal basis until the nature and extent of subsurface vapor contamination has been characterized and potential and current human exposures have been addressed. In cases of widespread vapor contamination and depending upon the basis for making decisions (e.g., a "blanket mitigation" approach within a specified area of documented vapor contamination [Section 3.3.1]), a representative number of buildings from an identified study area, rather than each building, may be sampled. Prior to implementation, this type of sampling approach should be approved by State agency personnel.

Within a building, sub-slab vapor samples should be collected

a. in at least one central location away from foundation footings, and

b. from the soil or aggregate immediately below the basement slab or slab-on-grade.

The number of sub-slab vapor samples that should be collected in a building depends upon the number of slabs (e.g., multiple slabs-on-grade in a large warehouse) and foundation types (e.g., combined basement and slab-on-grade in a residence). At least one sub-slab vapor sample should be collected from each representative area.

2.6.3 Indoor air

Existing environmental data (e.g., soil vapor, groundwater and soil data), site background information, and building construction details (e.g., basement, slab-on-grade, or multiple types of foundations; number and operation of HVAC systems; elevator shafts; tunnels or other confined-space entry points; etc.) should be considered when selecting buildings and

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locations within buildings for indoor air sampling. Indoor air samples are typically collected concurrently with sub-slab vapor and outdoor air samples [Section 2.2.4].

At a minimum, these general guidelines should be followed when selecting buildings to sample for indoor air:

a. where sub-slab vapor samples were collected without indoor air samples, buildings in which elevated concentrations of contaminants were measured in sub-slab vapor samples should be sampled;

b. buildings, including residential dwellings, located above or directly adjacent to known or suspected subsurface sources of volatile chemicals or known soil vapor contamination should be sampled;

c. buildings in which screening with field equipment (e.g., PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) suggests a completed migration pathway, such as when readings are above background and from unidentified sources or when readings show increasing gradients, should be sampled; and

d. buildings within known or suspected areas of subsurface volatile chemical contamination that are used or occupied by sensitive population groups (e.g., daycare facilities, schools, nursing homes, etc.) should be given special consideration for sampling.

To characterize contaminant concentration trends and potential exposures, indoor air samples should be collected

a. from the crawl space area,

b. from the basement (where vapor infiltration is suspected, such as near sump pumps or indoor wells, or in a central location) at a height approximately three feet above the floor to represent a height at which occupants normally are seated and/or sleep,

c. from the lowest level living space (in centrally-located, high activity use areas) at a height approximately three feet above the floor to represent a height at which occupants normally are seated and/or sleep, and

d. if in a commercial setting (e.g., a strip mall), from multiple tenant spaces at a height approximately three feet above the floor to represent a height at which occupants normally are seated.

These locations are illustrated in Figure 2.1.

Investigations of indoor air contamination should proceed outward from known or suspected subsurface sources, as appropriate, on an areal basis until potential and current human exposures associated with soil vapor intrusion have been addressed. In cases of widespread vapor contamination and depending upon the basis for making decisions (e.g., a "blanket mitigation" approach within a specified area of documented vapor contamination), a representative number of buildings from an identified study area, rather than each building, may be sampled. Prior to implementation, this type of sampling approach should be approved by State agency personnel.

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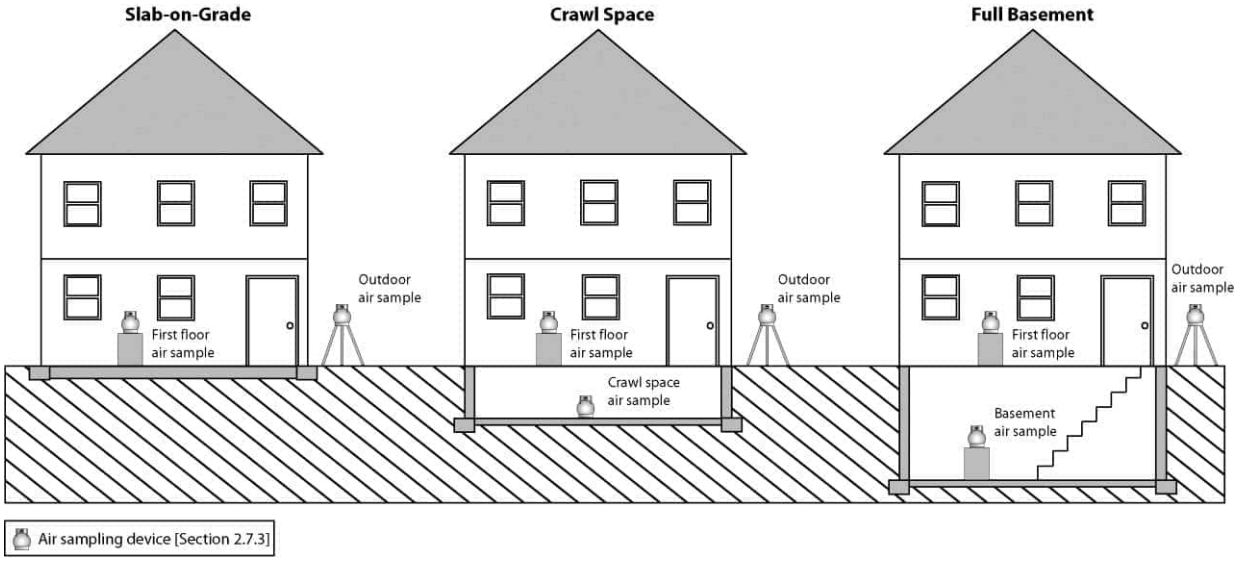


Figure 2.1
Schematic of indoor and outdoor air sampling locations

2.6.4 Outdoor air

Typically, an outdoor air sample is collected outside of each building where an indoor air sample is collected. However, if several buildings are being sampled within a localized area, representative outdoor air samples may be appropriate. For example, one outdoor air sample may be sufficient for three houses being sampled in a cul-de-sac. Outdoor air samples should be collected from a representative upwind location, away from wind obstructions (e.g., trees or bushes), and at a height above the ground to represent breathing zones (3 to 5 feet) [Figure 2.1]. 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.). For buildings with HVAC systems that draw outdoor air into the building, an outdoor air sample collected near the outdoor air intake may be appropriate.

2.7 Sampling protocols

The procedures recommended here may be modified depending on site-specific conditions, the sampling objectives, or emerging technologies and methodologies. Alternative sampling procedures should be described thoroughly and proposed in a work plan submitted for review by the State. The State will review and comment on the proposed procedure and consider the efficacy of the alternative sampling procedure based on the objectives of investigation. In all cases, work plans should thoroughly describe the proposed sampling procedure. Similarly, the procedures that were implemented in the field should be documented and included in the final report of the sampling results.

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2.7.1 Soil vapor

Soil vapor probe installations [Figure 2.2] may be permanent, semi-permanent or temporary. In general, permanent or semi-permanent installations are preferred for data consistency reasons and to ensure outdoor air infiltration does not occur. Temporary probes should only be used if measures are taken to ensure that an adequate surface seal is created to prevent outdoor air infiltration and if tracer gas is used at every sampling location. [See Section 2.7.5 for additional information about the use of tracer gas when collecting soil vapor samples.] Soil vapor implants or probes should be constructed in the same manner at all sampling locations to minimize possible discrepancies. The following procedures should be included in any permanent construction protocol:

a. implants should be installed using an appropriate method based on site conditions (e.g., direct push, manually driven, auger — if necessary to attain the desired depth or if sidewall smearing is a concern, etc.);

b. porous, inert backfill material (e.g., glass beads, washed #1 crushed stone, etc.) should be used to create a sampling zone 1 to 2 feet in length;

c. implants should be fitted with inert tubing (e.g., polyethylene, stainless steel, nylon, Teflon®, etc.) of the appropriate size (typically 1/8 inch to 1/4 inch diameter) and of laboratory or food grade quality to the surface;

d. soil vapor probes should be sealed above the sampling zone with a bentonite slurry for a minimum distance of 3 feet to prevent outdoor air infiltration and the remainder of the borehole backfilled with clean material;

e. for multiple probe depths, the borehole should be grouted with bentonite between probes to create discrete sampling zones or separate nested probes should be installed [Figure 2.2]; and

f. steps should be taken to minimize infiltration of water or outdoor air and to prevent accidental damage (e.g., setting a protective casing around the top of the probe tubing and grouting in place to the top of bentonite, sloping the ground surface to direct water away from the borehole like a groundwater monitoring well, etc.).

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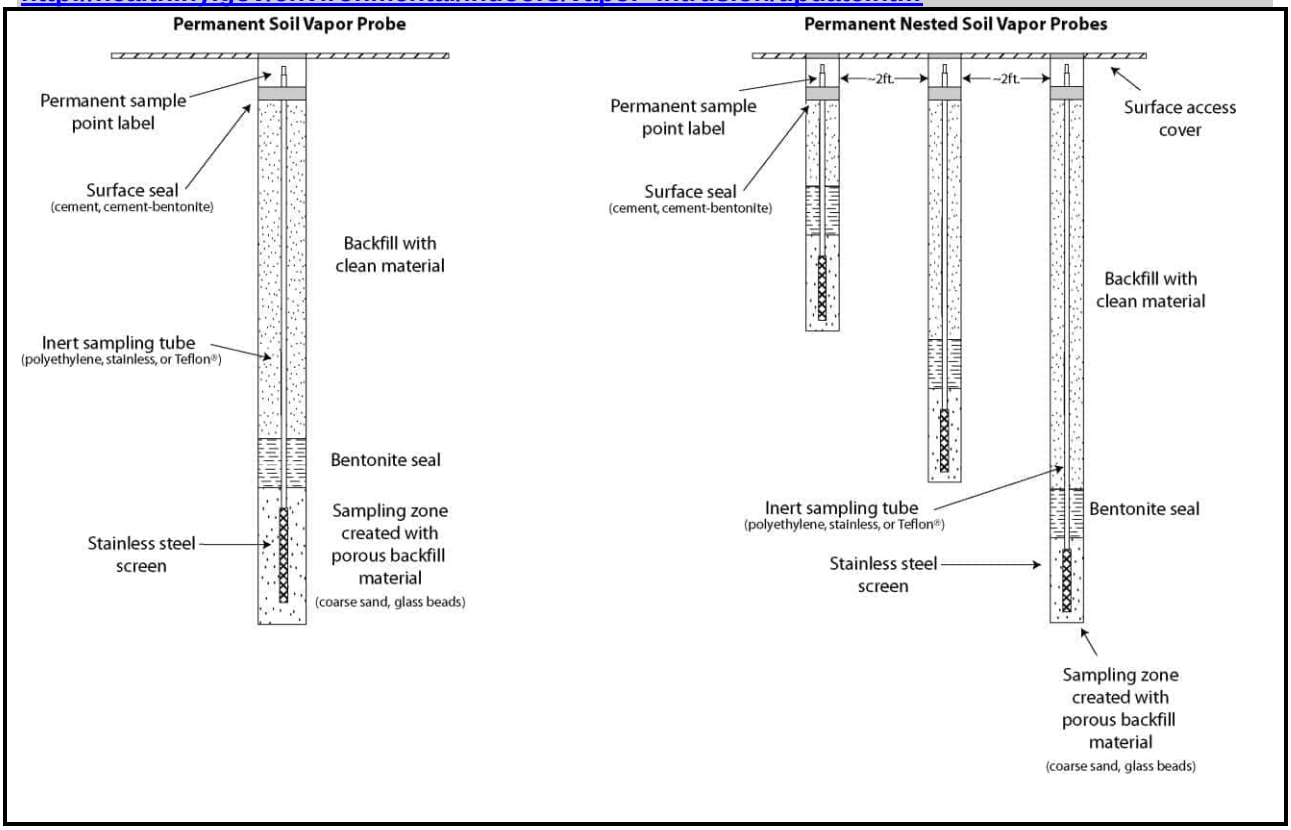


Figure 2.2

Schematics of a generic permanent soil vapor probe
and permanent nested soil vapor probes

[Note: Many variations exist and may be proposed in a work plan. Proposed installations should meet the sampling objectives and requirements of the analytical methods.]

To obtain representative samples and to minimize possible discrepancies, soil vapor samples should be collected in the following manner at all locations:

a. at least 24 hours after the installation of permanent probes and shortly after the installation of temporary probes, one to three implant volumes (i.e., the volume of the sample probe and tube) should be purged prior to collecting the samples;

b. flow rates for both purging and collecting should not exceed 0.2 liters per minute to minimize outdoor air infiltration during sampling;

c. samples should be collected, using conventional sampling methods, in an appropriate container — one which

   i. meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation),

   ii. is consistent with the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and

   iii. is certified clean by the laboratory;

d. sample size depends upon the volume of that will achieve minimum reporting limits [Section 2.9]; and

e. a tracer gas (e.g., helium, butane, sulfur hexafluoride, etc.) should be used when collecting soil vapor samples to verify that adequate sampling techniques are being implemented (i.e., to verify infiltration of outdoor air is not occurring) [Section 2.7.5].

In some cases, weather conditions may present certain limitations on soil vapor sampling. For example, condensation in the sample tubing may be encountered during winter sampling due to low outdoor air temperatures. Devices, such as tube warmers, may be used to address these conditions. Anticipated limitations to the sampling should be discussed prior to the sampling event so appropriate measures can be taken to address these difficulties and produce representative and reliable data.

When soil vapor samples are collected, the following actions should be taken to document local conditions during sampling that may influence interpretation of the results:

a. if sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified;

b. outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (north);

c. weather conditions (e.g., precipitation and outdoor temperature) should be noted for the past 24 to 48 hours; and

d. any pertinent observations should be recorded, such as odors and readings from field instrumentation.

Additional information that could be gathered to assist in the interpretation of the results includes barometric pressure, wind speed and wind direction.

The field sampling team should maintain a sample log sheet summarizing the following:

a. sample identification,

b. date and time of sample collection,

c. sampling depth,

d. identity of samplers,

e. sampling methods and devices,

f. purge volumes,

g. volume of soil vapor extracted,

h. if canisters used, the vacuum before and after samples were collected,

i. apparent moisture content (dry, moist, saturated, etc.) of the sampling zone, and

j. chain of custody protocols and records used to track samples from sampling point to analysis.

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2.7.2 Sub-slab vapor

During colder months, heating systems should be operating to maintain normal indoor air temperatures (i.e., 65 – 75 °F) for at least 24 hours prior to and during the scheduled sampling time. Prior to installation of the sub-slab vapor probe, the building floor should be inspected and any penetrations (cracks, floor drains, utility perforations, sumps, etc.) should be noted and recorded. Probes should be installed at locations where the potential for ambient air infiltration via floor penetrations is minimal.

Sub-slab vapor probe installations [Figure 2.3] may be permanent, semi-permanent or temporary. A vacuum should not be used to remove drilling debris from the sampling port. Sub-slab implants or probes should be constructed in the same manner at all sampling locations to minimize possible discrepancies. The following procedures should be included in any construction protocol:

a. permanent recessed probes should be constructed with brass or stainless steel tubing and fittings;

b. temporary probes should be constructed with inert tubing (e.g., polyethylene, stainless steel, nylon, Teflon®, etc.) of the appropriate size (typically 1/8 inch to 1/4 inch diameter), and of laboratory or food grade quality;

c. tubing should not extend further than 2 inches into the sub-slab material;

d. porous, inert backfill material (e.g., glass beads, washed #1 crushed stone, etc.) should be added to cover about 1 inch of the probe tip for permanent installations; and

e. the implant should be sealed to the surface with non-VOC-containing and non-shrinking products for temporary installations (e.g., permagum grout, melted beeswax, putty, etc.) or cement for permanent installations.

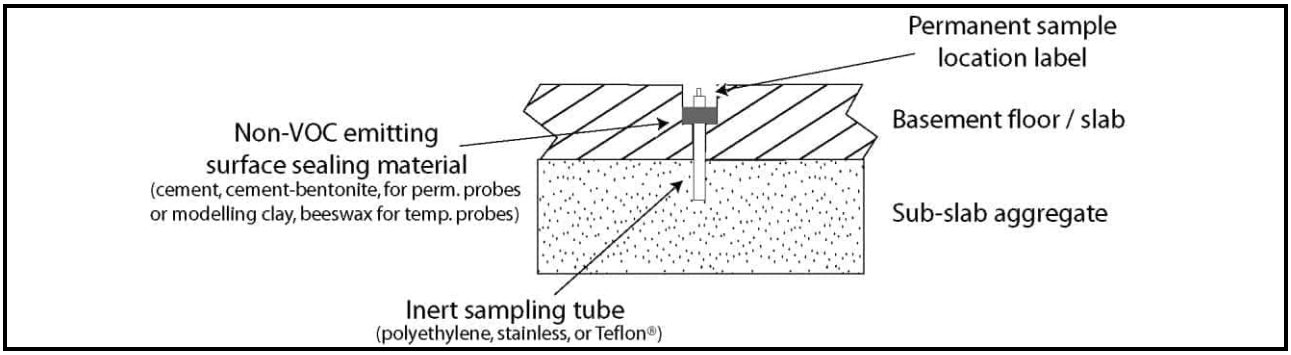


Figure 2.3

Schematic of a generic sub-slab vapor probe

[Note: Many variations exist and may be proposed in a work plan. Proposed installations should meet the sampling objectives and requirements of the analytical methods.]

To obtain representative samples that meet the data quality objectives, sub-slab vapor samples should be collected in the following manner:

a. after installation of the probes, one to three volumes (i.e., the volume of the sample probe and tube) must be purged prior to collecting the samples to ensure samples collected are representative;

b. flow rates for both purging and collecting must not exceed 0.2 liters per minute to minimize ambient air infiltration during sampling; and

c. samples should be collected, using conventional sampling methods, in an appropriate container — one which

    i. meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation),

    ii. is consistent with the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and

    iii. is certified clean by the laboratory;

d. sample size depends upon the volume of that will achieve minimum reporting limits [Section 2.9], the flow rate, and the sampling duration; and

e. ideally, samples should be collected over the same period of time as concurrent indoor and outdoor air samples.

When sub-slab vapor samples are collected, the following actions should be taken to document conditions during sampling and ultimately to aid in the interpretation of the sampling results [Section 3]:

a. historic and current storage and uses of volatile chemicals should be identified, especially if sampling within a commercial or industrial building (e.g., use of volatile chemicals in commercial or industrial processes and/or during building maintenance);

b. the use of heating or air conditioning systems during sampling should be noted;

c. floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, HVAC system air supply and return registers, compass orientation (north), footings that create separate foundation sections, and any other pertinent information should be completed;

d. outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas;

e. weather conditions (e.g., precipitation and indoor and outdoor temperature) and ventilation conditions (e.g., heating system active and windows closed) should be reported; and

f. any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.), should be recorded.

Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected

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contaminant sources and other areas), the barometric pressure and photographs to accompany floor plan sketches.

The field sampling team should maintain a sample log sheet summarizing the following:

a. sample identification,
b. date and time of sample collection,
c. sampling depth,
d. identity of samplers,
e. sampling methods and devices,
f. soil vapor purge volumes,
g. volume of soil vapor extracted,
h. if canisters used, vacuum of canisters before and after samples collected,
i. apparent moisture content (dry, moist, saturated, etc.) of the sampling zone, and
j. chain of custody protocols and records used to track samples from sampling point to analysis.

2.7.3 Indoor air

[Reference: NYSDOH's *Indoor Air Sampling & Analysis Guidance (February 1, 2005)*]

During colder months, heating systems should be operating to maintain normal indoor air temperatures (i.e., 65 – 75 °F) for at least 24 hours prior to and during the scheduled sampling time. If possible, prior to collecting indoor samples, a pre-sampling inspection [Section 2.11.1] should be performed to evaluate the physical layout and conditions of the building being investigated, to identify conditions that may affect or interfere with the proposed sampling, and to prepare the building for sampling. This process is described in Section 2.11.1.

In general, indoor air samples should be collected in the following manner:

a. sampling duration should reflect the exposure scenario being evaluated without compromising the detection limit or sample collection flow rate (e.g., an 8 hour sample from a workplace with a single shift versus a 24 hour sample from a workplace with multiple shifts). To ensure that air is representative of the locations sampled and to avoid undue influence from sampling personnel, samples should be collected for at least 1 hour. If the goal of the sampling is to represent average concentrations over longer periods, then longer duration sampling periods may be appropriate. Typically, 24 hour samples are collected from residential settings;
b. personnel should avoid lingering in the immediate area of the sampling device while samples are being collected;
c. sample flow rates must conform to the specifications in the sample collection method and, if possible, should be consistent with the flow rates for concurrent outdoor air and sub-slab samples; and
d. samples must be collected, using conventional sampling methods, in an appropriate container — one which

i. meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation),

ii. is consistent with the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and

iii. is certified clean by the laboratory.

At sites with tetrachloroethene contamination, passive air monitors that are specifically analyzed for tetrachloroethene (i.e., "perc badges") are commonly used to collect indoor and outdoor air samples. If site characterization activities indicate that degradation products of tetrachloroethene also represent a vapor intrusion concern, perc badges may be used to indicate the likelihood of vapor intrusion (i.e., by using tetrachloroethene as a surrogate) followed, as appropriate, by more comprehensive sampling and laboratory analyses to quantify both tetrachloroethene and its degradation products. Perc badge samples ideally should be collected over a twenty-four hour period, but for no less than eight hours.

The following actions should be taken to document conditions during indoor air sampling and ultimately to aid in the interpretation of the sampling results [Section 3]:

a. historic and current uses and storage of volatile chemicals should be identified, especially if sampling within a commercial or industrial building (e.g., use of volatile chemicals in commercial or industrial processes and/or during building maintenance);

b. a product inventory survey documenting sources of volatile chemicals present in the building during the indoor air sampling that could potentially influence the sample results should be completed [Section 2.11.2];

c. the use of heating or air conditioning systems during sampling should be noted;

d. floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, HVAC system supply and return registers, compass orientation (north), footings that create separate foundation sections, and any other pertinent information should be completed;

e. outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas;

f. weather conditions (e.g., precipitation and indoor and outdoor temperature) and ventilation conditions (e.g., heating system active and windows closed) should be reported; and

g. any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.), should be recorded.

Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected contaminant sources and other areas), the barometric pressure and photographs to accompany floor plan sketches.

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The field sampling team should maintain a sample log sheet summarizing the following:

a. sample identification,
b. date and time of sample collection,
c. sampling height,
d. identity of samplers,
e. sampling methods and devices,
f. depending upon the method, volume of air sampled,
g. if canisters are used, vacuum of canisters before and after samples collected, and
h. chain of custody protocols and records used to track samples from sampling point to analysis.

2.7.4 Outdoor air

Outdoor air samples should be collected simultaneously with indoor air samples to evaluate the potential influence, if any, of outdoor air on indoor air quality. They may also be collected simultaneously with soil vapor samples to identify potential outdoor air interferences associated with infiltration of outdoor air into the sampling apparatus while the soil vapor was collected. To obtain representative samples that meet the data quality objectives, outdoor air samples should be collected in a manner consistent with that for indoor air samples (described in Section 2.7.3).

The following actions should be taken to document conditions during outdoor air sampling and ultimately to aid in the interpretation of the sampling results [Section 3]:

a. outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations, the location of potential interferences (e.g., gasoline stations, factories, lawn movers, etc.), compass orientation (north), and paved areas;
b. weather conditions (e.g., precipitation and outdoor temperature) should be reported; and
c. 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) should be recorded.

2.7.5 Tracer gas

When collecting soil vapor samples as part of a vapor intrusion evaluation, a tracer gas serves as a quality assurance/quality control measure to verify the integrity of the soil vapor probe seal. Without the use of a tracer, there is no way to verify that a soil vapor sample has not been diluted by outdoor air.

Depending on the nature of the contaminants of concern, a number of different compounds can be used as a tracer. Typically, sulfur hexafluoride (SF_6) or helium are used as tracers because they are readily available, have low toxicity, and can be monitored with portable measurement devices. Butane and propane (or other gases) could also be used as a tracer in some situations. Compounds other than those mentioned here may be appropriate, provided they meet project-specific data quality objectives. Where applicable, steps should

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be taken to ensure that the gas used by the laboratory to clean the air sampling container is different from the gas used as a tracer during sampling (e.g., helium).

The protocol for using a tracer gas is straightforward: simply enrich the atmosphere in the immediate vicinity of the area where the probe intersects the ground surface with the tracer gas, and measure a vapor sample from the probe for the presence of high concentrations (> 10%) of the tracer. A cardboard box, a plastic pail, or even a garbage bag can serve to keep the tracer gas in contact with the probe during the testing. If there are concerns about infiltration of ambient air through other parts of the sampling train (such as around the fittings, not just at the probe/ground interface), then consideration should be given to ensuring that the tracer gas is in contact with the entire sampling apparatus. In these cases, field personnel may prefer to use a liquid tracer — soaking paper towels with a liquid tracer and placing the towels around the probe/ground interface, around fittings, and/or in the corner of a shroud.

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

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

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

Figure 2.4 depicts common methods for using tracer gas. In examples a, b and c, the tracer gas is released in the enclosure prior to initially purging the sample point. Care should be taken to avoid excessive purging prior to sample collection. Care should also be taken to prevent pressure build-up in the enclosure during introduction of the tracer gas. Inspection of the installed sample probe, specifically noting the integrity of the surface seal and the porosity of the soil in which the probe is installed, will help to determine the tracer gas setup. Figure 2.4a may be most effective at preventing tracer gas infiltration, however, it may not be appropriate in some situations depending on site-specific conditions. Figures 2.4b and 2.4c may be sufficient for probes installed in tight soils with well-constructed surface seals. Figure 2d provides an example of using a liquid tracer. In all cases, the same tracer gas application should be used for all probes at any given site.

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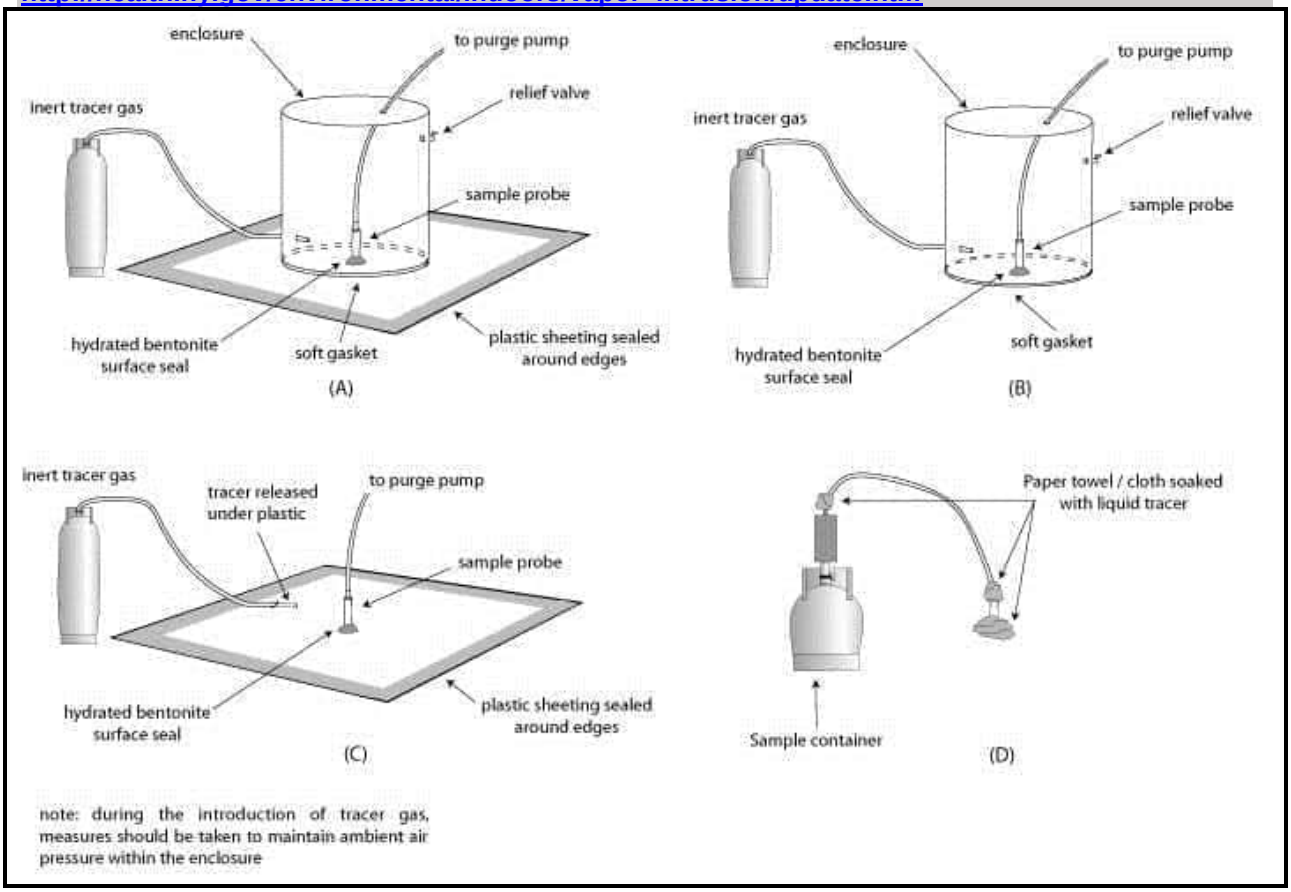


Figure 2.4
Schematics of generic tracer gas applications when collecting soil vapor samples

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

Where permanent or semi-permanent sampling probes are used, tracer gas samples should be collected at each of the sampling probes during the initial stages of a soil vapor sampling program. If the results of the initial samples indicate that the probe seals are adequate, reducing the number of locations at which tracer gas samples are employed may be considered. At a minimum, tracer gas samples should be collected with at least 10% of the soil vapor samples collected in subsequent sampling rounds. When using permanent soil vapor probes as part of a long-term monitoring program, annual testing of the probe integrity is recommended. Where temporary probes are used, tracer gas should be used at every sampling location, every time.

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2.8 Quality assurance/quality control (QA/QC)

[Reference: NYSDOH's *Indoor Air Sampling & Analysis Guidance (February 1, 2005)*]

In general, appropriate QA/QC procedures should be followed during all aspects of sample collection and analysis to ensure that sampling error is minimized and high quality data are obtained. Sampling team members should avoid actions (e.g., fueling vehicles, using permanent marking pens, wearing freshly dry-cleaned clothing or personal fragrances, etc.) which can cause sample interference in the field. Portable air monitoring equipment or field instrumentation should be properly maintained, calibrated and tested to ensure validity of measurements. Air sampling equipment should be stored, transported and between samples decontaminated in a manner consistent with the best environmental consulting practices to minimize problems such as field contamination and cross-contamination. Samples should be collected using certified clean sample devices. Where applicable, steps should be taken to ensure that the gas used by the laboratory to clean the sample device is different from the gas used as a tracer during sampling (e.g., helium). Samples should meet sample holding times and temperatures, and should be delivered to the analytical laboratory as soon as possible after collection. In addition, laboratory accession procedures should be followed, including field documentation (sample collection information and locations), chain of custody, field blanks, field sample duplicates and laboratory duplicates, as appropriate.

Some methods call for collecting samples in duplicate (e.g., indoor air sampling using passive sampling devices for tetrachloroethene) to assess errors. Duplicate and/or split samples should be collected in accordance with the sampling and analytical methods being implemented.

For certain regulatory programs, a Data Usability Summary Report (DUSR) or equivalent report may be required to determine whether or not the data, as presented, meets the site or project specific criteria for data quality and data use. This requirement may dictate the level of QC and the category of data deliverable to request from the laboratory. Guidance on preparing these reports is available by contacting the NYSDEC's Division of Environmental Remediation.

New York State Public Health Law requires laboratories analyzing environmental samples collected from within New York State to have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. If ELAP certification is not currently required for an analyte (e.g., trichloroethene), the analysis should be performed by a laboratory that has ELAP certification for similar compounds in air and uses analytical methods with minimum reporting limits similar to background (e.g., tetrachloroethene via EPA Method TO-15). Questions about a laboratory's current certification status should be directed to an ELAP representative at 518-485-5570 or by email at elap@health.state.ny.us.

The work plan should state that all samples that will be used to make decisions on appropriate actions to address exposures and environmental contamination will be analyzed by an ELAP-certified laboratory. The name of the laboratory should also be provided. Similarly, the name of the laboratory that was used should be included in the report of the sampling results. For samples collected and tested in the field for screening purposes by using field testing technology, the qualifications of the field technician should be documented in the work plan.

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2.9 Analytical methods

[Reference: NYSDOH's *Indoor Air Sampling & Analysis Guidance (February 1, 2005)*]

Proposed analytical procedures should be identified in work plans. Similarly, the analytical procedures that were used and corresponding reporting limits should be identified when reporting the sampling results. When selecting an appropriate analytical method, the data quality objectives should be considered. As described in Section 3, comparing sampling results for volatile chemicals with background concentrations and with indoor air/sub-slab vapor matrices are critical components of the data evaluation process. Therefore, samples should be analyzed by methods that can achieve minimum reporting limits to allow for comparison of the results with background levels and with the levels presented in the matrices [Section 3.4.2]. If there are additional data quality objectives, they should be considered also. Typically, a minimum reporting limit of 1 microgram per cubic meter (1 mcg/m^3) or less is sufficient for most analytes. Examples of commonly used analytical methods include the following:

a. EPA Method TO-15 for a wide range of VOCs (e.g., samples from evacuated canisters),

b. NYSDOH Method 311-9 for tetrachloroethene (i.e., samples from perc badges),

c. EPA Method TO-17 for VOCs (e.g., samples collected with sorbent tubes), and

d. EPA Method TO-15 for VOCs with selective ion monitoring (SIM) (e.g., to achieve minimum reporting limits lower than those achieved with Method TO-15 alone).

The laboratory should verify that they are capable of detecting the appropriate analytes and can report them at the appropriate reporting limit.

2.9.1 Subsurface vapor

Soil vapor and sub-slab vapor samples should be analyzed for a wide range of volatile chemicals during the first round of sampling (at a minimum) — unless it can be demonstrated that an abbreviated or site-specific analyte list is appropriate. This is analogous to analyzing groundwater samples for a suite of compounds (e.g., EPA's target analyte list/target compound list (TAL/TCL) chemicals) during the initial rounds of site characterization. Based on the initial sampling results, development and application of a site-specific analyte list may be considered for analysis of subsequent soil vapor and sub-slab vapor samples.

If a site-specific analyte list is developed, it should include the following:

a. volatile chemicals which have been previously detected in environmental media (e.g., soil, groundwater and air) at the site;

b. volatile chemicals which are known or demonstrated constituents of the contamination in question (e.g., petroleum products or tars from former manufactured gas plants); and

c. expected degradation products of the chemicals mentioned in a or b.

A site-specific analyte list might also include indicator compounds to assist in identifying and differentiating subsurface sources of volatile chemical contamination. The following are examples of indicator compounds that have been included in site-specific analyte lists given the nature of the contamination or type of site:

a. gasoline: benzene, toluene, ethylbenzene, xylenes, trimethylbenzene isomers, individual C-4 to C-8 aliphatics (e.g., hexane, cyclohexane, dimethylpentane, 2,2,4-trimethylpentane, etc.), and appropriate oxygenate additives (e.g., methyl-*tert*-butyl ether, ethanol, etc.);

b. middle distillate fuels (#2 fuel oil, diesel and kerosene): n-nonane, n-decane, n-undecane, n-dodecane, ethylbenzene, xylenes, trimethylbenzene isomers, tetramethylbenzene isomers, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene;

c. manufactured gas plant sites: trimethylbenzene isomers, tetramethylbenzene isomers, thiopenes, indene, indane, and naphthalene;

d. natural gas: propane, propene, butane, iso-butane, methylbutane, and n-pentane with lower levels of higher molecular weight aliphatic, olefinic, and some aromatic compounds; and

e. solvent-using industries: the solvent and its expected degradation products (e.g., tetrachloroethene, trichloroethene, dichloroethene(s), and vinyl chloride).

2.9.2 Indoor air

Indoor and outdoor air samples should be analyzed for a wide range of volatile chemicals if there are no existing data for subsurface vapors — unless it can be demonstrated that an abbreviated or site-specific analyte list is appropriate. If indoor air sampling is appropriate based on the levels of volatile chemicals in subsurface vapors, analysis of indoor air samples specifically for those volatile chemicals may be considered.

2.9.3 Outdoor air

Outdoor air samples should be analyzed in a manner consistent with corresponding indoor air samples.

2.10 Field laboratories and mobile gas chromatographs (GCs)

Use of field laboratories and mobile GCs as screening tools when collecting soil vapor samples may be considered on a site-specific basis. However, without ELAP certification, screening tools such as these are not acceptable when collecting sub-slab vapor, indoor air and outdoor air samples for the purpose of evaluating exposures related to soil vapor intrusion. ELAP certification for a particular laboratory does not indicate mobile laboratory or GC certification. Mobile laboratories and GCs have specific certification requirements through ELAP. Questions regarding a mobile laboratory's certification should be directed to the laboratory itself.

2.11 Surveys and pre-sampling building preparation

[Reference: NYSDOH's *Indoor Air Sampling & Analysis Guidance (February 1, 2005)*]

2.11.1 Pre-sampling building inspection and preparation

A pre-sampling inspection should be performed prior to each sampling event to identify and minimize conditions that may interfere with the proposed testing. The inspection should evaluate the type of structure, floor layout, air flows and physical conditions of the building(s) being studied. This information, along with information on sources of potential

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indoor air contamination [Section 2.11.2], should be identified on a building inventory form. An example of a building inventory form is given in Appendix B. Items to be included in the building inventory include the following:

a. construction characteristics, including foundation cracks and utility penetrations or other openings that may serve as preferential pathways for vapor intrusion;

b. presence of an attached garage;

c. recent renovations or maintenance to the building (e.g., fresh paint, new carpet or furniture);

d. mechanical equipment that can affect pressure gradients (e.g., heating systems, clothes dryers or exhaust fans);

e. use or storage of petroleum products (e.g., fuel containers, gasoline operated equipment and unvented kerosene heaters); and

f. recent use of petroleum-based finishes or products containing volatile chemicals.

Each room on the floor of the building being tested and on lower floors, if possible, should be inspected. This is important because even products stored in another area of a building can affect the air of the room being tested.

The presence and description of odors (e.g., solvent, moldy) and portable vapor monitoring equipment readings (e.g., PIDs, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) should be noted and used to help evaluate potential sources. This includes taking readings near products stored or used in the building. Where applicable, readings should be provided in units that denote the calibration gas (e.g., isobutylene-equivalent ppm, benzene-equivalent ppm, etc.).

Potential interference from products or activities releasing volatile chemicals should be controlled to the extent practicable. Removing the source from the indoor environment prior to testing is the most effective means of reducing interference. Ensuring that containers are tightly sealed may be sufficient. When testing for volatile organic compounds, containers should be tested with portable vapor monitoring equipment to determine whether compounds are leaking. The inability to eliminate potential interference may be justification for not testing, especially when testing for similar compounds at low levels. The investigator should consider the possibility that chemicals may adsorb onto porous materials and may take time to dissipate.

In some cases, the goal of the testing is to evaluate the impact from products used or stored in the building (e.g., pesticide misapplications, school renovation projects). If the goal of the testing is to determine whether products are an indoor volatile chemical contaminant source, the removing these sources does not apply.

Once interfering conditions are corrected (if applicable), ventilation may be appropriate prior to sampling to minimize residual contamination in the indoor air. If ventilation is appropriate, it should be completed 24 hours or more prior to the scheduled sampling time. Where applicable, ventilation can be accomplished by operating the building's HVAC system to maximize outside air intake. Opening windows and doors, and operating exhaust fans may also help or may be appropriate if the building has no HVAC system.

Air samples are sometimes designed to represent typical exposure in a mechanically ventilated building and the operation of HVAC systems during sampling should be noted on the building inventory form [Appendix B]. When samples are collected, the building's HVAC

system should be operating in a manner consistent with normal operating conditions when the building is occupied (e.g., schools, businesses, etc.). Unnecessary building ventilation should be avoided within 24 hours prior to and during sampling. During colder months, heating systems should be operating to maintain normal indoor air temperatures (i.e., 65 – 75 °F) for at least 24 hours prior to and during the scheduled sampling time.

Depending upon the goal of the indoor air sampling, some situations may warrant deviation from the above protocol regarding building ventilation. In such cases, building conditions and sampling efforts should be understood and noted within the framework and scope of the investigation.

To avoid potential interferences and dilution effects, occupants should make a reasonable effort to avoid the following for 24 hours prior to sampling:

a. opening any windows, fireplace dampers, openings or vents;
b. operating ventilation fans unless special arrangements are made;
c. smoking in the building;
d. painting;
e. using a wood stove, fireplace or other auxiliary heating equipment (e.g., kerosene heater);
f. operating or storing automobile in an attached garage;
g. allowing containers of gasoline or oil to remain within the house or garage area, except for fuel oil tanks;
h. cleaning, waxing or polishing furniture, floors or other woodwork with petroleum- or oil-based products;
i. using air fresheners, scented candles or odor eliminators;
j. engaging in any hobbies that use materials containing volatile chemicals;
k. using cosmetics including hairspray, nail polish, nail polish removers, perfume/cologne, etc.;
l. lawn mowing, paving with asphalt, or snow blowing;
m. applying pesticides;
n. using building repair or maintenance products, such as caulk or roofing tar; and
o. bringing freshly dry-cleaned clothing or furnishings into the building.

2.11.2 Product inventory

The primary objective of the product inventory is 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 appropriate to provide detailed information for each individual container of like items. However, it is appropriate to indicate that "20 bottles of perfume" or "12 cans of latex paint" were present with containers in good condition. This information is used to help formulate an indoor environment profile.

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An inventory should be provided for 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.

The presence and description of odors (e.g., solvent, moldy) and portable vapor monitoring equipment readings (e.g., PIDs, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) should be noted and used to help evaluate potential sources. This includes taking readings near products stored or used in the building. Where applicable, readings should be provided in units that denote the calibration gas (e.g., isobutylene-equivalent ppm, benzene-equivalent ppm, etc.).

Products in buildings should be inventoried every time air is tested to provide an accurate assessment of the potential contribution of volatile chemicals. If available, chemical ingredients of interest (e.g., analyte list) should be recorded for each product. If the ingredients are not listed on the label, record the product's exact and full name, and the manufacturer's name, address and telephone number, if available. In some cases, material Safety Data Sheets may be useful for identifying confounding sources of volatile chemicals in air. Adequately documented photographs of the products and their labeled ingredients can supplement the inventory and facilitate recording the information.

2.12 Role of modeling

At sites where there is a potential for human exposures to subsurface contamination due to soil vapor intrusion (as described in Section 2.1), use of modeling as the sole means of evaluating potential exposures should be avoided. The limitations of modeling (e.g., exclusion of preferential migration pathways) introduce uncertainty as to whether human exposure is occurring, in absence of actual field data. Conclusions drawn from modeling should be verified with actual field data. For example, if modeling results indicate indoor air concentrations are predicted to be below applicable guidelines or levels of concern, indoor air and/or sub-slab vapor sampling would be appropriate to verify a conclusion that mitigation or other actions are not needed.

Modeling may, however, be used as a tool in the evaluation process. Examples of situations in which modeling may be used as a tool include, but are not limited to, the following:

a. to help identify potential migration pathways on the basis of site-specific conditions;

b. to estimate potential exposures when field samples cannot be collected (e.g., access to collect the samples is denied or buildings have not yet been constructed over the subsurface contamination); and

c. to identify a preferred order for sampling buildings by predicting expected indoor air concentrations within each of the buildings if there are numerous buildings overlying the subsurface contamination.

Use of any model at a site should be discussed with the agencies prior to the model's development and application. If a model is used, it should incorporate site-specific parameters (e.g., attenuation factors, soil conditions, concentrations of volatile chemicals, depth to subsurface source, characteristics of subsurface source, and foundation slab thickness) as much as possible. Furthermore, both the limitations of the model (e.g., exclusion of preferential migration pathways) and the sensitivity of the variables in the model should be understood and identified with the modeling results.

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Section 3: Data Evaluation and Recommendations for Action

Section 3 describes the process by which data obtained during the investigation are evaluated. The goals of the evaluation are as follows:

a. to determine what volatile chemicals, if any, are present in the investigated media;

b. to identify the likely cause(s) of their presence; and

c. to identify completed and potential human exposures whether actions to address exposures should be taken.

Also discussed are actions typically recommended based on the evaluation. Actions to remediate the source(s) of soil vapor contamination, such as soil excavation or air-sparge/soil vapor extraction systems, are beyond the scope of this guidance and are not included.

3.1 Data quality

Before the data are evaluated, their representativeness and reliability should be verified. To assess analytical errors and the usability of the data, a qualified person should review the analytical data package and all associated QA/QC information to make sure that

a. the data package is complete;

b. holding times have been met;

c. the QC data fall within the protocol limits and specifications;

d. the data have been generated using established and agreed upon analytical protocols;

e. the raw data confirm the results provided in the data summary sheets and QC verification forms; and

f. correct data qualifiers have been used.

As discussed in Section 2.8, for sites in an environmental remediation program (e.g., State Superfund), a DUSR or equivalent report should be generated in accordance with NYSDEC guidance and should be submitted for regulatory review and approval.

If the investigation was not completed in accordance with the guidelines set forth in Section 2, additional investigation may be appropriate to either replace or complement the existing data. For example, product inventories [Section 2.11.2] filled out incompletely or incorrectly may need to be redone (and in some cases with additional air sampling) so that likely sources of volatile chemicals in the indoor air can be identified and appropriate actions to mitigate exposures can be recommended.

3.2 Overview

The results of individual soil vapor, sub-slab vapor, indoor air and outdoor air samples are not reviewed in isolation. Rather, they are evaluated with the consideration of several additional factors, which include the following:

a. the nature and extent of contamination in *all* environmental media;

b. factors that affect vapor migration and intrusion;

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c. completed or proposed remedial actions;

d. sources of volatile chemicals;

e. background levels of volatile chemicals in air;

f. relevant standards, criteria and guidance values; and

g. past, current and future land uses.

These factors are described in detail in this subsection.

3.2.1 Nature and extent of contamination in all environmental media

The type of volatile chemicals present and the extent of contamination in all environmental media — including soil, groundwater, subsurface vapors, indoor air and outdoor air — is considered when evaluating the data. Trends in environmental data (e.g., groundwater monitoring results show concentrations of volatile chemicals are decreasing) are also considered. This information is used to identify possible sources of contamination and migration pathways, as well as to recommend appropriate actions to address exposures.

3.2.2 Factors that affect vapor migration and intrusion

As discussed in Section 1.3, there are numerous site-specific environmental factors [Table 1.1] and building factors [Table 1.2] that can affect soil vapor migration and intrusion. This information is used to identify possible sources of contamination and migration pathways, as well as to recommend appropriate actions to address exposures.

3.2.3 Sources of volatile chemicals

An understanding of the likely sources of the chemicals is crucial for determining appropriate actions to address exposure, as well as identifying the parties responsible for implementing the actions. Volatile chemicals that are not site-related may be present in the investigated media for reasons such as the following:

a. *subsurface vapors* — misuse, misapplication, or improper disposal of the chemicals to the subsurface, unidentified subsurface sources of vapor contamination, presence of septic systems (where products, such as cleaning agents or degreasers, may be disposed), biodegradation of natural organic matter in soil, infiltration into the subsurface from a building under positive pressure in which the chemicals are heavily used (i.e., reverse process from soil vapor intrusion), etc.;

b. *indoor air* — use and storage (current or historic) of volatile chemical-containing products, off-gassing from building materials or new furnishings, use of contaminated groundwater during private well usage, infiltration of outdoor air containing volatile chemicals, etc. [Table 1.3]; and

c. *outdoor air* — emissions from automobiles, lawn mowers, oil storage tanks, gasoline stations, dry cleaners or other commercial/industrial facilities, etc. [Table 1.3].

Site-related chemicals may also be present for these same reasons. Information about household products and their ingredients are available on web sites, such as the National Institute of Health's site at http://householdproducts.nlm.nih.gov.

3.2.4 Background levels of volatile chemicals in air

Chemicals are part of our everyday life [Section 1.4]. As such, they are found in the indoor air of buildings not affected by intrusion of contaminated soil vapor. They are also found in the outdoor air that enters a home or place of business. Commonly found concentrations of these chemicals in indoor and outdoor air are referred to as "background levels." Background levels of volatile chemicals are one of the factors considered when evaluating sampling results at a site [Section 3.3.2 – 3.3.4]. Estimates of background levels come from studies where air samples were collected in homes, offices and outdoor areas.

Several studies have been conducted, both nationally and in the State of New York, to provide information on indoor and outdoor air background levels in a variety of settings (e.g., residential or commercial buildings). Each of these studies offers useful information and has its own limitations. Each database provides statistical measures of background levels and the criteria used to select sampling locations. The criteria in some of the studies required that sampling locations not be located near known sources of volatile chemicals (for example, not near a chemical spill, hazardous waste site, dry-cleaner, or factory). The criteria may also have included checking containers of volatile chemicals in or near the building to make sure they are tightly closed or removing those products before samples are taken. Depending on the criteria for site selection and sampling conditions, statistical measures of background levels in a given study may differ from what would be expected if indoor air were sampled in randomly selected homes.

The background databases that are used for evaluating indoor and outdoor air data are introduced below. A more detailed description of each database along with statistical measures of background levels are provided in Appendix C.

a. *NYSDOH 2003: Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes*
   Results of indoor and outdoor air samples collected from 104 single-family fuel oil heated homes throughout New York State. Samples collected in evacuated canisters and analyzed for 69 aromatic, aliphatic, and halogenated hydrocarbons, and ketones by modified EPA Method TO-15. Limitations: only fuel oil heated homes were included, homes were not randomly selected, and five boroughs of New York City were excluded.

b. *EPA 2001: Building Assessment and Survey Evaluation (BASE) Database*
   Study of measured concentrations of volatile organic compounds from 100 randomly selected public and commercial office buildings. Samples collected by evacuated canisters and/or tube methodologies. Limitations: only represents office settings, two methodologies used for sampling and analysis that are not completely overlapping and do not show agreement in results in some cases.

c. *NYSDOH 1997: Control Home Database*
   Indoor and outdoor air samples compiled from 53 residences in New York State that were considered "control Homes" with neighborhood, construction, and occupancy similar to potentially impacted homes that were being investigated at the time. Limitations: multiple methodologies for sampling and analysis, small sample size, and varying detection limits often higher than current background levels.

d. *EPA 1988: National Ambient Volatile Organic Compounds (VOCs) Data Base Update*
   Published and unpublished air data compiled by the EPA in 1988. The document includes data from studies between 1970 to 1987. The database covers more than

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300 chemicals in indoor and outdoor settings. Limitations: data are compiled from numerous studies with limitations on selection or screening criteria, data are 20-35 years old, indoor air data include both residential and office spaces, sample size for some analytes is very small (less than 10). Outdoor air data include rural, suburban, urban, source dominated and remote locations.

e. *Health Effects Institute (HEI) 2005: Relationship of Indoor, Outdoor, and Personal Air (RIOPA)*

Indoor, outdoor and personal air concentrations of 18 VOCs, 10 carbonyl compounds and particulate matter (PM2.5) were measured in 100 homes in each of 3 cities between the summer of 1999 and the spring of 2001. Limitations: limited numbers of VOCs, passive organic vapor badge method is subject to sampling bias in stationary versus mobile locations, the passive organic vapor badge method is only approved for tetrachloroethene in New York State.

Among the databases, the Upper Fence (see *NOTE below) values from the NYSDOH Fuel Oil Study data may be used as initial benchmarks when evaluating residential indoor air (see Appendix C.1) and the 90th percentile values from the EPA BASE data for indoor air in office and commercial buildings (see Appendix C.2). These initial benchmark values should be considered along with the overall distribution of results in the background database to characterize sampling results from a single building or from multiple buildings in a community. The Health Effects Institute 2005 database and the older NYSDOH and EPA databases can also provide useful information on the range of concentrations found in air. The database or combination of databases that best represents site-specific conditions should be used as the basis for comparison. State agency personnel should review and have the opportunity to comment on the proposed use of other databases or subsets of data within a database for evaluating test results.

*NOTE: The Upper Fence is calculated as 1.5 times the interquartile range (difference between the 25th and 75th percentile values) above the 75th percentile value. It is a boundary estimate used to account for outliers in the data.

3.2.5 Relevant standards, criteria and guidance values

a. *Subsurface vapors*

The State of New York does not have any standards, criteria or guidance values for concentrations of volatile chemicals in subsurface vapors (either soil vapor or sub-slab vapor).

b. *Indoor and outdoor air*

The NYSDOH has developed several guidelines for chemicals in air. The development process is initiated for specific situations. For example, in New York State, particularly in New York City, dry cleaners are often located in apartment buildings. Because air in buildings mixes to some extent and the dry cleaning chemical tetrachloroethene (PCE) is volatile, it may migrate to residential apartments. When the NYSDOH became aware of this problem and how widespread it is, the NYSDOH developed an air guideline for PCE of 100 micrograms per cubic meter (mcg/m^3). In addition to PCE, the NYSDOH has developed guidelines for methylene chloride (also referred to as dichloromethane) and trichloroethene (TCE) in air, as well as dioxin and polychlorinated biphenyls (PCBs) in indoor air. Each guideline went through a peer review process, in which expert scientists outside of the NYSDOH reviewed the technical documentation that describes

the scientific basis for the guidance value. The peer reviewers provided technical comments on the data and methods used to derive the guidelines, each of which were addressed by the NYSDOH. Upon completion of the reviews and responses to comments, the guidelines were finalized.

Air guideline values derived by the NYSDOH are summarized in Table 3.1. Additional information about these guidelines is provided in the following:

- Appendix D — overview of how the NYSDOH develops air guidelines; and
- Appendix H — copies of fact sheets that discuss the air guidelines for PCE and TCE.

The purpose of a guideline is to help guide decisions about the nature of efforts to reduce exposure to the chemical. Reasonable and practical actions should be taken to reduce exposures when indoor air levels are above background, even when they are below the guideline. The urgency to complete these actions increases with indoor air levels, particularly when air levels are above the guideline, and additional actions taken if the initial actions do not sufficiently reduce levels. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended actions is to reduce chemical levels in indoor air to as close to background as practical.

Table 3.1 Air guideline values derived by the NYSDOH

Chemical		Air Guideline Value (mcg/m^3)	Reference
methylene chloride (also referred to as dichloromethane)	MeCl	60	1
polychlorinated biphenyls	PCBs	1*	2,3
tetrachlorodibenzo-*p*-dioxin equivalents	TCDD	0.00001*	3,4
tetrachloroethene	PCE	100	5
trichloroethene	TCE	5	6,7

*The guideline is specific to indoor air.

References:

[1] NYSDOH. 1988. Letter from N. Kim to T. Allen, Division of Air, New York State Department of Environmental Conservation. November 28, 1988.
[2] NYSDOH. 1985. Binghamton State Office Building (BSOB) Re-Entry Guidelines: PCBs. Document 1330P. Albany, NY: Bureau of Toxic Substance Assessment.
[3] NYSDOH. 1988. Letter from D. Axelrod to J. Egan, New York State Office of General Services. March 8, 1988.
[4] NYSDOH. 1984. Re-Entry Guidelines. Binghamton State Office Building. Document 0549P. Albany, NY: Bureau of Toxic Substance Assessment.
[5] NYSDOH. 1997. Tetrachloroethene Ambient Air Criteria Document. Albany, NY: Bureau of Toxic Substance Assessment.
[6] NYSDOH. 2003. Letter from N. Kim to D. Desnoyers, Division of Environmental Remediation, New York State Department of Environmental Conservation. October 31, 2003. [Provided in Appendix D.]
[7] NYSDOH. 2006. Final Report: Trichloroethene (TCE) Air Criteria Document. Center for Environmental Health, Bureau of Toxic Substance Assessment. Troy, NY.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

3.2.6 Completed or proposed remedial actions

The status and effectiveness of actions taken to remediate environmental contamination (e.g., soil removal, groundwater treatment, soil vapor extraction, etc.) are considered when making decisions pertaining to additional sampling and the selection of mitigation actions. For example,

a. if a comparison of pre-remediation and post-remediation subsurface vapor sampling results indicates negligible improvement in the quality of subsurface vapors,

    1. additional sampling may be appropriate to document a decreasing trend in subsurface vapor concentrations;

    2. termination of mitigation system operations may not be appropriate without additional sampling; or

    3. additional remedial actions may be appropriate to address contaminated subsurface vapors;

b. when monitoring a building is appropriate, it may be more cost-effective to install a mitigation system if subsurface contamination is wide-spread and is expected to take many years to remediate; and

c. if exposures in an on-site building will be addressed concurrently by a method selected to remediate subsurface contamination (e.g., a soil vapor extraction system), installation of a mitigation system may be redundant. However, if the remedial system is not expected to be operational in the immediate future, or if it is not expected to mitigate indoor air levels in a reasonable time frame, a mitigation system may still be appropriate. [Refer to Section 4.1 for a description of the appropriate use of concurrent techniques.]

3.2.7 Past, current and future land uses

Past, current and future land uses are considered when evaluating the investigation data and determining appropriate actions for further investigation or measures to address exposures. For example,

a. if the parcel or buildings were historically used for commercial or industrial purposes (e.g., gasoline station, automotive repair facility, electroplating facility, etc.), but are currently used for residential purposes or commercial or industrial purposes where volatile chemicals are not used in current operations, off-gassing of volatile chemicals from building materials [Table 1.3] or additional subsurface sources should be considered;

b. subsurface vapor sampling of a parcel that is undeveloped or contains unoccupied buildings may be appropriate based on the data evaluation. However, sampling may be delayed as discussed in Section 2.3;

c. air sampling of a building may be appropriate based on the data evaluation. However, provisions may be put in place to defer sampling until occupancy of the building is expected; or

d. if actions should be taken to mitigate exposures related to soil vapor intrusion should the site be developed, the appropriate mitigation method will depend upon the proposed land use — a parking lot, recreational field, single-family home, commercial building, high-rise building with underground parking, occupied or unoccupied building, etc. — since each presents a different exposure scenario.

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3.3 Sampling results and recommended actions

This subsection describes the process for evaluating sampling results. It also describes actions that may be recommended based on the evaluation. The evaluation procedures and actions described may not be directly applicable to samples collected as part of an emergency response. For guidance on how to proceed in such situations, refer to Section 3.5.

3.3.1 Soil vapor

If soil vapor samples are collected from locations where there are no known sources of volatile chemicals, we do not expect the chemicals to reach detectable levels in the samples. However, concentrations of volatile chemicals in soil vapor are commonly detected. This is likely due to several factors, including infiltration of outdoor air into the subsurface (to a limited extent) and background interferences (similar to indoor and outdoor air [Section 3.2.4]).

New York State currently does not have any standards, criteria or guidance values for concentrations of compounds in soil vapor. Additionally, there are currently no databases available of background levels of volatile chemicals in soil vapor. In the absence of this information, soil vapor sampling results are reviewed "as a whole," in conjunction with the results of other environmental sampling and the site conceptual model, to identify trends and spatial variations in the data [Section 3.2.1]. To put some perspective on the data, soil vapor results might be compared to background outdoor air levels [Section 3.2.4], site-related outdoor air sampling results, or the NYSDOH's guidelines for volatile chemicals in air [Table 3.1].

These comparisons are used to

a. identify areas of relatively elevated concentrations of volatile chemicals in soil vapor;
b. select buildings for sub-slab vapor, indoor air and outdoor air sampling;
c. identify possible sources of subsurface vapor contamination;
d. monitor the progress, or verify the completion, of efforts to remediate subsurface vapor contamination (either directly or indirectly); and
e. characterize the nature and extent of subsurface vapor contamination.

When determining appropriate actions, the following should also be considered:

a. Soil vapor results may not indicate a traditional plume-like pattern of contamination (as is often described for groundwater). Rather, the nature and extent of contamination may follow a "hit and miss" pattern.

b. Our experience to date indicates soil vapor results alone typically cannot be relied upon to rule out sampling at nearby buildings. For example, concentrations of volatile chemicals in sub-slab vapor samples have been substantially higher (e.g., by a factor of 100 or more) than concentrations found in nearby soil vapor samples (e.g., collected at 8 feet below grade near the building). This may be due to differences in factors such as soil moisture content and pressure gradients. Therefore, exposures are evaluated primarily based on sub-slab vapor, indoor air and outdoor air sampling results and soil vapor results are primarily used as a tool to guide these investigations.

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There are no concentrations of volatile chemicals in soil vapor that automatically trigger action or no further action. Based on the comparisons and considerations described, the following actions may be recommended:

a. *No further soil vapor sampling*

The nature and extent of subsurface vapor contamination has been adequately characterized with respect to addressing exposures and designing measures to remediate subsurface vapor contamination (either directly or indirectly).

Sub-slab vapor samples, rather than soil vapor samples, will be used to identify potential exposures and to characterize the nature and extent of subsurface vapor contamination since soil vapor results are not following a consistent pattern (i.e., hit and miss).

b. *Additional soil vapor sampling*

To characterize the nature and extent of subsurface vapor contamination if soil vapor results are following a consistent pattern (e.g., traditional plume-like pattern).

To identify possible sources of subsurface vapor contamination.

To verify sampling results that appear inconsistent with previous sampling and/or the current understanding of the site [Sections 3.2.1 and 3.2.2].

To resample locations where results may have been invalidated by short-circuiting (outdoor air infiltration), cross contamination, or other problems.

To monitor the progress, or verify the completion, of efforts to remediate subsurface vapor contamination (either directly or indirectly).

c. *Sub-slab vapor, indoor air and outdoor air sampling*

Generally, if soil vapor results are fairly consistent throughout the study area, buildings closest to the site are sampled first. The investigation then proceeds outward, as appropriate, on an areal basis until potential and current human exposures have been adequately addressed. If there is an area of relatively elevated concentrations of volatile chemicals in soil vapor (when looking at the soil vapor results as a whole), then the buildings in this area are also sampled.

d. *Address exposures related to soil vapor intrusion*

Provisions on parcels may be appropriate so that the parcel will not be developed or buildings occupied without addressing exposure concerns [Sections 2.3 and 3.6].

As discussed previously, soil vapor sampling results alone typically do not drive actions to mitigate exposures in existing buildings. Rather, they guide sampling efforts in buildings. However, a "blanket mitigation" approach may be taken provided the nature and extent of soil vapor contamination has been sufficiently characterized. A "blanket mitigation" approach is where an area is defined within which each building may be offered a mitigation system. The offer is made regardless of what actions may be appropriate based on an evaluation of air results (e.g., no further action or monitoring).

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Notes:

a. The recommended actions may be modified or supported upon consideration of the factors given in Section 3.2.

b. Additional sampling may become appropriate based on the migration of subsurface contamination (e.g., contaminated groundwater or vapors) or if environmental monitoring indicates a change in chemical constituents (e.g., the production of degradation products that may be more toxic than the parent compounds).

3.3.2 Sub-slab vapor

The goals of collecting sub-slab vapor samples are to identify potential and current (when collected concurrently with indoor and outdoor air samples) exposures associated with soil vapor intrusion and to characterize the nature and extent of subsurface vapor contamination. As discussed in Sections 3.2.5 and 3.3.1, New York State currently does not have any standards, criteria or guidance values for concentrations of compounds in sub-slab vapor. Additionally, there are no databases available of background levels of volatile chemicals in subsurface vapors.

The detection of volatile chemicals in sub-slab vapor samples does not necessarily indicate soil vapor intrusion is occurring or actions should be taken to address exposures. When making these decisions, the State considers the following:

a. the sampling results — sub-slab vapor, indoor air, outdoor air, soil vapor;

b. background concentrations of volatile chemicals in indoor air;

c. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];

d. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air;

e. attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations),

f. the NYSDOH's decision matrices [described in Section 3.4], and

g. the factors described in Section 3.2.

Based on this evaluation, the following actions may be recommended:

a. *No further action*

When the volatile chemical is not detected in the indoor air and sub-slab sample results are not expected to substantially affect indoor air quality.

b. *Take reasonable and practical actions to identify source(s) and reduce exposures*

The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

c. *Resampling*

Resampling may also be recommended when the results are not consistent with the conceptual site model. For example, when the sub-slab vapor results of a building do not indicate a need to take action, but the sub-slab vapor results of adjacent buildings indicate a need to take actions to address exposures related to soil vapor intrusion.

Resampling may be appropriate if samples were collected outside of the heating season. As discussed in Section 2.4.2, results obtained outside of the heating season should not be used to rule out exposures related to soil vapor intrusion.

d. *Monitoring*

Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, may be recommended to determine whether concentrations in indoor air or sub-slab vapor have changed. It is also recommended to determine what affect, if any, active soil and groundwater remediation techniques (e.g., chemical oxidation, air sparging, etc.) may be having on subsurface vapor and indoor air quality. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions.

e. *Mitigate*

Mitigation may be appropriate to minimize current or potential exposures associated with soil vapor intrusion. Mitigation methods are described in Section 4.

Notes:

a. The recommended actions may be modified or supported upon consideration of the factors given in Section 3.2.

b. Additional sampling may be appropriate based on the migration of subsurface contamination (e.g., contaminated groundwater or vapors) or if environmental monitoring indicates a change in chemical constituents (e.g., the production of degradation products that may be more toxic than the parent compounds).

c. Monitoring and mitigation measures to address exposures related to soil vapor intrusion are considered interim measures implemented until contaminated environmental media (e.g., soil, groundwater and/or soil vapor) are remediated.

d. Actions more protective of human health may be proposed. For example, such a decision may be based on a comparison of the costs associated with resampling or monitoring to the costs associated with installation and monitoring of a mitigation system.

e. Additional sampling associated with post-mitigation testing, operation, maintenance and monitoring activities, and termination of mitigation system operations is described in Section 4.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

3.3.3 Indoor air

Indoor air samples are used to assess current exposures to volatile chemicals in air. The detection of volatile chemicals in indoor air samples does not necessarily indicate soil vapor intrusion is occurring or actions should be taken to address exposures. When making these decisions, the State considers the following:

a. the sampling results — sub-slab vapor, indoor air, outdoor air, soil vapor;

b. background concentrations of volatile chemicals in indoor air;

c. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];

d. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air;

e. attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations), and

f. the NYSDOH's decision matrices [described in Section 3.4], and

g. the factors described in Section 3.2.

When evaluating indoor air data, the results are compared to background levels of volatile chemicals in indoor air [Section 3.2.4], the NYSDOH's guidelines for volatile chemicals in air [Table 3.1], the NYSDOH's decision matrices [Section 3.4], and human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air. This helps to put the results into perspective and to determine the need for action and the urgency with which actions should be taken. As discussed in Section 3.2.5, the urgency to complete reasonable and practical actions to reduce exposures increases with indoor air levels, particularly when air levels are above a guideline.

Generally, if the results are comparable to background levels, then no further action is needed to address *current* human exposures. However, additional sampling may be appropriate if

a. samples were collected at times when vapor intrusion is not expected to have its greatest effect on indoor air quality (typically, samples collected outside of the heating season). As discussed in Section 2.4, these results may not be used to rule out exposures related to soil vapor intrusion;

b. the potential for exposures related to soil vapor intrusion should be monitored based on the sub-slab vapor results [Section 3.3.2]; and/or

c. subsurface conditions change over time (e.g., due to the migration of contaminated groundwater or vapors).

If the concentrations of volatile chemicals are not consistent with background levels, then the likely cause of the exposure should be determined. Understanding the source is crucial for selecting the best method to address exposures. For example, although a volatile chemical may be detected in the sub-slab vapor sample, the results may indicate that indoor air effects are more likely to be coming from products stored in the building or from outdoor air rather than from contaminated soil vapors. Therefore, a sub-slab depressurization system to minimize exposures associated with soil vapor intrusion may not be appropriate.

As discussed in Sections 1.4 and 3.2.3, volatile chemicals may be present in the indoor air due to any one, or a combination, of the following:

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

a. the indoor environment itself and/or building characteristics;

b. off-gassing of volatile chemicals from contaminated water that may enter the building at the tap or shower head, or during flooding events, or contaminated water that rests in a sump or a subsurface drain;

c. outdoor sources; and/or

d. migration from the subsurface (i.e., soil vapor intrusion).

To determine the likely cause, the following assessment is completed:

a. qualitative and quantitative comparisons are made between the types and concentrations of the contaminants found in the indoor air sample(s) and those found in the outdoor air and sub-slab vapor sample;

b. qualitative and quantitative comparisons are made between indoor air results obtained in different locations of the building (e.g., different floors or rooms);

c. indoor air results are compared to the product inventory to evaluate the extent to which indoor sources are affecting indoor air quality; and

d. the indoor air quality questionnaire and building inventory form is reviewed to identify potential preferential pathways for soil vapor intrusion into the building, potential outdoor sources of volatile chemicals to the outdoor air (e.g., gasoline station or dry cleaner), and routes of air distribution within the building (e.g., HVAC system operations, airflow observations, etc.).

If a likely source or multiple sources can be identified from the available information, one or more of the following actions may be recommended given the source:

a. *Indoor source or building characteristics*

Products containing volatile chemicals should be tightly capped. Alternatively, the products can be stored in places where people do not spend much time, such as a garage or outdoor shed. If the products are no longer needed, consideration should be given to disposing of them properly (e.g., hazardous waste cleanup days). The list of products and corresponding readings from field instrumentation provided in the product inventory [Appendix B] can help identify products that may be contributing to the levels that were detected in the indoor air.

If exposures are assumed to be associated with off-gassing of new building materials, paint, etc., resampling may be appropriate to confirm this assumption or to confirm that actions taken to address these exposures have been effective.

b. *Off-gassing from contaminated groundwater within the building*

Measures should be taken to prevent contaminated groundwater from entering the house (e.g., filter on private well supply, sealed sump, etc.).

c. *Outdoor source*

No further action to address exposures related to soil vapor intrusion, unless the evaluation for soil vapor intrusion cannot be completed until outdoor interferences are addressed.

d. *Soil vapor intrusion*

Depending upon the relationship between indoor air concentrations and sub-slab vapor concentrations and the results of environmental sampling in the area, resampling, monitoring or mitigation may be recommended by the State.

1. Resampling, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, may be recommended when the results are not consistent with the conceptual site model. For example, when indoor air results are comparable or higher than the corresponding sub-slab vapor results and the results do not appear to be due to building characteristics or alternate sources (either indoor or outdoor).

2. Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, may be recommended to determine whether concentrations in indoor air or sub-slab vapor have changed. It is also recommended to determine what affect, if any, active soil and groundwater remediation techniques (e.g., chemical oxidation, air sparging, etc.) may be having on subsurface vapor and indoor air quality. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions.

3. Methods to mitigate exposures related to soil vapor intrusion are described in Section 4.

The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

Likely sources may not be evident given the information available. Therefore, the above recommendations cannot be made. This situation most often arises for the following reasons:

a. Interfering indoor sources are identified. However, the possibility of vapor intrusion cannot be ruled out due to the concentrations of the same volatile chemicals detected in the sub-slab vapor sample. Differentiating the contribution of each source is not possible.

b. Indoor air samples were collected without concurrent outdoor air and sub-slab vapor samples. Depending upon other information that may be available (e.g., building inventory and well-characterized subsurface vapor contamination), identifying likely sources and recommending appropriate actions may not be possible.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

c. All appropriate air samples are collected. However, the indoor air quality questionnaire and building inventory forms are filled out incompletely or incorrectly. The contribution of indoor sources cannot be evaluated.

When the source(s) of volatile chemicals to indoor air cannot be identified with confidence, resampling is typically recommended with corrections made as appropriate. For example, using the three scenarios presented above:

a. resampling occurs after interferences are removed;

b. concurrent indoor air, outdoor air and sub-slab vapor samples are collected; and

c. an indoor air quality questionnaire and building inventory form is filled out completely and correctly when samples are collected.

Notes: See notes presented in Section 3.3.2.

3.3.4 Outdoor air

Outdoor air sampling results are primarily used to evaluate the extent to which outdoor air may be contributing to the levels of volatile chemicals detected in indoor air. However, people are also exposed to the outdoor air and the outdoor air results are indicative of outdoor air conditions. As such, outdoor air results are also reviewed to determine whether outdoor air conditions present a potential concern that requires further investigation.

As discussed in Sections 1.4 and 3.2.3, volatile chemicals may be present in outdoor air due to emissions from automobiles, lawn mowers, oil storage tanks, gasoline stations, and dry cleaners or other commercial and industrial facilities. To determine what extent, if any, outdoor air is affecting indoor air quality, indoor air results are compared to outdoor air results. To determine whether outdoor air conditions present a potential concern that requires further investigation, the State looks at the data set as a whole and considers the following:

a. background concentrations of volatile chemicals in outdoor air;

b. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];

c. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air; and

d. the factors described in Section 3.2.

3.4 Decision matrices

3.4.1 Overview

Decision matrices are risk management tools, developed by the NYSDOH in conjunction with other agencies, to provide guidance on a case-by-case basis about actions that should be taken to address current and potential exposures related to soil vapor intrusion. The matrices are intended to be used when evaluating the results from buildings with full slab foundations. The matrices encapsulate the data evaluation processes and actions recommended to address exposures discussed in Sections 3.3.2 and 3.3.3. The general format of a decision matrix is shown in Table 3.2.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Table 3.2 General format of a decision matrix

	Indoor Air Concentration of Volatile Chemical (mcg/m³)		
Sub-slab Vapor Concentration of Volatile Chemical (mcg/m³)	Concentration Range 1	Concentration Range 2	Concentration Range 3
Concentration Range 1	ACTION	ACTION	ACTION
Concentration Range 2	ACTION	ACTION	ACTION
Concentration Range 3	ACTION	ACTION	ACTION

Indoor air and sub-slab vapor concentration ranges in a matrix are selected based on a number of considerations in addition to health risks. For example, factors that are considered when selecting the ranges include, but are not limited to, the following:

a. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air;
b. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];
c. background concentrations of volatile chemicals in air [Section 3.2.4];
d. analytical capabilities currently available; and
e. attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations).

3.4.2 Matrices

The NYSDOH has developed two matrices, which are included at the end of Section 3.4, to use as tools in making decisions when soil vapor may be entering buildings. The first decision matrix was originally developed for TCE and the second for PCE. As summarized in Table 3.3, four chemicals have been assigned to the two matrices to date.

Table 3.3 Volatile chemicals and their decision matrices

Chemical	**Soil Vapor/Indoor Air Matrix***
Carbon tetrachloride	Matrix 1
Tetrachloroethene (PCE)	Matrix 2
1,1,1-Trichloroethane (1,1,1-TCA)	Matrix 2
Trichloroethene (TCE)	Matrix 1

*The decision matrices are available at the end of Section 3.4.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Because the matrices are risk management tools and consider a number of factors, the NYSDOH intends to assign chemicals to one of these two matrices, if possible. For example, if a chemical other than those already assigned to a matrix is identified as a chemical of concern during a soil vapor intrusion investigation, assignment of that chemical into one of the existing decision matrices will be considered by the NYSDOH. Factors that will be considered in assigning a chemical to a matrix include, but are not limited to, the following:

a. human health risks, including such factors as a chemical's ability to cause cancer, reproductive, developmental, liver, kidney, nervous system, immune system or other effects, in animals and humans and the doses that may cause those effects;

b. the data gaps in its toxicologic database;

c. background concentrations of volatile chemicals in indoor air [Section 3.2.4]; and

d. analytical capabilities currently available.

If the NYSDOH determines that the assignment of the chemical into an existing matrix is inappropriate, then the NYSDOH will either modify an existing matrix or develop a new matrix.

To use the matrices appropriately as a tool in the decision-making process, the following should be considered:

a. The matrices are generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).

b. Indoor air concentrations detected in samples collected from the building's basement or, if the building has a slab-on-grade foundation, from the building's lowest occupied living space should be used.

c. Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.

d. When current exposures are attributed to sources other than vapor intrusion, the agencies should be provided documentation(e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix and to support assessment and follow-up by the agencies.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

3.4.3 Description of recommended actions

Actions recommended in the matrix are based on the relationship between sub-slab vapor concentrations and corresponding indoor air concentrations. They are intended to address both potential and current human exposures and include the following:

a. *No further action*

When the volatile chemical is not detected in the indoor air sample and the concentration detected in the corresponding sub-slab vapor sample is not expected to substantially affect indoor air quality.

b. *Take reasonable and practical actions to identify source(s) and reduce exposures*

The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile chemical-containing products in places where people do not spend much time, such as a garage or shed). Resampling may also be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

d. *Monitor*

Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is appropriate to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be appropriate to determine whether existing building conditions (e.g., positive pressure HVAC systems) are maintaining the desired mitigation endpoint and to determine whether changes are appropriate.

The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions.

e. *Mitigate*

Mitigation is appropriate to minimize current or potential exposures associated with soil vapor intrusion. Methods to mitigate exposures related to soil vapor intrusion are described in Section 4.

f. *Monitor / Mitigate*

Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Soil Vapor/Indoor Air Matrix 1

October 2006

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m³)			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m³)	< 0.25	0.25 to < 1	1 to < 5.0	5.0 and above
< 5	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
5 to < 50	5. No further action	6. MONITOR	7. MONITOR	8. MITIGATE
50 to < 250	9. MONITOR	10. MONITOR / MITIGATE	11. MITIGATE	12. MITIGATE
250 and above	13. MITIGATE	14. MITIGATE	15. MITIGATE	16. MITIGATE

No further action:
Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

Take reasonable and practical actions to identify source(s) and reduce exposures:
The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

MONITOR:
Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MITIGATE:
Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MONITOR / MITIGATE:
Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

ADDITIONAL NOTES FOR MATRIX 1

This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 0.25 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended for buildings with full slab foundations, and 1 microgram per cubic meter for buildings with less than a full slab foundation.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Soil Vapor/Indoor Air Matrix 2

October 2006

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 3	3 to < 30	30 to < 100	100 and above
< 100	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
100 to < 1,000	5. MONITOR	6. MONITOR / MITIGATE	7. MITIGATE	8. MITIGATE
1,000 and above	9. MITIGATE	10. MITIGATE	11. MITIGATE	12. MITIGATE

No further action:
Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

Take reasonable and practical actions to identify source(s) and reduce exposures:
The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

MONITOR:
Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MITIGATE:
Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MONITOR / MITIGATE:
Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

ADDITIONAL NOTES FOR MATRIX 2

This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 3 micrograms per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

3.5 Emergency response

The NYSDOH's staff are responsible for recommending that residents relocate in cases where there may be health risks resulting from exposure to petroleum spills. These roles and responsibilities are outlined in Environmental Health Manual Technical Reference and Procedural Items BTSA-01. Air sampling is appropriate in some cases for demonstrating that spill cleanup and engineering controls have been effective in reducing indoor air impacts and associated health risks to residents. At a minimum, air samples are collected from the basement, first floor and from outdoors. Whether sub-slab or soil gas samples will be taken is evaluated on a case-by-case basis. Air testing data are sometimes used as the basis for ending emergency relocation financial support. For additional information, please contact the NYSDOH's Bureau of Toxic Substance Assessment by calling 1-800-458-1158.

Emergency actions not related to petroleum spills are handled on a case-by-case basis.

3.6 Parcels that are undeveloped or contain unoccupied buildings

If investigation of a parcel that is undeveloped or contains unoccupied buildings is being delayed until the site is being developed or occupied, measures should be in place that assure the State that no development or occupation will occur without addressing the exposures. Institutional controls may be used for this purpose. An institutional control is any non-physical means of enforcing a restriction on the use of real property that

a. limits human or environmental exposure,

b. provides notice to potential owners, operators or members of the public, or

c. prevents actions that would interfere with the effectiveness of remedial actions or with the effectiveness and/or integrity of operation, maintenance or monitoring activities at a site.

An institutional control that is often used is an environmental easement. An environmental easement is an enforced mechanism used for property where the remedial actions leave residual contamination that makes the property suitable for some, but not all uses, or includes engineering controls that must be maintained for the easement to be effective. The purpose of the easement is to ensure that such use restrictions or engineering controls remain in place. An environmental easement

a. can only be created by the property owner (the *grantor*) through a written instrument recorded in the appropriate county recording office. It can only be granted to the State (the *grantee*) and can only be extinguished or amended by a written instrument executed by the Commissioner of the Department of Environmental Conservation and duly recorded;

b. is binding upon all subsequent owners and occupants of the property. The deed or deeds for the property (as well as any other written instruments conveying any interest in the property) must contain a prominent notice that it is subject to an environmental easement; and

c. may be enforced in perpetuity against the *grantor*, subsequent owners of the property, lessees, and any person using the property by its grantor, by the State, or by the municipality in which the property is located.

If these actions cannot be implemented, alternative measures should be in place that assure the State that the parcel will not be developed or buildings occupied without addressing the exposure concerns. For example, arrangements should be made for the town, village or city

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
to notify the appropriate party when new construction or tenants are proposed for the parcel (e.g., permit applications and grants) or ownership of the parcel changes.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Section 4: Soil Vapor Intrusion Mitigation

As discussed in Section 1.1, soil vapor can enter a building through cracks or perforations in slabs or basement floors and walls, and through openings around sump pumps or where pipes and electrical wires go through the foundation primarily because of a difference between interior and exterior pressures. This intrusion is similar to how radon gas enters buildings from the subsurface. Fortunately, given this similarity, well-established techniques for mitigating exposures to radon may also be used to mitigate exposures related to soil vapor intrusion.

Once it is determined that steps should to be taken to address exposures associated with soil vapor intrusion, they should be implemented with all due expediency. This section provides an overview of:

a. methods of mitigation,
b. installation and design of mitigation systems,
c. post-mitigation testing,
d. operation, maintenance and monitoring of mitigation systems,
e. termination of mitigation system operations, and
f. annual certification.

Mitigation is considered to be an interim measure to address exposures until contaminated environmental media are remediated, or until mitigation is no longer needed to address exposures related to soil vapor intrusion.

4.1 Methods of mitigation

The most effective mitigation methods involve sealing infiltration points and actively manipulating the pressure differential between the building's interior and exterior (on a continuous basis). As discussed in the following subsections, the appropriate method to use will largely depend upon the building's foundation design. Furthermore, buildings having more than one foundation design feature (e.g., a basement under one portion of the house and a crawl space beneath the remainder) may require a combination of mitigation methods. This section describes methods of mitigation that are expected to be the most reliable options under a wide range of circumstances. Occasionally, there are site-specific or building-specific conditions under which alternative methods (such as HVAC modification, sealing, room pressurization, passive ventilation systems, or vapor barriers) may be more appropriate. Such mitigation proposals may be considered on a case-by-case basis.

4.1.1 Buildings with a basement slab or slab-on-grade foundation

In conjunction with *sealing* potential subsurface vapor entry points, an active *sub-slab depressurization system* (SSD system) is the preferred mitigation method for buildings with a basement slab or slab-on-grade foundation. A SSD system uses a fan-powered vent and piping to draw vapors from the soil beneath the building's slab (i.e., essentially creating a vacuum beneath the slab) and discharge them to the atmosphere. This results in lower sub-slab air pressure relative to indoor air pressure, which prevents the infiltration of sub-slab vapors into the building.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

The most common approach to achieving depressurization beneath the slab is to insert the piping through the floor slab into the crushed rock or soil underneath. However, the EPA, in their "Consumer's Guide to Radon Reduction" (EPA 402-K-03-002; revised February 2003), lists the following approaches as ways to reduce radon levels in a building, either in place of the more common sub-slab suction point method or in conjunction with that method:

a. *Drain tile suction* — Some houses have drain tiles or perforated pipe to direct water away from the foundation of the house. Suction on these tiles or pipes is often effective;

b. *Sump hole suction* — If the building has a sump pump to remove unwanted water, the sump can be capped so that it can continue to drain water and serve as the location for piping. If the sump is not used as the suction or extraction point, the associated wiring and piping should be sealed and an air-tight cover should be installed to enhance the performance of the SSD system; and

c. *Block wall suction* — If the building has hollow block foundation walls, the void network within the wall may be depressurized by drawing air from inside the wall and venting it to the outside. This method is often used in combination with sub-slab depressurization.

The depressurization approach, or combination of approaches, selected for a building should be determined on a building-specific basis due to building-specific features that may be conducive to a specific depressurization approach. For example, if the contaminants are entering the building through a block wall, block wall suction in conjunction with traditional sub-slab depressurization may be more effective at minimizing exposures related to soil vapor intrusion rather than sub-slab depressurization alone.

Although sealing is not a reliable mitigation technique on its own, it can significantly improve the effectiveness of a SSD system since it limits the flow of subsurface vapors into the building. All joints, cracks and other penetrations of slabs, floor assemblies and foundation walls below or in contact with the ground surface should be sealed with materials that prevent air leakage.

If the State concurs that a SSD system is not a practicable alternative or that exposures will be mitigated concurrently by a method selected to remediate subsurface contamination, alternative mitigation methods may be considered, such as the following:

a. *HVAC modification* — a technique where the building's HVAC system is modified to avoid depressurization of the building relative to underlying and surrounding soil (i.e., to maintain a positive pressure within the building); and

b. S*oil vapor extraction (SVE) system* — a technique used to remediate contaminated subsurface soil vapor. SVE systems use high flow rates, induced vacuum or both to collect and remove contamination, while SSD systems use a minimal flow rate to effect the minimum pressure gradient (see the EPA's technical guidance documents for recommended gradients; Section 4.2.3) needed to reverse air flow across a building's foundation. Depending upon the SVE system's design, the system may also serve to mitigate exposures. For example, the SVE system's radius of influence includes the subsurface beneath affected buildings or horizontal legs of the system will be installed beneath affected buildings. However, complications can arise if the SVE system is no longer effective at remediating contaminated vapors, exposures should still be mitigated due to residual vapor contamination.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

4.1.2 Buildings with a crawl space foundation

A *soil vapor retarder* with *sub-membrane depressurization (SMD) system* is the preferred mitigation method for buildings with a crawl space foundation. A soil vapor retarder is a synthetic membrane or other comparable material that is placed on the ground in the crawl space to retard the flow of soil vapors into the building. A SMD system is similar to a SSD system. It uses a fan-powered vent and piping to draw vapors from beneath the soil vapor retarder and discharge them to the atmosphere. This results in lower air pressure beneath the membrane relative to air pressure in the crawl space, which prevents the infiltration of subsurface vapors into the building.

If the State concurs that a soil vapor retarder with a SMD system is not a practicable alternative or that exposures will be mitigated concurrently by a method selected to remediate subsurface contamination, alternative mitigation methods may be considered, such as the following:

a. *HVAC modification* — a technique where the building's HVAC system is modified to avoid depressurization of the building relative to the crawl space;

b. C*rawl space ventilation with sealing* — a technique that uses a fan to draw air out of the crawl space; and

c. *SVE system* [Section 4.1.1].

4.1.3 Buildings with dirt floor basements

Either a SSD system with a newly poured slab or a SMD system with a soil vapor retarder may be used. However, the former method is preferred.

4.1.4 Buildings with multiple foundation types

Mitigation in a building with a combination of foundations should be achieved by applying the specific methods described previously [Sections 4.1.1 through 4.1.3] to the corresponding foundation segments of the building. Special consideration should be given to the points at which different foundation types join, since additional soil vapor entry routes exist in such locations. Often, the various systems can be installed and connected to a common depressurization system and fan.

4.1.5 Undeveloped parcels

If sampling results indicate a mitigation system is recommended to address exposures in buildings that may be constructed, then a SSD system with sealing, or a SMD system with a soil vapor retarder, or a combination of these methods is recommended, as appropriate to the design of the proposed buildings.

4.1.6 Additional references

The following documents provide additional information on selecting an appropriate mitigation method:

a. *A Consumer's Guide to Radon Reduction*
EPA [EPA 402-K-03-002, revised February 2003]

This document provides assistance in selecting a qualified radon mitigation contractor to reduce the radon levels in a home, determining an appropriate radon reduction method, and maintaining a radon reduction system. It is available at the EPA's web site: http://www.epa.gov/iaq/radon/pubs/index.html; and

b. *Reducing Radon in Schools: A Team Approach*
EPA [EPA 402-R-94-008, April 1994]

This document will provide assistance in determining the best way to reduce elevated radon levels found in a school. It provides guidance on the process of confirming a radon problem, selecting the best mitigation strategy, and directing the efforts of a multidisciplinary team assembled to address elevated radon levels in a way that will contribute to the improvement of the overall indoor air quality of the school. Copies can be ordered from the EPA's Indoor Air Quality Information Clearinghouse at 1-800-438-4318.

4.2 Design and installation of mitigation systems

Once a mitigation method is selected, it should be designed and installed. The components of the design and installation of mitigation systems, the procedures for specific mitigation techniques, and references for technical guidance are provided in the following subsections.

4.2.1 General recommendations

Systems should be designed and installed by a professional engineer or environmental professional. In most areas of the state, there are contractors who have met certain requirements and are trained to identify and fix radon problems in buildings. To obtain the names of local contractors, contact the NYSDOH's Radon Program at 1-800-458-1158, extension 27556, or visit the National Radon Safety Board's web site (www.nrsb.org) or National Environmental Health Association's web site (www.neha.org).

Typically, the party responsible for remediating the site is responsible for arranging design and installation activities. If no responsible party is available, the State will arrange for the design and installation of the system. All design and installation activities should be documented and reported to the agencies. Furthermore, once a mitigation system is installed, an information package should be given to the building's owner and tenants, if applicable, to facilitate their understanding of the system's operation, maintenance and monitoring [Section 5.6].

With the exception of SVE systems, the mitigation methods introduced in Section 4.1 are not intended to remediate the source of subsurface vapors (e.g., contaminated groundwater, soil, etc.). Rather, they are designed to minimize the infiltration of subsurface vapors into a building. For consistency in implementing the techniques in residential buildings, mitigation systems should be designed and installed in accordance with the following:

a. *Standard Practice for Installing Radon Mitigation Systems in Existing Low-rise Residential Buildings* (ASTM E-2121)

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

American Society for Testing and Materials (ASTM) International [ASTM E-2121-03, February 10, 2003]

This document applies to existing buildings. The purpose of this document is to provide radon mitigation contractors with uniform standards that will ensure quality and effectiveness in the design, installation, and evaluation of radon mitigation systems in detached and attached residential buildings three stories or less in height. Information on how to obtain a copy of this standard is available in Appendix E; and

b. *Model Standards and Techniques for Control of Radon in New Residential Buildings* EPA [EPA 402-R-94-009, March 1994]

This document applies to new construction and contains information on how to incorporate radon reduction techniques and materials in residential construction. A copy of this document is provided in Appendix F.

4.2.2 System-specific recommendations

Basic design and installation recommendations for mitigation systems follow. These are based upon recommendations and requirements given by the EPA for mitigating exposures related to radon intrusion (for additional information see EPA's web site on radon at http://www.epa.gov/iaq/radon/pubs/index.html).

a. *Sealing* — To improve the effectiveness of depressurization and ventilation systems and to limit the flow of subsurface vapors into the building, materials that prevent air leakage should be used, such as elastomeric joint sealant (as defined in ASTM C920-87), compatible caulks, non-shrink mortar, grouts, expanding foam, "Dranjer" drain seals, or airtight gaskets. Some effective sealants may contain volatile organic compounds; in some situations, this may be a consideration in choosing an appropriate sealing material.

b. *Soil vapor retarder (membrane)* —

1. To retard the infiltration of subsurface vapors into the building and enhance the performance of a SMD system, a minimum 6 mil (or 3 mil cross-laminated) polyethylene or equivalent flexible sheeting material should be used.

2. The sheet should cover the entire floor area and be sealed at seams (with at least a 12 inch overlap) and penetrations, around the perimeter of interior piers and to the foundation walls.

3. Enough of the sheeting should be used so it will not be pulled away from the walls when the depressurization system is turned on and the sheet is drawn down.

4. If a membrane is installed in areas that may have future foot traffic (e.g., a dirt floor in a basement), consideration should be given to also installing a wearing surface such as sand or stone to protect the integrity of the membrane. Additionally, a layer of fine sand may be prudent beneath the membrane to protect it from penetrations by sharp objects in the dirt floor.

c. *Depressurization systems —*

1. The systems should be designed to avoid the creation of other health, safety, or environmental hazards to building occupants (e.g., backdrafting of natural draft combustion appliances).

2. The systems should be designed to minimize soil vapor intrusion effectively while minimizing excess energy usage, to avoid compromising moisture and temperature controls and other comfort features, and to minimize noise.

3. To evaluate the potential effectiveness of a SSD before it is installed, a diagnostic test (commonly referred to as a "communication" test) should be performed to measure the ability of a suction field and air flow to extend through the material beneath the slab. This test is commonly conducted by applying suction on a centrally located hole drilled through the concrete slab and simultaneously observing the movement of smoke downward into small holes drilled in the slab at locations separated from the central suction hole. A similar quantitative evaluation may also be performed by using a digital micromanometer or comparable instrument. Depending on test results, multiple suction points may be needed to achieve the desired effectiveness of the system.

4. Passive systems (i.e., a SSD system without a vent fan) are not as effective as active systems and their performance varies depending upon ambient temperatures and wind conditions. Therefore, active systems should be used to ensure exposures are being addressed.

5. The vent fan and discharge piping should not be located in or below a livable or occupied area of the building to avoid entry of extracted subsurface vapors into the building in the event of a fan or pipe leak.

6. To avoid entry of extracted subsurface vapors into the building, the vent pipe's exhaust should be

    i. above the eave of the roof (preferably, above the highest eave of the building at least 12 inches above the surface of the roof),

    ii. at least 10 feet above ground level,

    iii. at least 10 feet away from any opening that is less than 2 feet below the exhaust point, and

    iv. 10 feet from any adjoining or adjacent buildings, or HVAC intakes or supply registers.

7. Rain caps, if used, should be installed so as not to increase the potential for extracted subsurface vapors to enter the building.

8. To avoid accidental changes to the system that could disrupt its function, the depressurization system should be labeled clearly. An example of such labeling is shown in Figure 5.1.

9. A warning device or indicator should be installed to alert building occupants if the active system stops working properly. Examples of system failure warning devices and indicators include the following: a liquid gauge (e.g., a

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manometer), a sound alarm, a light indicator, and a dial (needle display) gauge. The warning device or indicator should be placed where it can be easily heard or seen. The party installing the system should verify the warning device or indicator is working properly. Building occupants should be made aware of the warning device or indicator (what it is, where it is located, how it works, how to read/understand it, and what to do if it indicates the system is not working properly).

d. *HVAC systems* — HVAC systems should be carefully designed, installed and operated to avoid depressurization of basements and other areas in contact with the soil.

e. *Crawl space ventilation* —

1. Ventilation systems should be designed to avoid the creation of other health, safety, or environmental hazards to building occupants (e.g., backdrafting of natural draft combustion appliances).

2. Openings and cracks in floors above the crawl space that would permit conditioned air to pass into or out of the occupied spaces of the building, should be identified, closed and sealed.

f. *SVE systems designed to also mitigate exposures* —

1. The systems should be designed to avoid the creation of other health, safety, or environmental hazards to building occupants (e.g., backdrafting of natural draft combustion appliances).

2. To avoid reentry of soil vapor into the building(s), the exhaust point should be located away from the openings of buildings and HVAC air intakes. Depending upon the concentrations of volatile chemicals in subsurface vapors and the expected mass removal rate, treatment (e.g., via carbon filters) of the SVE system effluent may be appropriate to minimize outdoor air effects.

3. The SVE system's radius of influence should adequately address buildings requiring mitigation, as well as subsurface sources requiring remediation. If it does not, additional actions may be appropriate. For example, if the radius of influence does not completely extend beneath a building, a complementary air monitoring program may be appropriate to confirm that exposures are being addressed adequately while the SVE system is operating.

4.2.3 Technical guidance

To address exposures effectively in larger buildings, some of the same techniques used in residential buildings can be scaled up in size, number, or performance (e.g., adjustments in the size and air movement capacity of the vent pipe fan, or installation of multiple suction points through the slab instead of a single point). The design of the techniques may also be modified (e.g., installation of horizontal pipes beneath the building instead of a single suction point).

Detailed technical guidance on designing and installing mitigation systems in residential and non-residential buildings is provided in various documents, such as the following, released by the EPA and others:

a. References provided in ASTM's E-2121 (see Appendix E for information on how to obtain a copy) and the EPA's *Model Standards and Techniques for Control of Radon in New Residential Buildings* (Appendix F);

b. *Radon Reduction Techniques for Existing Detached Houses: Technical Guidance (Third Edition) for Active Soil Depressurization Systems*
EPA [EPA 625/R-93-011, October 1993]

This technical guidance document has been prepared to serve as a comprehensive aid in the detailed selection, design, installation, and operation of indoor radon reduction measures for existing houses based on active soil depressurization techniques. It is intended for use by radon mitigation contractors, building contractors, concerned homeowners, state and local officials and other interested persons. Copies can be ordered from the EPA's Indoor Air Quality Information Clearinghouse at 1-800-438-4318;

c. *Protecting Your Home From Radon: A Step-by-Step Manual for Radon Reduction*
Kladder *et al.*, 1993

This manual is designed to provide sufficient information to a homeowner to make many of the basic repairs that can significantly reduce radon levels in the home;

d. *Building Radon Out: A Step-by-Step Guide on How to Build Radon-Resistant Homes*
EPA [EPA 402-K-01-002, April 2001]

This fully illustrated guide contains all the information needed in one place to educate home builders about radon-resistant new construction (RRNC), including the following: basic questions and detailed answers about radon and RRNC, specific planning steps before installing a system, detailed installation instructions with helpful illustrations, tips and tricks when installing a system, marketing know-how when dealing with homebuyers, and architectural drawings. This document is available at the EPA's web site: http://www.epa.gov/iaq/radon/pubs/index.html; and

e. *Radon Prevention in the Design and Construction of Schools and Other Large Buildings*
EPA [EPA 625-R-92-016, June 1994]

It is typically easier and much less expensive to design and construct a new building with radon-resistant and/or easy-to-mitigate features, than to add these features after the building is completed and occupied. Specific guidelines on how to incorporate radon prevention features in the design and construction of schools and other large buildings are detailed in this manual. Copies can be ordered from the EPA's Indoor Air Quality Information Clearinghouse at 1-800-438-4318. This document is also available on the EPA Office of Research and Development's web site: http://www.epa.gov/ORD/NRMRL/pubs/625r92016/625r92016.htm.

4.3 Post-mitigation or confirmation testing

Once a mitigation system is installed, its effectiveness and proper installation should be confirmed. The party that installed the system should conduct post-mitigation testing and for developing a post-mitigation testing plan. Minimum objectives for post-mitigation testing associated with specific mitigation methods are provided in the following

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subsections. All post-mitigation testing activities should be documented and reported to the agencies.

4.3.1 SSD systems with sealing

a. Reasonable and practical actions should be taken to identify and fix leaks. With the depressurization system operating, smoke tubes are used to check for leaks through concrete cracks, floor joints, and at the suction point. Any leaks identified should be resealed until smoke is no longer observed flowing through the opening.

b. Once a depressurization system is installed, its operation may compete with the proper venting of fireplaces, wood stoves and other combustion or vented appliances (e.g., furnaces, clothes dryers, and water heaters), resulting in the accumulation of exhaust gases in the building and the potential for carbon monoxide poisoning. Therefore, in buildings with natural draft combustion appliances, the building should be tested for backdrafting of the appliances. Backdrafting conditions should be corrected before the depressurization system is placed in operation.

c. The distance that a pressure change is induced in the sub-slab area (i.e., a pressure field extension test) should be conducted. Analogous to a communication test, this test is commonly conducted by operating the depressurization system and simultaneously observing the movement of smoke downward into small holes (e.g., 3/8 inch) drilled through the slab at sufficient locations to demonstrate that a vacuum is being created beneath the entire slab. A similar quantitative evaluation may also be performed by using a digital micromanometer or comparable instrument. If adequate depressurization is not occurring, the reason (e.g., improper fan operation) should be identified and corrected.

d. Adequate operation of the warning device or indicator should be confirmed.

e. Except as indicated below, post-mitigation indoor and outdoor air sampling should be conducted in all buildings where pre-mitigation samples were collected and in all buildings where physical data suggest possible impediments to comprehensive sub-slab communication of the depressurization system (i.e., locations with wet or dense sub-slab soils, multiple foundations and footings, minimal pressure differentials between the interior and sub-slab). Generally, indoor and outdoor air sampling locations, protocols and analytical methods should be consistent between pre-mitigation and post-mitigation sampling, where applicable. In buildings with basements, post-mitigation indoor air sampling from the basement alone (i.e., without a concurrent indoor air sample from the first floor) is recommended in most circumstances.

   Typically, post-mitigation sampling should be conducted no sooner than 30 days after installing a depressurization system. If the system is installed outside of the heating season or at the end of a season, post-mitigation air sampling may be postponed until the heating season.

   In cases of widespread mitigation due to vapor contamination and depending upon the basis of making decisions (e.g., a "blanket mitigation" approach within a specified area of documented vapor contamination [Section 3.3.1]), a representative number of buildings from an identified study area, rather than each building, may be

sampled. Prior to implementation, this type of post-mitigation sampling approach should be approved by State agency personnel.

In newly constructed buildings, a site-specific and building-specific indoor air sampling plan is recommended due to potential interferences caused by the off-gassing of volatile chemicals in new building materials (e.g., paints, carpets, furniture, etc. [Section 1.4]). In these situations, if indoor air sampling is appropriate samples should be

i. collected while the system is operational but before potentially interfering factors are brought into the building,

ii. analyzed for a targeted list of volatile chemicals based on previous environmental sampling (e.g., groundwater, soil, soil vapor, etc.), and/or

iii. collected while the system is operational but after potentially interfering factors have had an opportunity to off-gas.

If post-mitigation sampling results do not indicate a significant decrease in the concentrations of volatile chemicals previously believed to be present in the indoor air due to soil vapor intrusion, the reason (e.g., indoor or outdoor sources, improper operation of the mitigation system, etc.) should be identified and corrected as appropriate.

4.3.2 SMD systems with soil vapor retarder

a. Reasonable and practical actions should be taken to identify and fix leaks. With the depressurization system operating, smoke tubes are used to check for leaks in the membrane at seams, edge seals and at locations where the sheet was sealed around obstructions. Any leaks identified should be resealed until smoke is no longer observed flowing through the opening.

b. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].

c. Adequate operation of the warning device or indicator should be confirmed.

d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [as discussed in Section 4.3.1].

4.3.3 HVAC modifications

a. Check the building for positive pressure conditions (e.g., verify a pressure controller is maintaining the desired pressure differential and/or measure the pressure differential between the sub-slab and indoor air by using field instruments).

b. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].

c. Adequate operation of the warning device or indicator, if applicable, should be confirmed.

d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [Section 4.3.1].

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4.3.4 Crawl space ventilation and sealing

a. Reasonable and practical actions should be taken to identify and fix leaks. With the ventilation system operating, smoke tubes are used to check for leaks in openings and cracks in floors above the crawl space that were sealed during installation of the system. Any leaks identified should be resealed until smoke is no longer observed flowing through the opening.

b. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].

c. Adequate operation of the warning device or indicator, if applicable, should be confirmed.

d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [as discussed in Section 4.3.1].

4.3.5 SVE systems designed to also mitigate exposures

a. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].

b. The distance that a pressure change is induced in the sub-slab area should be conducted. This may be done by operating the SVE system and simultaneously observing the movement of smoke downward into small holes (e.g., 3/8 inch) drilled through the building's slab at sufficient locations to demonstrate that a vacuum is being created beneath the entire slab.

c. Adequate operation of the warning device or indicator, if applicable, should be confirmed.

d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [Section 4.3.1].

4.4 Operation, maintenance and monitoring of mitigation systems

When mitigation systems are implemented at a site, the operation, maintenance and monitoring (OM&M) protocols for the systems should be included in a site-specific site management plan (formerly referred to as operation, maintenance and monitoring plan). The party that installed the system should conduct OM&M activities and should develop the site management plan. Recommendations for minimum OM&M activities associated with specific mitigation methods are provided in the following subsections. Also included is a discussion of non-routine maintenance. All routine and non-routine OM&M activities should be documented and reported to the agencies.

4.4.1 SSD and SMD systems

Routine maintenance should commence within 18 months after the system becomes operational, and should occur every 12 to 18 months thereafter. Based upon a demonstration of the system's reliability, the State recommends that, if a different frequency is desired, a petition describing the alternative frequency and the reasons that frequency is preferred be submitted to the State. Any comments the State may have on the petition should be considered before the frequency is altered.

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During routine maintenance, the following activities (at a minimum) should be conducted:

a. a visual inspection of the complete system (e.g., vent fan, piping, warning device or indicator, labeling on systems, soil vapor retarder integrity, etc.),

b. identification and repair of leaks [Sections 4.3.1 and 4.3.2], and

c. inspection of the exhaust or discharge point to verify no air intakes have been located nearby.

As appropriate preventative maintenance (e.g., replacing vent fans), repairs and/or adjustments should be made to the system to ensure its continued effectiveness at mitigating exposures related to soil vapor intrusion. The need for preventative maintenance will depend upon the life expectancy and warranty for the specific part, as well as visual observations over time. The need for repairs and/or adjustments will depend upon the results of a specific activity compared to that obtained when system operations were initiated.

If significant changes are made to the system or when the system's performance is unacceptable, the system may need to be redesigned and restarted. Many, if not all, of the post-mitigation testing activities, as described in Sections 4.3.1 and/or 4.3, may be appropriate. The extent of such activities will primarily depend upon the reason for the changes and the documentation of sub-slab depressurization.

Generally, air monitoring is not recommended if the system has been installed properly and is maintaining a vacuum beneath the entire slab.

In addition to the routine OM&M activities described here, the building's owner and tenants are given information packages that explains the system's operation, maintenance and monitoring [Section 5.6]. Therefore, at any time during the system's operation, the building's owner or tenants may check that the system is operating properly.

4.4.2 Other mitigation systems

For other mitigation systems (e.g., HVAC modifications, crawl space ventilation, etc.), routine maintenance activities are generally comparable to post-mitigation testing activities [Section 4.3]. Activities typically include a visual inspection of the complete system, and identification and repair of leaks. System performance checks, such as air stream velocity measurements of ventilation systems, also should be performed.

As appropriate, preventative maintenance (e.g., replacing filters, cleaning lines, etc.), repairs and/or adjustments should be made to the system to ensure its continued effectiveness at mitigating exposures related to soil vapor intrusion. If significant changes are made to the system or when the system's performance is unacceptable, redesigning and restarting the system may be appropriate[Section 4.4.1].

Air monitoring, such as periodic sub-slab vapor, indoor air and outdoor air sampling, may be appropriate to determine whether existing building conditions are maintaining the desired mitigation endpoint and to determine whether changes are appropriate. The type and frequency of monitoring is determined based upon site-specific and building-specific conditions, taking into account applicable environmental data, building operating conditions, and the mitigation method employed.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

4.4.3 Non-routine maintenance

Non-routine maintenance may also be appropriate during the operation of a mitigation system. Examples of such situations include the following:

a. the building's owners or occupants report that the warning device or indicator indicates the mitigation system is not operating properly;

b. the mitigation system becomes damaged; or

c. the building has undergone renovations that may reduce the effectiveness of the mitigation system.

Activities conducted during non-routine maintenance visits will vary depending upon the reason for the visit. In general, building-related activities may include examining the building for structural or HVAC system changes, or other changes that may affect the performance of the depressurization system (e.g., new combustion appliances, deterioration of the concrete slab, or significant changes to any of the building factors listed in Table 1.2). Depressurization system-related activities may include examining the operation of the warning device or indicator and the vent fan, or the extent of sub-slab depressurization. Repairs or adjustments should be made to the system as appropriate. If appropriate, the system should be redesigned and restarted [Section 4.4.1].

4.5 Termination of mitigation system operations

Mitigation systems should not be turned off, until the State receives, and has had the opportunity to comment on, a proposal to turn off mitigation systems. The party seeking to turn off the mitigation systems should consider any comments the State may have on the proposal, except in emergency situations. Systems should remain in place and operational until they are no longer needed to address current or potential exposures related to soil vapor intrusion. This determination should be based upon several factors, including the following:

a. subsurface sources (e.g., groundwater, soil, etc.) of volatile chemical contamination in subsurface vapors have been remediated based upon an evaluation of appropriate post-remedial sampling results;

b. residual contamination, if any, in subsurface vapors is not expected to affect indoor air quality significantly based upon soil vapor and/or sub-slab vapor sampling results;

c. residual contamination, if any, in subsurface vapors is not affecting indoor air quality when active mitigation systems are turned off based upon indoor air, outdoor air and sub-slab vapor sampling results at a representative number of buildings; and

d. there is no "rebound" effect for which additional mitigation efforts would be appropriate observed when the mitigation system is turned off for prolonged periods of time. This determination should be based upon indoor air, outdoor air and/or sub-slab vapor sampling from the building over a time period, determined by site-specific conditions.

Given the prevalence of radon throughout the State of New York, consideration should be given to leaving the system in place and operating to address exposures related to radon intrusion after concurrence is reached that the system is no longer needed to mitigate exposures related to soil vapor intrusion. This action should be done only with permission of the property owner and after the property owner is aware of their responsibilities in

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operating, monitoring and maintaining the system for this specific purpose. If the property owner declines the offer, the system should be shut down and, if requested, removed in a timely manner.

4.6 Annual certification and notification recommendations

Mitigation systems are considered engineering controls, defined as any physical barrier or method employed to

1. actively or passively contain, stabilize, or monitor hazardous waste or petroleum,
2. restrict the movement of hazardous waste or petroleum to ensure the long-term effectiveness of remedial actions, or
3. eliminate potential exposure pathways to hazardous waste or petroleum.

Therefore, depending upon the remedial program, submission of an annual certification to the State may be required. This certification must be prepared and submitted by a professional engineer or environmental professional and affirm that the engineering controls are in place, are performing properly and remain effective. This requirement of certification remains in effect until the State provides notification, in writing, that this certification is no longer needed.

If a property owner declines a mitigation system, the party responsible for arranging the design and installation of the system should renew the offer on an annual basis, unless they demonstrate environmental conditions have changed such that a system is no longer needed.

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Section 5: Community Outreach

While community outreach is an essential component of the investigation and remediation of any site, it is particularly critical when evaluating soil vapor intrusion at a site due to the following:

a. a heightened awareness by environmental professionals and the general public (both nationally and state-wide) for the importance of soil vapor intrusion;

b. the relatively complicated nature of the exposure pathway (e.g., chemicals in groundwater or soil ending up in the indoor air of buildings versus contaminated groundwater entering the house through the use of a private well);

c. the unknowns associated with the evolving science of investigating, evaluating, and mitigating exposures related to soil vapor intrusion; and

d. the relatively complicated nature of mitigating the exposure pathway (e.g., the design, installation and operation of a sub-slab depressurization system in a home versus an immediate switch from using private well water to using bottled water).

When people have been or may be exposed to contamination, providing them with accurate and timely information about those exposures is extremely important. This information should include details about the types of chemicals, the levels of exposure, and possible health effects from those exposures. In addition, information should include details about the planning and progress of the investigation and remediation efforts. Techniques commonly used to inform the community about soil vapor intrusion issues are described in this section. The type, or types, of techniques selected for a site will vary depending upon the community's needs, site-specific conditions and remedial program-specific requirements.

5.1 Site contact list

A contact list contains names, addresses and telephone numbers of individuals and organizations with interest or involvement in a site. They may be affected by or interested in the site, or have information that staff needs to make effective remedial decisions. Contact lists typically include residents near the site, elected officials, appropriate federal, state, and local government contacts, local media, organized environmental groups and the responsible party, as well as local businesses, civic and recreational groups, religious facilities, school district officials, and all staff (NYSDEC, NYSDOH, county health department, EPA, etc.) involved in the site. The checklist provided in Appendix G.1 will help to identify who should be included in a particular site's contact list.

With respect to soil vapor intrusion, the site contact list is often used to

a. send a fact sheet announcing a proposed investigation in the area, a major project decision or proposal, the project's status or progress, a public meeting or availability session, or the availability of documents in the repositories;

b. contact building owners and tenants to arrange sampling dates and times and to transmit sampling results (in written form and/or verbally); and

c. provide community members with verbal updates on the project's status or progress.

The member of the project team (defined as the NYSDEC, NYSDOH, responsible party, etc.) that develops and maintains the site contact list is determined on a site-specific and/or

NOTE: Updates to this final guidance are available at
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program-specific basis. Development and revision of the contact list are ongoing activities throughout the site's investigation and remediation. Guidance on how to create a site contact list is provided in Appendix G.1.

5.2 Project staff contact sheet

As implied by the name, this is a summary of the contact information for staff working on the site that can be handed out to the community. Often included on the sheet are the name, title, affiliation, role or area of expertise, address, telephone number, email address, facsimile number for each staff member. The contact sheet provides the community with a quick reference on whom to call with questions, comments or concerns about the site. Project staff may also use the site contact sheet to direct inquiries to the most appropriate person. This is particularly useful when there are many agencies working on the site and many issues, such as site investigation, health studies, medical outreach, etc., being addressed.

The site contact sheet should be handed out at public meetings or availability sessions, when door-to-door visits and sampling are conducted, and in conjunction with other appropriate outreach activities. The sheet should be developed early on in the process and kept up-to-date. The member of the project team that develops and maintains the staff contact sheet is determined on a site-specific and/or program-specific basis.

5.3 Fact sheets

A fact sheet is a written summary of important information about a site. It presents information in clear and concise terms for the community. Fact sheets aid consistent distribution of information and citizens' understanding of significant issues associated with site-related activities. With respect to soil vapor intrusion, fact sheets are often used to

a. announce a proposed soil vapor intrusion investigation in the area, either as a stand-alone activity or in conjunction with the site's overall investigation;

b. summarize the results of an investigation and the anticipated next steps in the process;

c. invite the public to a meeting or availability session to discuss the proposed investigation, the results of a recently completed investigation, the anticipated next steps, etc.; and

d. provide additional information on topics associated with soil vapor intrusion, such as specific air guidelines for volatile chemicals.

The member of the project team that plans, develops and distributes the fact sheet is determined on a site-specific and/or program-specific basis. Factors to consider when designating the lead include the site's remedial program, the expected content of the fact sheet, and the relationship of various team members with the community. For example, if the community strongly distrusts the responsible party and wants to know how the state is determining that their actions are appropriate, the state should be the lead. A combination of team members may also be suitable.

All team members should be included in reviewing and finalizing the fact sheet. Once the state approves the fact sheet, it may be released to the public. Timely distribution of the fact sheet is important. Sufficient time should be allowed in the development and review

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http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
schedule to ensure that the fact sheet is distributed — *and that it is received* — before the critical activity takes place. Specific timeframes for release include the following:

a. 2 weeks prior to a public meeting or availability session, or commencement of field activities;

b. within 24 hours of receiving a specific request for an available fact sheet from the community (e.g., members of the community that did not receive a copy of the fact sheet in the mail);

c. if applicable, before a comment period begins (otherwise a 30-day comment period becomes, in reality, a 25-day comment period); and

d. if appropriate, concurrently with letters to the community explaining sampling results.

Copies of fact sheets commonly used to supplement discussions related to soil vapor intrusion are provided in Appendix H. They are also available from the NYSDOH's soil vapor intrusion web page: http://www.health.state.ny.us/environmental/indoors/vapor_intrusion/. Additional guidance on how to plan, develop and distribute fact sheets is provided in Appendix G.2.

5.4 Public gatherings

The following are several types of public gatherings where project staff can meet with the community:

a. Traditional Public Meetings: Project staff generally present information and answer questions. Citizens are encouraged to ask questions and provide comments;

b. Public Availability Sessions: The session is held in a casual setting, without a formal agenda and presentation. Staff generally conduct an availability session about a specific aspect of a site, which it publicizes ahead of time. The format promotes detailed individual or small group discussion between staff and the public. An availability session may be targeted to a specific subgroup of the overall community. For example, a session may be held where project staff meet with building owners and tenants to discuss their individual sampling results;

c. Public Forum: The forum is held in a casual setting, without a formal presentation. Typically, the format is one of "question and answer" — a panel of project staff (or, if applicable, outside experts) answer questions asked by community members in an open discussion; and

d. Other: Project staff may be invited to give presentations or to make themselves available for questions at community group meetings, such as community or neighborhood board meetings, school board meetings, etc.

If appropriate, a combination of the above may be used. The type, or combination of types, of gathering (if any) selected should be decided based on site-specific, program requirements and community-specific conditions, such as the following:

a. Is the investigation limited to on-site buildings, to a localized area of off-site buildings, or to the off-site neighborhood surrounding the site?;

b. Is the soil vapor investigation being performed as part of ongoing site investigation activities (and consequently ongoing outreach activities), or is this issue being revisited at a site where remediation was considered "complete?";

c. What type of outreach has the community favored in the past?;

d. What are the objectives of the meeting? Can one meeting type accomplish each of the objectives or are different meeting types needed on successive days (e.g., public meeting followed by an availability session)?; and

e. Who is the desired audience? Should the meeting be held in the afternoon to accommodate an elderly population and repeated in the evening for people who work during normal business hours?

The member of the project team that coordinates and implements the gathering is determined on a site-specific and/or program-specific basis. Factors to consider when designating the lead include the site's remedial program, the expected subject of the meeting, and the relationship of various team members with the community. A combination of team members may also be appropriate.

Additional guidance on how to plan and conduct a public meeting and an availability session is provided in Appendices G.3 and G.4.

5.5 Letters transmitting results

When indoor air and/or sub-slab vapor samples are collected from within or beneath a building, a letter providing the sampling results and the conclusions drawn from the data evaluation should be transmitted to the building's owner. If the building is a rental property, the transmittal letter should be sent to the tenants residing in the areas where the samples were collected and a copy to the property owner/landlord. In some cases where responsible parties are carrying out indoor air sampling, access agreements are commonly executed between such a party and the property owner. Consequently, the transmittal letter may be sent to the property owner, and where feasible by prior arrangement with the property owner and/or tenant, with a copy to the tenant.

A transmittal letter should include the following (as applicable):

a. the address of the building sampled;

b. the date samples were collected;

c. the type of samples collected (e.g., sub-slab vapor, indoor air and outdoor air);

d. indoor air sampling locations (e.g., basement, crawl space, first floor living room, etc.)

e. who collected the samples (e.g., the state, or [Consultant Name] on behalf of [Responsible Party name], etc.);

f. why samples were collected (e.g., to evaluate the potential for exposures associated with soil vapor intrusion);

g. the site name and number (usually included in the subject line);

h. the compound(s) or group of compounds of concern (e.g., trichloroethene or volatile organic compounds);

i. an overview of the sampling results (e.g., a table summarizing compounds detected in each sample and/or a figure illustrating sampling locations and corresponding results);

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j. copies of the laboratory sheets for each sample collected and the completed building questionnaire/inventory;

k. a statement of the conclusions drawn and the next steps (e.g., soil vapor intrusion appears to be the likely source of volatile chemicals in your indoor air and we would like to install a sub-slab depressurization system to minimize exposures);

l. if applicable, what information should be shared with employees and/or patrons of the facility (e.g., the transmittal letter and enclosed fact sheets, a situation-specific fact sheet and cover memorandum, etc.);

m. contact information for project staff; and

n. fact sheets that supplement information provided in the letter.

The member of the project team that transmits the letter is typically the member that conducted the investigation. A representative of each member should be copied on each transmittal. For example, for investigations conducted by the state, letters are transmitted by the NYSDOH; state and local agencies, as well as a representative for the responsible party (or other non-agency project staff), should be copied. For investigations conducted by the responsible party, the responsible party should transmit letters that have been reviewed and approved by the state, and copy state and local agency representatives.

The level of detail provided in the letter will depend upon who transmits the letter. For example, letters written by the NYSDOH may recommend actions to reduce exposures to indoor sources (i.e., not site-related sources) of volatile chemicals, or address expected risks associated with an identified exposure. Letters transmitted by a responsible party generally focus on site-related contamination and their identified next steps. These letters generally refer the recipients to the state for questions regarding non-site-related compounds and health concerns. For additional guidance on the content of the transmittal letters, contact the NYSDOH's Bureau of Environmental Exposure Investigation at 1-800-458-1158, extension 27850.

Timely distribution of the transmittal letter is important. Generally, final (i.e., verified) sampling results from the laboratory are available 6 to 8 weeks after the samples are submitted. As soon as they are available, final results should be forwarded to the team member that is transmitting them. Sufficient time should be allowed in the development and review schedule to ensure that the letter is transmitted within 2 weeks after final results are available.

If there is significant community interest in the sampling results, reasonable attempts should be made to inform the building owners and tenants of their results verbally in addition to sending a transmittal letter. Other interested community members, such as residents, press and elected officials, may be given an overview of the investigation results and the conclusions drawn *after* each building owner and tenant has been notified.

5.6 Soil vapor intrusion mitigation information

Once a mitigation system (e.g., sub-slab depressurization system) is installed in a building, an information package should be given to the building's owner and tenants, if applicable, to facilitate their understanding of the system's operation, maintenance and monitoring. This package should include the following:

a. a description of the mitigation system installed and its basic operating principles;

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b. how the owner or tenant can check that the system is operating properly;

c. how the system will be maintained and monitored and by whom;

d. a list of appropriate actions for the owner or tenant to take if the system's warning device or indicator (e.g., pressure gauge, alarm, etc.) indicates system degradation or failure; and

e. contact information (e.g., names, telephone numbers, etc.) if the owner or tenant has questions, comments or concerns.

The building's owner should also receive the following information:

a. any building permits required by local codes;

b. copies of contracts and warranties; and

c. a description of the proper operating procedures of any mechanical or electrical system installed, including manufacturer's operation and maintenance instructions and warranties.

Wherever possible, illustrations should be provided. For example, pictures of a manometer under normal operating conditions [Figure 5.1], as well as drawings or schematics showing the system at work [Figure 5.2].

The member of the project team who provides this information is the member who installed the mitigation system.



Figure 5.1
Manometer indicating the SSD system is operating properly.

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http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

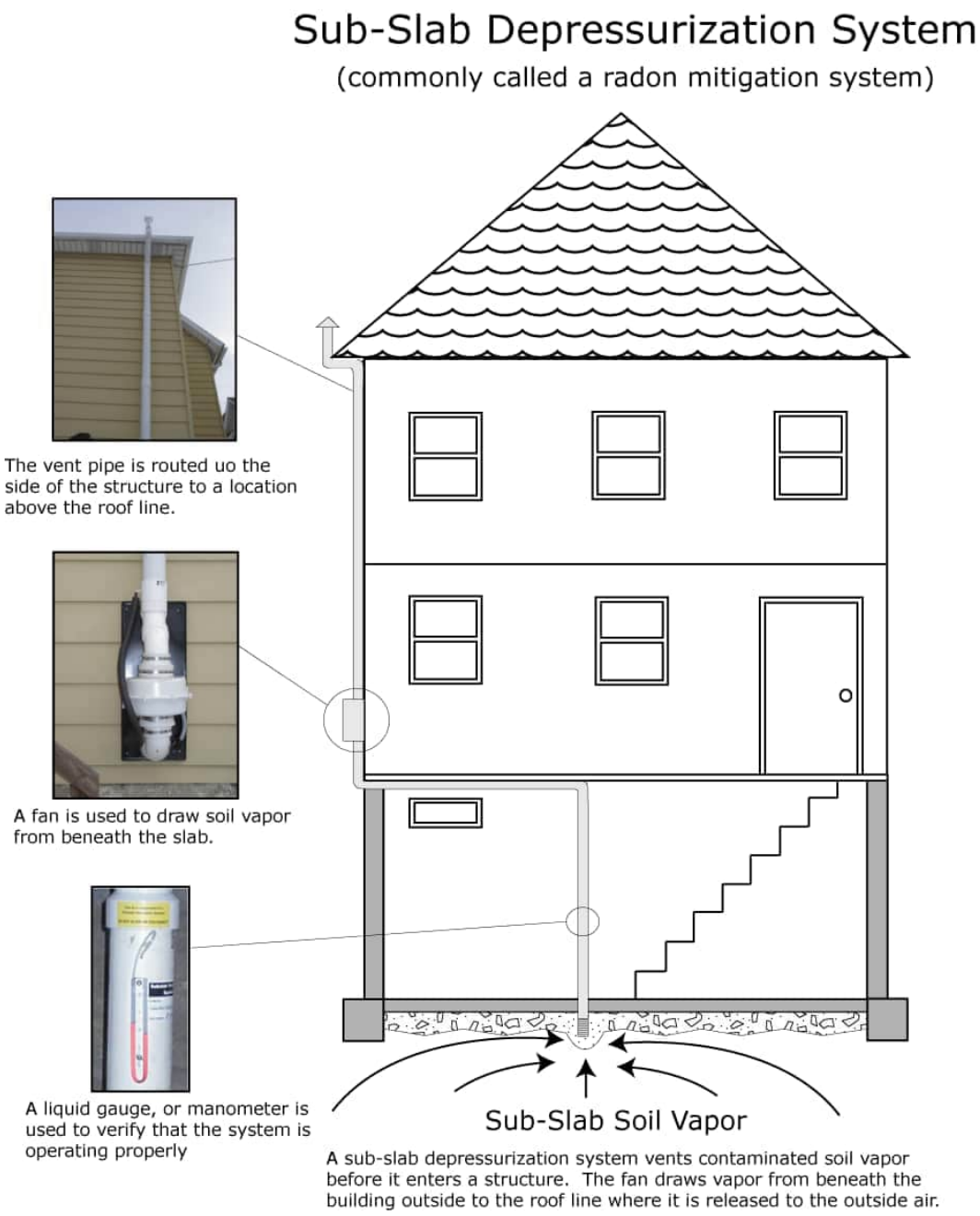


Figure 5.2
Example of an illustration showing how a SSD system works.

5.7 Toll-free "800" numbers

Toll-free information numbers provide quick, easy access for people who have questions, comments or concerns about a site. At a minimum, the NYSDOH site project manager's name and the following "800" number should be shared with the community in fact sheets and transmittal letters, at public gatherings, when samples are collected, and with other outreach techniques for their use if they have health-related questions, concerns or comments related to soil vapor intrusion at the site.

NYSDOH
Center for Environmental Health
Bureau of Environmental Exposure Investigation
Toll-free Information Line

1-800-458-1158, ext. 27850

Note: The "800" number is an *information* line — not a "*hotline*" — because callers may not receive immediate response, such as on nights or weekends.

Similarly, applicable toll-free numbers setup and maintained by other project team members should also be shared with the community whenever appropriate. Additional information on the use of toll-free "800" numbers as an outreach tool is provided in Appendix G.5.

5.8 Door-to-door visits

Door-to-door visits involve gathering or distributing site information by meeting individuals at their residences or businesses. Typically, this outreach technique is used to supplement other communication, such as telephone calls and letters. With respect to soil vapor intrusion, project staff may visit residents near a site to provide information, answer questions, or obtain permission for activities on private properties. All team members should be aware of the specifics of the door-to-door visits (e.g., who will be conducting the visits, the reason, the dates, etc.).

Additional information on conducting door-to-door visits is provided in Appendix G.6.

5.9 Document repositories

A document repository is a collection of documents and other information developed during the investigation and remediation of a site. It is located in a convenient, public facility, such as a library, so that affected and interested members of the public can easily access and review important information about the site. A repository is maintained through the site's operation and maintenance phase, or until its release from the applicable remedial program.

A site document repository helps the public review

a. documents about which the state is seeking public comment;

b. studies, reports and other information; and

c. complete versions of documents summarized in fact sheets, meeting presentations or media releases (summaries should note the locations of local repositories where the complete documents are available).

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
The member of the project team that establishes and maintains the document repository is determined on a site-specific and/or program-specific basis. Additional guidance on how to establish and maintain a document repository is provided in Appendix G.7.

5.10 Medical community outreach

Outreach to the medical community is an activity or combination of activities undertaken to assist local health care providers in caring for people who have concerns about site-specific environmental exposures. The goal of this type of outreach is to assist the individual provider by giving him/her much of the site-specific information related to the contaminants and to provide information about the site itself. This type of outreach is undertaken whenever the NYSDOH and/or other health agencies determine that the site-specific contaminants may be unfamiliar to the local medical community. Conversely, this outreach can be undertaken when community members express the concern that their health care providers may be unfamiliar with potential adverse health effects related to contaminants at the site.

The targeted audience for this type of outreach consists of specific groups of health care providers most likely to treat people with concerns about potential environmental exposures. Some examples of targeted groups of specialists could include any combination of the following: Family Practice, Internal Medicine, Preventive Medicine, Oncology, Neurology, Allergy, Pediatrics, Obstetrics, Dermatology and Emergency Medicine. Likewise, materials can be sent to medical and nursing schools, residency programs, and medical libraries if they are located nearby. Developing the targeted list of health-care providers is a cooperative effort between local and state departments of health, with input from the community as well.

The NYSDOH, in partnership with the Agency for Toxic Substance and Disease Registry (ATSDR) and the local health department, can conduct these activities, which could include any one or a combination of the following:

a. announcements made at public meetings that the NYSDOH Center for Environmental Health will mail out information packets to individual physicians at the request of any concerned citizen;

b. an article placed in a local newspaper, or, if applicable, in a newsletter periodically sent to residents, stating that the NYSDOH Center for Environmental Health will mail out packets to individual physicians at the request of any concerned citizen. The NYSDOH "800" number and two NYSDOH contact names would be given;

c. an article submitted to the newsletter of the local county medical society, stating that the NYSDOH and the ATSDR have information to help providers with questions about site-related contamination in the area of the site. The NYSDOH "800" number and two NYSDOH contact names would be given; and

d. materials sent to medical and nursing schools, residency programs, and medical libraries if they are located nearby.

Local and state departments of health, and ATSDR, have developed appropriate outreach materials. The information packets should contain a letter to the physician, site-specific fact sheets, brochures, and booklets about potential exposures and about the contaminants in the area of the site. As an example, here is a list of fact sheets and pamphlets that an information packet for a site with PCE and TCE as contaminants of concern might contain:

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a. a letter of explanation to the provider, including the NYSDOH "800" number to call for access to more information, as well as two NYSDOH contacts with whom to speak initially;

b. a site-specific fact sheet written for the community, explaining various site-related issues;

c. a compact disc of ATSDR case studies in environmental medicine (CSEMs), with opportunities for earning many free continuing medical education (CME) credits through the Centers for Disease Control and Prevention;

d. a hard copy of both the "Trichloroethylene (TCE) Toxicity" and "Taking an Environmental Exposure History" case studies;

e. two small "quick reference guides" produced by ATSDR about evaluating environmental exposures and doing an exposure history;

f. a NYSDOH fact sheet on Trichloroethene (TCE) in indoor and outdoor air;

g. an ATSDR fact sheet on Trichloroethylene (TCE);

h. a NYSDOH fact sheet on Tetrachloroethene (PERC) in indoor and outdoor air; and

i. an ATSDR fact sheet on Tetrachloroethylene (PERC).

For additional information on this outreach tool, please contact the NYSDOH Center for Environmental Health's Outreach and Education Unit at 1-800-458-1158, extension 27530.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

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NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix A

Highlights of document revisions

February 2005 Public Comment Draft → October 2006 Final Guidance

- Throughout: Revised language to clarify that the guidance is not a rule, regulation or requirement, and to eliminate text that might create a contrary impression.
- Preface: Revised to clarify that the guidance was developed in consultation with the NYSDEC and that it represents the State's methodology and our experience. Added notes for special considerations (e.g., naturally-occurring subsurface gases).
- Section 1: Replaced image in Figure 1.1. Identified additional factors in Table 1.1. Added section on conceptual site models. Provided additional information regarding the applicability of the guidance to specific scenarios (such as residential and non-residential settings and petroleum hydrocarbon sites).
- Section 2: Revised the discussion in Section 2.2.1 to clarify the use of soil vapor samples. Included crawl space air samples. Expanded the discussion on time of year in which to sample. Revised text to emphasize the importance of selecting methods that meet the data quality objectives. Clarified which information is highly recommended to gather at the time of sampling. Included liquid tracers in the section on tracer gas. Added QA/QC considerations. Revised text on target analyte lists. Relocated guidance on applicability in non-residential settings to Section 1.7.
- Section 3: Revised text and removed summary table in Section 3.2.4 to clarify that background levels are not defined as levels within a 25^{th} to 75^{th} percentile range. Added a summary of a recently published Health Effects Institute database to the discussion on background databases. Included "resampling" as one of the potential recommended actions in Section 3.3.2 and 3.3.3. Added text to clarify who is responsible for implementing recommended actions. Revised the outdoor air evaluation section to clarify that outdoor air samples are not collected and evaluated as part of a comprehensive assessment of outdoor air.
- Matrix 1: Based on comments received on the NYSDOH's TCE Criteria Document (NYSDOH 2006), the following two revisions were made to Matrix 1: changed the boundary between the indoor air concentration ranges in Columns 2 and 3 from 2.5 to 1 mcg/m^3 and added "Monitor/Mitigate" as a recommended action in Box 10 (see memorandum from N. Kim to R. Tramontano dated October 12, 2006, provided on p. A-3 for additional information). Removed Monitor action from Box 3. Removed Mitigate and Monitor actions from Box 4. Revised the definitions of actions and the additional notes, including a definition of "Monitor/Mitigate" and a recommendation that resampling may be necessary to demonstrate the effectiveness of actions taken to reduce exposures.
- Matrix 2: Removed Monitor action from Box 3. Removed Mitigate and Monitor actions from Box 4. Added Monitor/Mitigate action to Box 6 (see memorandum from N. Kim to R. Tramontano dated October 12, 2006, provided on p. A-3 for additional information). Similar to Matrix 1, revised the definitions of actions and the additional notes.
- Section 4: Revised text to clarify that we are emphasizing preferred mitigation methods and not precluding the use of other mitigation methods. Added text to Section 4.3 about post-mitigation indoor air sampling in buildings with basements. Replaced EPA's *Radon Mitigation Standards* with ASTM E-2121. Replaced references to Operation, Maintenance and Monitoring Plans to Site Management Plans.
- Section 5: Replaced image in Figure 5.2.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

- Appendix C: Added a discussion on a recently published Health Effects Institute database. Added tables for each database with additional volatile chemicals and statistical measures of background levels.
- Appendix E: Removed EPA's *Radon Mitigation Standards*. Provided EPA's web site explaining how to get copies of the recommended ASTM E-2121.

The reader is also referred to the NYSDOH's complementary document titled "Response to Comments received on the New York State Department of Health's *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (Public comment draft dated February 2005)."

STATE OF NEW YORK - DEPARTMENT OF HEALTH
INTEROFFICE MEMORANDUM

TO: Ronald Tramontano, Director
Center for Environmental Health

FROM: Nancy K. Kim, Director
Division of Environmental Health Assessment

SUBJECT: Trichloroethene

DATE: October 12, 2006

Center for Environmental Health staff in the New York State Department of Health (DOH) have written several documents to address health concerns about exposure to trichloroethene (TCE) from soil vapor intrusion and are revising those documents in response to comments from a scientific review panel and the public. The documents and related reports are:

- Draft Report Trichloroethene Air Criteria Document (DOH, 2005)(contains the derivation of the TCE guideline),
- Comments of the Trichloroethene (TCE) Panel (letter from Henry Anderson, M.D. to Nancy K. Kim, Ph.D. dated November 1, 2005),
- Guidance for Evaluating Soil Vapor Intrusion in the State of New York, Public Comment Draft (DOH, 2005), which includes the
  - Soil Vapor/Indoor Air Matrix 1 and Matrix 2 (both are a decision making tool for soil vapor and indoor air levels), and
  - TCE in Indoor and Outdoor Air (fact sheet), and
- Assessing the Human Health Risks of Trichloroethylene: Key Scientific Issues, a report issued by the National Research Council (NRC) of the National Academy of Sciences (July, 2006).

After reviewing these materials, I am recommending that we change Matrix 1. The 2.5 micrograms of trichloroethene per cubic meter of indoor air (2.5 mcg/m^3) in the column headings for Indoor Air Concentration of Compound in Matrix 1 should be reduced to 1.0 mcg/m^3. I am also recommending that mitigate be included as an option in Box 10 of Matrix 1 and Box 6 of Matrix 2.

Use of the Air Guideline

The purpose of the air guideline for TCE of 5 mcg/m^3 given in the fact sheet, "...is to help guide decisions about the nature of the efforts to reduce TCE exposures. Reasonable and practical actions should be taken to reduce TCE exposure when indoor air levels are above background, even when they are below the guideline of 5 mcg/m^3. The urgency to take actions increases as indoor air levels increase, especially when air

levels are above the guideline. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended action is to reduce TCE levels in indoor air to as close to background as practical." This general advice applies to all situations including the following:

an individual wants to know if he should keep a closed bottle of TCE in his house,
a school asks DOH if it has a problem with a bottle of TCE being in a shop, and
an office wants to know if it should do anything about residual exposure from past TCE use.

DOH also uses the guideline to make decisions about the need for remedial actions because of state regulated sources or sites. DOH would use this value to decide if it needs to work with the New York State Department of Environmental Conservation to reduce outdoor air levels of TCE. DOH also uses this value in Matrix 1, a decision making tool for responding to soil vapor intrusion problems; for this use, the guideline is considered to be a TCE concentration that should not be exceeded in indoor air.

Indoor Air Concentrations

Several different studies provide information about background levels of TCE in indoor air. These data differ because of a number of factors such as the criteria for choosing sampling locations, the time period of the studies, etc. Three studies give a 50^{th} percentile (less than 0.25 mcg/m^3, less than 1.4 mcg/m^3 and 0.12 mcg/m^3) and a 95^{th} percentile (less than 0.25 mcg/m^3, 1.36 mcg/m^3 and 4.2 mcg/m^3). Two studies provide a 75^{th} percentile (less than 0.25 mcg/m^3 and 1.2 mcg/m^3). One way to characterize these values is to state that background values are mostly less than 1 mcg/m^3 and frequently less than 0.25 mcg/m^3. (References: DOH 2003, USEPA 2001, and HEI, 2005)

Peer Review of the Derivation of the TCE Air Guideline

After receiving the TCE panel's comments, the Department considered changes in the guideline or Matrix 1. The TCE panel was asked to answer technical questions about the derivation of the guideline and a specific question on the guideline itself (Is the summary transparent and does it adequately justify the guideline of 5 mg/m^3?). In responding to the latter question, several panel members voiced their opinion about what they would select as a guideline. The consensus comment from the panel was "Some panel members suggested that additional consideration be given to lowering the guideline value."

The panel also commented on aspects of the guideline when answering questions about cancer risk estimates.

One of the panel's consensus comment was:

"The fact that TCE is a multi-species and multi-site carcinogen with a combination of both malignant and benign tumors should be further emphasized in the document

because these data coupled with the human data have led several authoritative bodies (EPA, NTP, & IARC) to the conclusion that TCE is on the cusp between a known and probable (likely, reasonably anticipated to be) human carcinogen. Thus, the NYSDOH should have flexibility in using risk levels of both 1 in 10^{-6} and 1 in 10^{-5}." (Part of response to question 4 of the TCE Panel's comments.)

Another consensus comment was:

"The rationale to utilize the human epidemiologic studies for weight of evidence support for the animal carcinogenicity studies rather than as the primary for the quantitative cancer risk assessment is appropriate. The weaknesses of the exposure estimates and potential confounding exposures support this decision. However, the DOH may want to consider the human studies to a greater extent when weighting the cancer evidence to establish a guideline." (Part of response to question 5 of the TCE Panel's comments)

Other, individual comments on the guideline follow.

George Lucier, Ph.D.

"Based on the available data, especially the cancer data, a guideline in the range of 1-5 mcg/m^3 could be justified. After all, a linear model cannot be rejected, for some sites acceptable risk levels are less than 5 mcg/m^3 and in some cases less than 1 mcg/m^3 and EPA has stated that TCE is highly likely to be a human carcinogen. The NYSDOH may wish to consider an acceptable risk level to be 3-5 cancers per million since TCE appears to be on the cusp between a known human carcinogen and a probable human carcinogen**."**

James Dix, Ph.D.

"The extensive review of the cancer literature in the draft document seems to indicate TCE levels giving 1×10^{-6} increased cancer risk can be in the range 0.1-1 mcg/m^3 (e.g., p. 132, 133, 141, 147, 149, and 150 of the draft document), which prima facia (sic) would support an air criterion of below 1 μ/m^3(sic). The DOH weighted these studies less. However, given the support on this scientific review panel for weighting the non-Hodgkin's lymphoma more strongly, an air criterion of less than 1 μg/m^3 might be justified."

NRC Report on Trichloroethene

In July 2006, the NRC released its report on TCE. We have reviewed that report. The approaches and methods we used to derive health-based air criteria for TCE are consistent with the recommendations of the NRC Committee. For example, both NRC and DOH identified kidney cancer, liver cancer, central nervous system effects, reproductive problems and developmental problems as human health endpoints that might be sensitive to the effects of TCE. NRC recommended that animal data, not human health data, be used to derive quantitative estimates of human cancer risks from TCE exposure and that the available human data be used only for validation. DOH used this approach in evaluating cancer risks.

Integration, Matrix 1 and Matrix 2

The attached tables compare the TCE criteria in the draft document with the revised TCE criteria in the final document. These data indicate that the guideline of 5 mcg/m^3 is below the recommended health-based criteria for non-cancer effects and that the excess lifetime cancer risks at the guideline are in the lower end of the risk range that is generally used by regulatory agencies when setting guidelines or standards. However, Matrix 1 is a major determinant for remediation in the soil vapor intrusion program, a state program addressing involuntary risks, and two revisions would help to align decisions in that program with the goals stated in the DOH TCE fact sheet and with the requirements of the Brownfields legislation.

In the current state program, mitigation is recommended when the potential for soil vapor intrusion to affect indoor air is high (sub-slab levels are equal to or greater than 250 mcg/m^3) regardless of the measured indoor air levels. However, when the potential for soil vapor intrusion to affect indoor air is moderate (sub-slab concentrations are equal to or greater than 50 mcg/m^3, but less than 250 mcg/m^3), mitigation is only recommended when an indoor air level is equal to or greater than 2.5 mcg/m^3. The excess risk levels associated with 2.5 mcg/m^3 range from 0.3 to 8 x 10^{-6}; the upper end of this range exceeds the 3 to 5 cancers per million recommended by Dr. Lucier and the 1 x 10^{-6} risk level given in the Brownfields legislation. This concentration also exceeds most background concentrations for TCE, a goal stated in the TCE fact sheet. Reducing 2.5 mcg/m^3 to 1.0 mcg/m^3 in Matrix 1 would result in recommending remediation at levels above most background levels and at risk levels of 0.1 to 3 x 10^{-6}.

In Matrix 1 of the draft soil vapor intrusion guidance, Box 10 (sub-slab vapor levels of 50 mcg/m^3 or greater to less than 250 mcg/m^3 and indoor air levels of 0.25 mcg/m^3 or greater to less than 2.5 mcg/m^3) recommends monitoring. (The recommendation in the previous paragraph would change 2.5 mcg/m^3 to 1.0 mcg/m^3.) Box 10 addresses situations where the potential for soil vapor to affect indoor air is moderate, but indoor air levels are in the range of most background levels. Recommending an option for mitigation in Box 10 when environmental factors for a specific site suggest a high potential for indoor air concentrations to increase is consistent with the goals outlined in the previous paragraph. A similar mitigation option is recommended for Box 6 of Matrix 2.

Attachments

P:\Trichloroethene\RT memo.doc

Table 1. Non-Carcinogenic Effects: Draft and Final Criteria Used in Guideline Derivation.

Organ/System/ Lifestage	Study*	Recommended TCE Air Criteria (mcg/m^3)			
		Draft		Final	
		Study	System	Study	System
CNS	Arito et al. (1994)	40	40	4 (childhood)	10
	Rasmussen et al. (1993)	40		11 (adult & childhood)	
Liver	Kjellstrand et al. (1983)	160	160	160 (adult & childhood)	160
Kidney	Kjellstrand et al. (1983)	165	165	160 (adult & childhood)	160
Reproduction	Land et al. (1981)	32	32	32	20
	DuTeaux et al. (2004)	110		110	
	Kumar et al. (2000; 2001a)	not done		20	
	NTP (1986)	not done		110	
Developmental	Dawson et al. (1993)	11	11	11 (supporting study)	20
	Healy et al. (1982)	38		38	
	Isaacson & Taylor (1989)	19		19	
	NTP (1986)	not done		22	

*References from Trichloroethene Air Criteria Document.

Table 2. Carcinogenic Effects: Draft and Final Criteria Used in Guideline Derivation.

Cancer	Recommended TCE Air Criteria (mcg/m^3)*					
	Draft			Final		
	LADE		LADD (PBPK)	LADE		LADD (PBPK)
	Unadjusted	Adjusted**		Unadjusted	Adjusted**	
Animal Data (Fukuda et al., 1983; Henschler et al., 1980; Maltoni et al., 1986)***						
liver	1.8	not done	1.4	1.8	1.1	1.4
kidney	13	not done	3100	13	7.8	3100
lymphoma	not a recommended site			0.3	not done	not done given uncertainty in appropriate internal dose & mode of action
testes (benign)	not a recommended site					
lung	not a recommended site					
Human Data (Hansen et al., 2001)***						
esophagus	0.077 – 1.2#	not done	not done	0.36 – 1.2##	not done	not done
NHL	0.062 – 0.91#	not done	not done	0.29 – 0.91##	not done	not done

*Air concentrations associated with an excess lifetime human risk of 1 x 10^{-6} are provided for comparative purposes, air concentrations associated with excess risks 1 x 10^{-5} and 1 x 10^{-4} are 10X and 100X the given concentration.

**The LADE (lifetime average daily exposure) estimates based on linear low-dose extrapolation are unadjusted and adjusted for the potential increased sensitivity of children to the early-life TCE exposures following US EPA guidance. Adjusted values were not calculated using age-specific internal dose metrics (LADD, lifetime average daily dose) because validated TCE PBPK models for children are unavailable and because of additional uncertainties associated with estimating model parameter values for children. Adjusted values were not calculated based on lymphomas because the mode-of-action for those cancers is unknown, and in such cases, the US EPA guidance recommends using unadjusted values.

***References from Trichloroethene Air Criteria Document.

Range of values based on two measures of relative risk, two occupational exposure levels, and three estimates of exposure duration.

Range of values based on two measures of relative risk, one occupational exposure level, and three estimates of exposure duration.

Soil Vapor/Indoor Air Matrix A

May 2017

Analytes Assigned:
Trichloroethene (TCE), *cis*-1,2-Dichloroethene (*c*-1,2-DCE), 1,1-Dichloroethene (1,1-DCE), Carbon Tetrachloride

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)		
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 0.2	0.2 to < 1	1 and above
< 6	1. No further action	2. No Further Action	3. IDENTIFY SOURCE(S) and RESAMPLE or MITIGATE
6 to < 60	4. No further action	5. MONITOR	6. MITIGATE
60 and above	7. MITIGATE	8. MITIGATE	9. MITIGATE

mcg/m^3 = micrograms per cubic meter

No further action: No additional actions are recommended to address human exposures.

Identify Source(s) and Resample or Mitigate: We recommend that reasonable and practical actions be taken to identify the source(s) affecting the indoor air quality and that actions be implemented to reduce indoor air concentrations to within background ranges. For example, if an indoor or outdoor air source is identified, we recommend the appropriate party implement actions to reduce the levels. In the event that indoor or outdoor sources are not readily identified or confirmed, resampling (which might include additional sub-slab vapor and indoor air sampling locations) is recommended to demonstrate that SVI mitigation actions are not needed. Based on the information available, mitigation might also be recommended when soil vapor intrusion cannot be ruled out.

Monitor: We recommend monitoring (sampling on a recurring basis), including but not necessarily limited to sub-slab vapor, basement air and outdoor air sampling, to determine whether concentrations in the indoor air or sub-slab vapor have changed and/or to evaluate temporal influences. Monitoring might also be recommended to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined based on site-, building- and analyte-specific information, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: We recommend mitigation to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

These general recommendations are made with consideration being given to the additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX A

This matrix summarizes actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate analyte-specific, building-specific conditions (e.g., dirt floor in basement, crawl spaces, thick slabs, current occupancy, etc.), and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, collection of additional samples may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Mitigation might be recommended when the results of multiple contaminants indicate monitoring is recommended. Proactive actions may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action might be undertaken for reasons other than public health (e.g., seeking community acceptance, reducing costs, etc.). However, actions implemented *in lieu* of sampling will typically be expected to be captured in the final engineering report and site management plan, and might not rule out the need for post-implementation sampling (e.g., to document effectiveness or to support terminating the action).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of soil vapor contamination, nor does it preclude remediating contaminated soil vapor or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 0.20 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples and dirt floor soil vapor samples, a minimum reporting limit of 1 microgram per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions might be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including but not limited to the following: the identified source of the volatile chemicals, the environmental remediation program, and analyte-specific, site-specific and building-specific factors.

Soil Vapor/Indoor Air Matrix B

May 2017

Analytes Assigned:
Tetrachloroethene (PCE), 1,1,1-Trichloroethane (1,1,1-TCA), Methylene Chloride

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m³)		
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m³)	< 3	3 to < 10	10 and above
< 100	1. No further action	2. No Further Action	3. IDENTIFY SOURCE(S) and RESAMPLE or MITIGATE
100 to < 1,000	4. No further action	5. MONITOR	6. MITIGATE
1,000 and above	7. MITIGATE	8. MITIGATE	9. MITIGATE

mcg/m³ = micrograms per cubic meter

No further action: No additional actions are recommended to address human exposures.

Identify Source(s) and Resample or Mitigate: We recommend that reasonable and practical actions be taken to identify the source(s) affecting the indoor air quality and that actions be implemented to reduce indoor air concentrations to within background ranges. For example, if an indoor or outdoor air source is identified, we recommend the appropriate party implement actions to reduce the levels. In the event that indoor or outdoor sources are not readily identified or confirmed, resampling (which might include additional sub-slab vapor and indoor air sampling locations) is recommended to demonstrate that SVI mitigation actions are not needed. Based on the information available, mitigation might also be recommended when soil vapor intrusion cannot be ruled out.

Monitor: We recommend monitoring (sampling on a recurring basis), including but not necessarily limited to sub-slab vapor, basement air and outdoor air sampling, to determine whether concentrations in the indoor air or sub-slab vapor have changed and/or to evaluate temporal influences. Monitoring might also be recommended to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined based on site-, building- and analyte-specific information, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: We recommend mitigation to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

These general recommendations are made with consideration being given to the additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX B

This matrix summarizes actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate analyte-specific, building-specific conditions (e.g., dirt floor in basement, crawl spaces, thick slabs, current occupancy, etc.), and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, collection of additional samples may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Mitigation might be recommended when the results of multiple contaminants indicate monitoring is recommended. Proactive actions may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action might be undertaken for reasons other than public health (e.g., seeking community acceptance, reducing costs, etc.). However, actions implemented *in lieu* of sampling will typically be expected to be captured in the final engineering report and site management plan, and might not rule out the need for post-implementation sampling (e.g., to document effectiveness or to support terminating the action).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of soil vapor contamination, nor does it preclude remediating contaminated soil vapor or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 1 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples and dirt floor soil vapor samples, a minimum reporting limit of 1 microgram per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions might be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including but not limited to the following: the identified source of the volatile chemicals, the environmental remediation program, and analyte-specific, site-specific and building-specific factors.

Soil Vapor/Indoor Air Matrix C

May 2017

Analytes Assigned:
Vinyl Chloride

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)	
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 0.2	0.2 and above
< 6	1. No further action	3. IDENTIFY SOURCE(S) and RESAMPLE or MITIGATE
6 to < 60	4. MONITOR	6. MITIGATE
60 and above	7. MITIGATE	9. MITIGATE

mcg/m^3 = micrograms per cubic meter

No further action: No additional actions are recommended to address human exposures.

Identify Source(s) and Resample or Mitigate: We recommend that reasonable and practical actions be taken to identify the source(s) affecting the indoor air quality and that actions be implemented to reduce indoor air concentrations to within background ranges. For example, if an indoor or outdoor air source is identified, we recommend the appropriate party implement actions to reduce the levels. In the event that indoor or outdoor sources are not readily identified or confirmed, resampling (which might include additional sub-slab vapor and indoor air sampling locations) is recommended to demonstrate that SVI mitigation actions are not needed. Based on the information available, mitigation might also be recommended when soil vapor intrusion cannot be ruled out.

Monitor: We recommend monitoring (sampling on a recurring basis), including but not necessarily limited to sub-slab vapor, basement air and outdoor air sampling, to determine whether concentrations in the indoor air or sub-slab vapor have changed and/or to evaluate temporal influences. Monitoring might also be recommended to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined based on site-, building- and analyte-specific information, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: We recommend mitigation to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

These general recommendations are made with consideration being given to the additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX C

This matrix summarizes actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate analyte-specific, building-specific conditions (e.g., dirt floor in basement, crawl spaces, thick slabs, current occupancy, etc.), and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, collection of additional samples may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Mitigation might be recommended when the results of multiple contaminants indicate monitoring is recommended. Proactive actions may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action might be undertaken for reasons other than public health (e.g., seeking community acceptance, reducing costs, etc.). However, actions implemented *in lieu* of sampling will typically be expected to be captured in the final engineering report and site management plan, and might not rule out the need for post-implementation sampling (e.g., to document effectiveness or to support terminating the action).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of soil vapor contamination, nor does it preclude remediating contaminated soil vapor or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 0.20 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples and dirt floor soil vapor samples, a minimum reporting limit of 1 microgram per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions might be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including but not limited to the following: the identified source of the volatile chemicals, the environmental remediation program, and analyte-specific, site-specific and building-specific factors.

Soil Vapor/Indoor Air Matrix D

February 2024

Analytes Assigned:
Benzene, ethylbenzene, naphthalene, cyclohexane, isooctane (2,2,4-trimethylpentane), 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, *o*-xylene

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m³)		
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m³)	< 2	2 to < 10	10 and above
< 60	1. No further action	2. No Further Action	3. IDENTIFY SOURCE(S) or RESAMPLE or MITIGATE
60 to < 600	4. No further action	5. MONITOR	6. MITIGATE
600 and above	7. MITIGATE	8. MITIGATE	9. MITIGATE

mcg/m³ = micrograms per cubic meter

No further action: No additional actions are recommended to address human exposures.

Identify Source(s) or Resample or Mitigate: We recommend that reasonable and practical actions be taken to identify the source(s) affecting the indoor air quality and that actions be implemented to reduce indoor air concentrations to within background ranges. For example, if an indoor or outdoor air source is identified, we recommend the appropriate party implement actions to reduce the levels. In the event that indoor or outdoor sources are not readily identified or confirmed, resampling (which might include additional sub-slab vapor and indoor air sampling locations) is recommended to demonstrate that SVI mitigation actions are not needed. Based on the information available, mitigation might also be recommended when soil vapor intrusion cannot be ruled out.

Monitor: We recommend monitoring (sampling on a recurring basis), including but not necessarily limited to sub-slab vapor, basement air and outdoor air sampling, to determine whether concentrations in the indoor air or sub-slab vapor have changed and/or to evaluate temporal influences. Monitoring might also be recommended to determine whether existing building conditions (e.g., positive pressure heating, ventilation, and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined based on site-, building- and analyte-specific information, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: We recommend mitigation to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building -specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

These general recommendations are made with consideration being given to the additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX D

This matrix summarizes actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate analyte-specific, building-specific conditions (e.g., dirt floor in basement, crawl spaces, thick slabs, current occupancy, etc.), and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, collection of additional samples may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Mitigation might be recommended when the results of multiple contaminants indicate monitoring is recommended. Proactive actions may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action might be undertaken for reasons other than public health (e.g., seeking community acceptance, reducing costs, etc.). However, actions implemented *in lieu* of sampling will typically be expected to be captured in the final engineering report and site management plan, and might not rule out the need for post-implementation sampling (e.g., to document effectiveness or to support terminating the action).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of soil vapor contamination, nor does it preclude remediating contaminated soil vapor or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 1 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples and dirt floor soil vapor samples, a minimum reporting limit of 1 microgram per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions might be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including but not limited to the following: the identified source of the volatile chemicals, the environmental remediation program, and analyte-specific, site-specific and building-specific factors.

Soil Vapor/Indoor Air Matrix E

February 2024

Analytes Assigned:
m,p-xylene, heptane, hexane

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m³)		
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m³)	< 6	6 to < 20	20 and above
< 200	1. No further action	2. No Further Action	3. IDENTIFY SOURCE(S) or RESAMPLE or MITIGATE
200 to < 2,000	4. No further action	5. MONITOR	6. MITIGATE
2,000 and above	7. MITIGATE	8. MITIGATE	9. MITIGATE

mcg/m³ = micrograms per cubic meter

No further action: No additional actions are recommended to address human exposures.

Identify Source(s) or Resample or Mitigate: We recommend that reasonable and practical actions be taken to identify the source(s) affecting the indoor air quality and that actions be implemented to reduce indoor air concentrations to within background ranges. For example, if an indoor or outdoor air source is identified, we recommend the appropriate party implement actions to reduce the levels. In the event that indoor or outdoor sources are not readily identified or confirmed, resampling (which might include additional sub-slab vapor and indoor air sampling locations) is recommended to demonstrate that SVI mitigation actions are not needed. Based on the information available, mitigation might also be recommended when soil vapor intrusion cannot be ruled out.

Monitor: We recommend monitoring (sampling on a recurring basis), including but not necessarily limited to sub-slab vapor, basement air and outdoor air sampling, to determine whether concentrations in the indoor air or sub-slab vapor have changed and/or to evaluate temporal influences. Monitoring might also be recommended to determine whether existing building conditions (e.g., positive pressure heating, ventilation, and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined based on site-, building- and analyte-specific information, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: We recommend mitigation to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building -specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

These general recommendations are made with consideration being given to the additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX E

This matrix summarizes actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate analyte-specific, building-specific conditions (e.g., dirt floor in basement, crawl spaces, thick slabs, current occupancy, etc.), and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, collection of additional samples may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Mitigation might be recommended when the results of multiple contaminants indicate monitoring is recommended. Proactive actions may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action might be undertaken for reasons other than public health (e.g., seeking community acceptance, reducing costs, etc.). However, actions implemented *in lieu* of sampling will typically be expected to be captured in the final engineering report and site management plan, and might not rule out the need for post-implementation sampling (e.g., to document effectiveness or to support terminating the action).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of soil vapor contamination, nor does it preclude remediating contaminated soil vapor or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 1 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples and dirt floor soil vapor samples, a minimum reporting limit of 1 microgram per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions might be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including but not limited to the following: the identified source of the volatile chemicals, the environmental remediation program, and analyte-specific, site-specific and building-specific factors.

Soil Vapor/Indoor Air Matrix F

February 2024

Analytes Assigned:
Toluene

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m³)		
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m³)	< 10	10 to < 50	50 and above
< 300	1. No Further Action	2. No Further Action	3. IDENTIFY SOURCE(S) or RESAMPLE or MITIGATE
300 to < 3,000	4. No Further Action	5. MONITOR	6. MITIGATE
3,000 and above	7. MITIGATE	8. MITIGATE	9. MITIGATE

mcg/m³ = micrograms per cubic meter

No further action: No additional actions are recommended to address human exposures.

Identify Source(s) or Resample or Mitigate: We recommend that reasonable and practical actions be taken to identify the source(s) affecting the indoor air quality and that actions be implemented to reduce indoor air concentrations to within background ranges. For example, if an indoor or outdoor air source is identified, we recommend the appropriate party implement actions to reduce the levels. In the event that indoor or outdoor sources are not readily identified or confirmed, resampling (which might include additional sub-slab vapor and indoor air sampling locations) is recommended to demonstrate that SVI mitigation actions are not needed. Based on the information available, mitigation might also be recommended when soil vapor intrusion cannot be ruled out.

Monitor: We recommend monitoring (sampling on a recurring basis), including but not necessarily limited to sub-slab vapor, basement air and outdoor air sampling, to determine whether concentrations in the indoor air or sub-slab vapor have changed and/or to evaluate temporal influences. Monitoring might also be recommended to determine whether existing building conditions (e.g., positive pressure heating, ventilation, and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined based on site-, building- and analyte-specific information, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: We recommend mitigation to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building -specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

These general recommendations are made with consideration being given to the additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX F

This matrix summarizes actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate analyte-specific, building-specific conditions (e.g., dirt floor in basement, crawl spaces, thick slabs, current occupancy, etc.), and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, collection of additional samples may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Mitigation might be recommended when the results of multiple contaminants indicate monitoring is recommended. Proactive actions may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action might be undertaken for reasons other than public health (e.g., seeking community acceptance, reducing costs, etc.). However, actions implemented *in lieu* of sampling will typically be expected to be captured in the final engineering report and site management plan, and might not rule out the need for post-implementation sampling (e.g., to document effectiveness or to support terminating the action).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of soil vapor contamination, nor does it preclude remediating contaminated soil vapor or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 1 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples and dirt floor soil vapor samples, a minimum reporting limit of 1 microgram per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions might be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including but not limited to the following: the identified source of the volatile chemicals, the environmental remediation program, and analyte-specific, site-specific and building-specific factors.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix B

Indoor air quality questionnaire and building inventory

As discussed in Section 2.11, products in buildings should be inventoried every time indoor air is sampled to provide an accurate assessment of the potential contribution of volatile chemicals. In addition, the type of structure, floor layout and physical conditions of the building being studied should be noted to identify (and minimize) conditions that may interfere with the proposed testing.

Toward this end, a blank copy of the NYSDOH Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory is provided in this appendix. Also provided is an example that demonstrates how the form should be completed properly.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

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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_____

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	Other: _____

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_____

If multiple units, how many? _____

If the property is commercial, type?

Business Type(s) _____

Does it include residences (i.e., multi-use)? Y / N If yes, how many? _____

Other characteristics:

Number of floors_____ Building age_____

Is the building insulated? Y / N How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and 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
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 / not applicable			

Basement/Lowest level depth below grade: _____(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

_____

_____

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 _____

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: _____

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other_____
Air conditioning:	Central Air	Window units	Open Windows	None

Are there air distribution ducts present? 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., familyroom, 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) 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? Y / N If yes, where vented?_____

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type?_____

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: _____

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: _____

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

11. 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.

Basement:

First Floor:

12. 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.

13. PRODUCT INVENTORY FORM

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.

OSR – 3 Example 1 Correct

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 Mary Jones Date/Time Prepared 10/22/04 10:00am

Preparer's Affiliation XYZ Consulting Phone No. 518-555-1212

Purpose of Investigation Thomasville Soil Vapor Intrusion Investigation (Site#32141)

1. OCCUPANT:

Interviewed: (Y)/ N

Last Name: Smith First Name: Carol

Address: 25 Main Street Thomasville, New York 25230

County: Albany

Home Phone: 518-556-2222 Office Phone: 518-556-2400

Number of Occupants/persons at this location 2 Age of Occupants 36, 10

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y (N)

Last Name: White First Name: Frank

Address: 64 Mountain Road Bainbridge, New York 26390

County: Dutchess

Home Phone: 845-876-1301 Office Phone: 845-227-2430

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

(Residential)	School	Commercial/Multi-Use
Industrial	Church	Other: _____

Example Correct 2

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? NA

If the property is commercial, type?

Business Type(s) NA

Does it include residences (i.e. multi-use)? Y / N If yes, how many? _____

Other characteristics:

Number of floors 1 Building age 20 years

Is the building insulated? (Y) / N How air tight? (Tight) / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

Basement air flows up to 1st floor through plumbing waste line and domestic water line floor penetrations

Airflow near source

Yes, furnace/oil tank area open to rest of basement

Outdoor air infiltration

Outdoor air enters at loose bilco doorway openings, and at sill plate near furnace.

Infiltration into air ducts

Basement air flows into bottom of hot air unit and in loose cold air return joints.

Example Correct 3

5. **BASEMENT AND CONSTRUCTION CHARACTERISTICS** (Circle all that apply)

a. Above grade construction:	(wood frame)	concrete	stone	brick
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 / (not applicable)			

Basement/Lowest level depth below grade: 6 (feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

Floor drain in laundry area

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 _____

The primary type of fuel used is:

Natural Gas	(Fuel Oil)	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: gas

Boiler/furnace located in: (Basement) Outdoors Main Floor Other _____

Air Conditioning: Central Air (Window units) Open Windows None

Example Correct 4

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.

Cold air return ductwork on ceiling in basement. Cold air return joints appear loose.

7. OCCUPANCY

Basement / Is lowest level occupied? Full time Occasionally (Seldom) Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	Storage and laundry
1st Floor	living area and bedrooms
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 etc.)	(Y) N / NA Please specify lawnmower, car
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? w/in week - windex, tilex
i. Have cosmetic products been used recently?	(Y) N When & Type? yesterday - hairspray

Example Correct

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? carpet in dining room

l. Have air fresheners been used recently? Y / (N) When & Type? _____

m. Is there a kitchen exhaust fan? (Y) N If yes, where vented? outside

n. Is there a bathroom exhaust fan? Y / (N) If yes, where vented? _____

o. Is there a clothes dryer? (Y) / N If yes, is it vented outside? (Y) N

p. Has there been a pesticide application? Y / (N) When & Type? _____

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, automechanic or autobody shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist etc.)

If yes, what types of solvents are used? hair salon dyes, alcohols, peroxides, acetone

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: June 2000
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: _____

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: not applicable

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

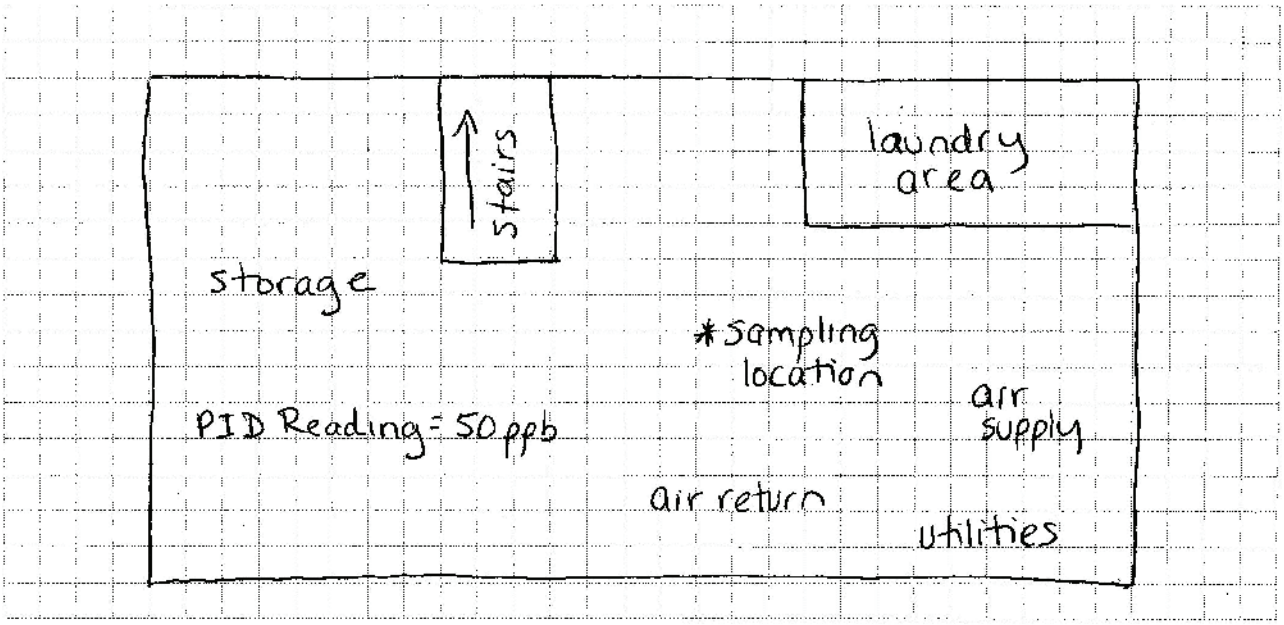
d. Relocation package provided and explained to residents? Y / N

Example Correct

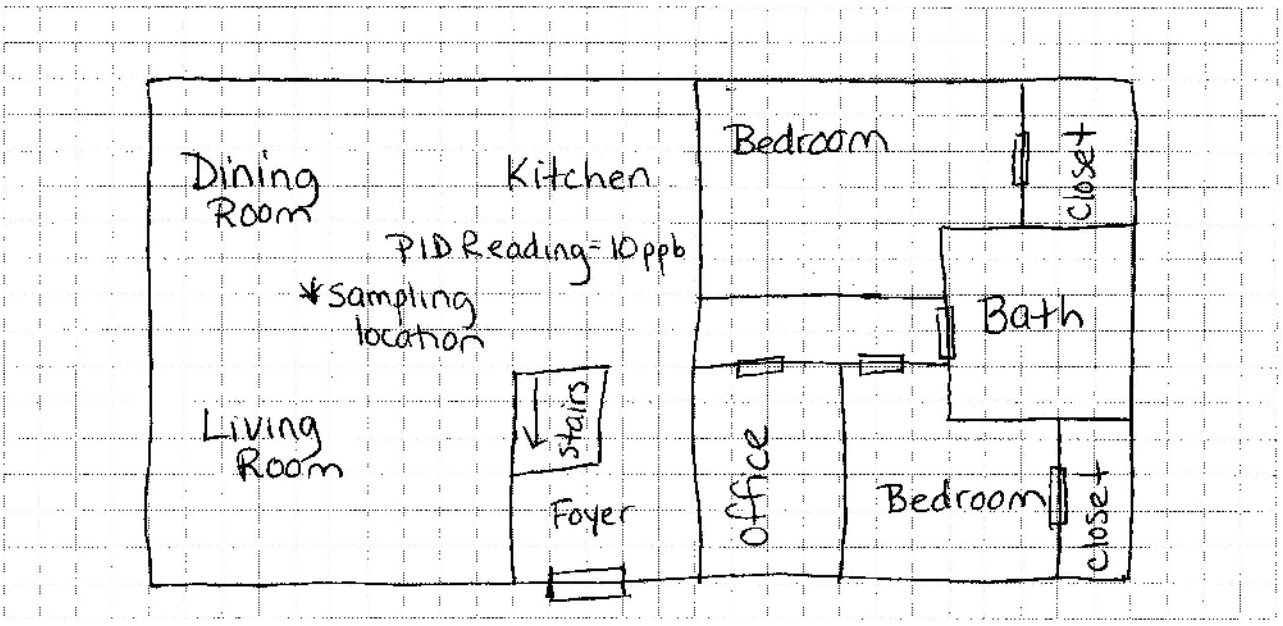
11. FLOOR PLANS

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.

Basement:



First Floor:

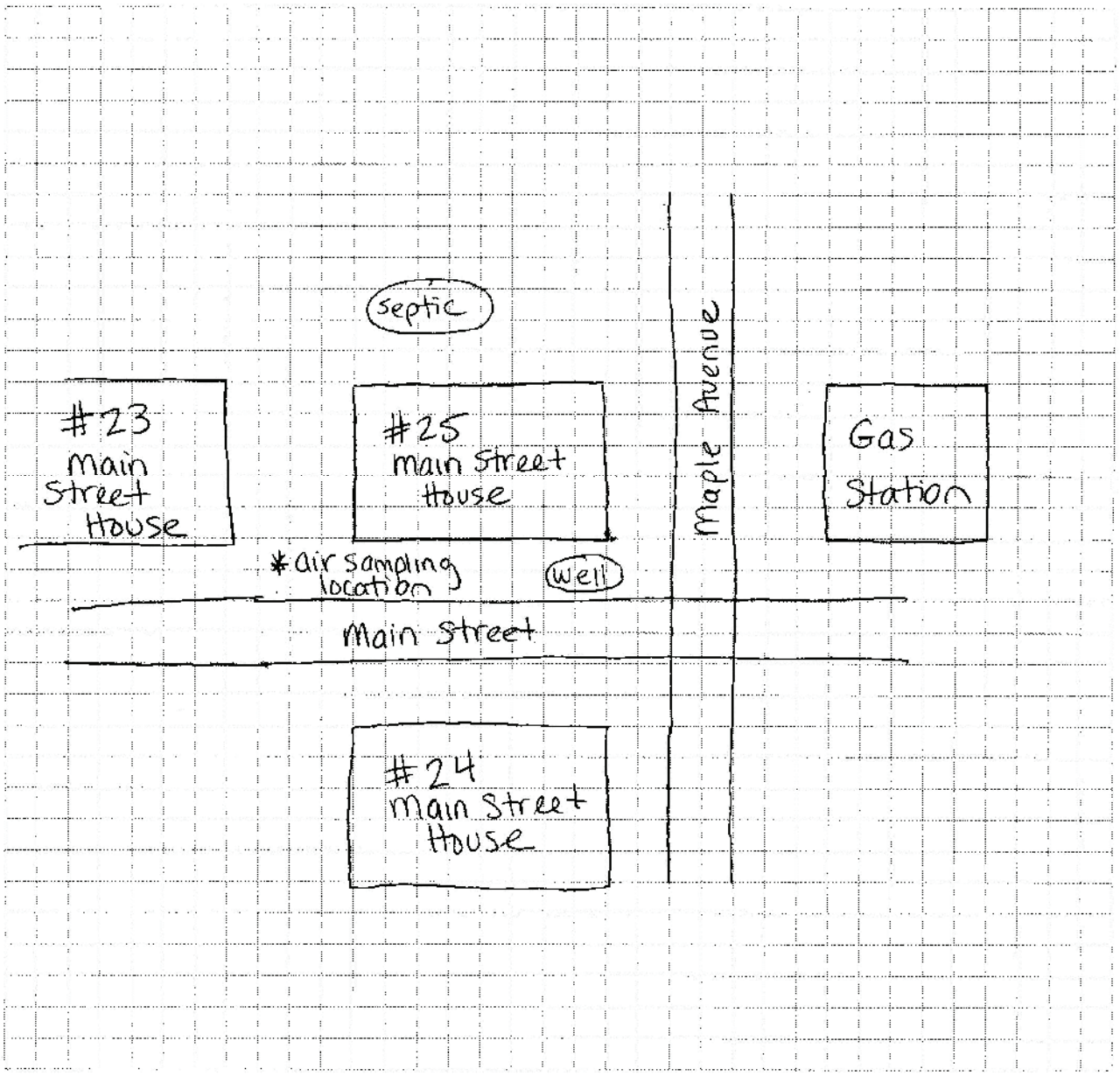


Example Correct 7

12. 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.



Example Correct 8

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: RAE photoionization detector

List specific products found in the residence that have the potential to affect indoor air quality.

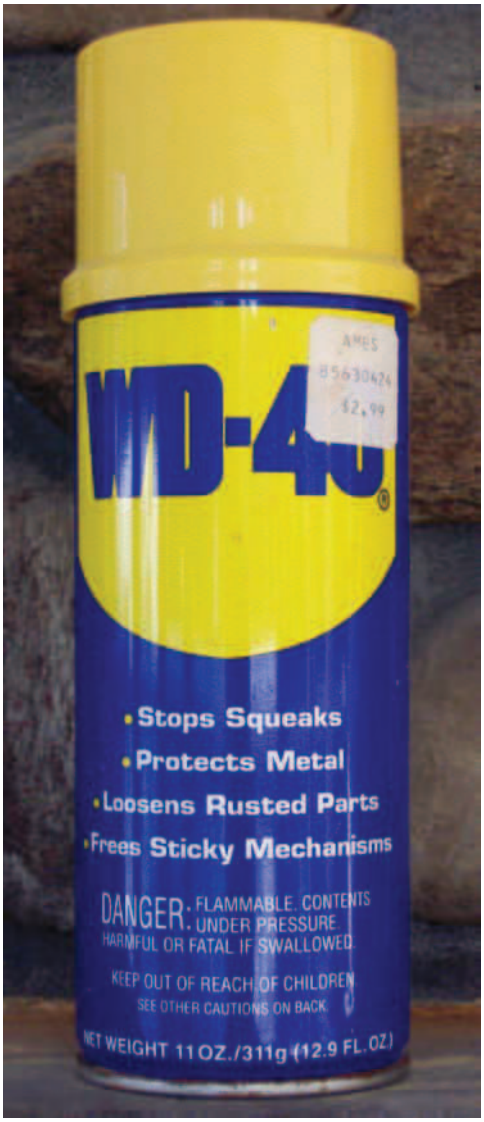
Location	Product Description	Size (oz.)	Condition*	Chemical Ingredients	Field Instrument Reading	Photo** Y / N
Kitchen	WD-40	12oz	UO	See photo	10 ppb	Y
garage	mineral spirits	24oz	U	benzene, toluene	15 ppb	N
garage	American Semi-Gloss latex paint	64oz	U	titanium dioxide, ethylene, glycol, aluminum hydroxide, 2,2,4-trimethyl 1-1,3-pentanediol isobutyrate, Vinyl acetate	2 ppb	N
garage	Krylon Semi-gloss oil paint	64oz	D	butane, propane, titanium dioxide, xylene, ethylbenzene, acetone, MEK, butanol, MIK	10 ppb	N
garage	Rustoleum	12oz	U	talc, calcium carbonate, titanium dioxide, xylene, ethylbenzene, acetone, liquified petroleum gases, pentaerythritol	4 ppb	N
garage	Deep 6 Double Strength Insect Repellent	8oz	D	propane, isobutane, N,N-Diethyl-meta-toluamide, Di-n-propyl isocinchomeronate	0.5 ppb	N
basement	12 cans latex paint	128oz	U	talc, titanium dioxide, Kaolin clay, 2,24-trimethyl-1,3 pentanediol isobutyrate, vinyl acetate	0	N

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

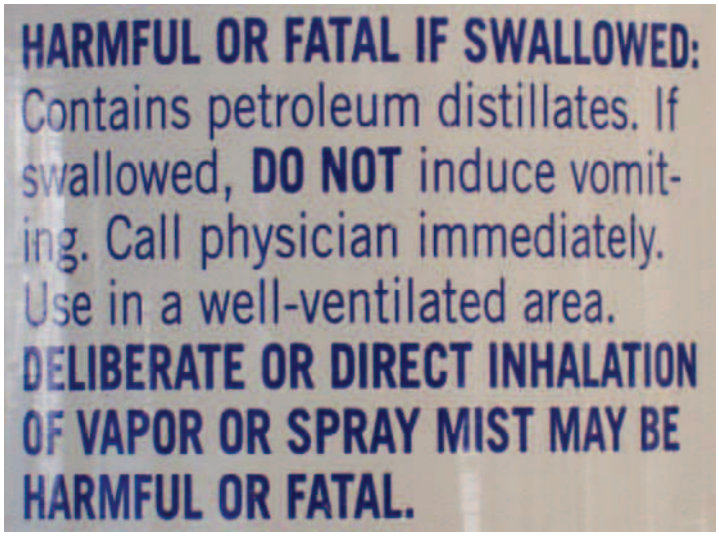
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

Product Inventory Attachment — 25 Main Street, City

WD-40 FRONT



WD-40 INGREDIENTS



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NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix C

Volatile organic chemicals in air — summary of background databases

A detailed description of each background database introduced in Section 3.2.4 is provided in this appendix.

C.1 NYSDOH 2003: Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes

Between 1997 and 2003, the New York State Department of Health (NYSDOH) conducted a study of the occurrence of volatile organic chemicals (VOCs) in the indoor air of homes that heat with fuel oil. The purpose of the study was to characterize the indoor environment of fuel oil heated homes as a means of evaluating post clean-up conditions in residences affected by petroleum spills. The study included basement, living space and outdoor samples from 104 homes, tested during both heating and non-heating seasons. Most of the more than 600 samples collected in the study were analyzed for 69 individual VOCs. This summary report presents the results to help characterize commonly found concentrations of these 69 compounds in the indoor and outdoor air of residential settings heated with fuel oil.

The study is comprised of single family homes heated with fuel oil. With the exception of New York City, homes from across the state were included in the study, with the majority of the homes being near the Albany area. Prospective residences were required to have no past oil spills, no hobbies or home business that regularly use products containing VOCs, and no recent activities utilizing products that contain VOCs (e.g. painting, staining). A pre-sampling inspection was conducted in each home and included completing a building questionnaire to gather building information such as age, basement characteristics, heating and ventilation parameters, location of fuel oil tank, garage placement, etc. and an inventory of products that might be sources of indoor VOCs. When present, the products and their ingredients were listed on the inventory form. In addition, the product containers were screened with a photoionization detector (PID) to identify potential chemical interference during each sampling event and elevated readings were noted on the inventory forms. In most homes, gross sources of VOCs were not identified and containers were generally found to be sealed tightly. In some homes the PID detected elevated VOC levels associated with a product; however, the products were not removed and samples were still collected.

Sampling was performed in a manner consistent with the NYSDOH's February 1, 2005, Indoor Air Sampling and Analysis Guidance (available on the NYSDOH's web site at http://www.health.state.ny.us/nysdoh/indoor/guidance.htm). Two-hour samples were collected in 6-liter pre-cleaned, passivated, evacuated whole air canisters prepared and analyzed at the NYSDOH's Wadsworth Center laboratory. The samples were analyzed in accordance with EPA Method TO-15 utilizing a Tekmar® AutoCan® concentrator / Agilent® 6890/5973 GC/MSD analytical system. The method detection limits for all compounds except hexachlorobutadiene were 0.25 micrograms per cubic meter (mcg/m^3). The method detection limit for hexachlorobutadiene was 0.43 mcg/m^3.

The dataset exhibits a lognormal distribution typical of environmental data. Table C1 provides a summary of the indoor and outdoor air data. It contains the mean, 25^{th}, 50^{th},

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
75th, 90th percentile values and the upper fence value for each compound. The upper fence is calculated as 1.5 times the interquartile range (difference between the 25th and 75th percentile values) above the 75th percentile value. The upper fence is a boundary used for identifying the presence of outliers in the data. In cases where the 25th or 75th percentiles were below the laboratory detection limit of 0.25 mcg/m^3, randomly generated values between 0.000 and 0.250 were used in calculating the upper fence. All of the values calculated for the lower fence were negative and are not included in the table. For hexachlorobutadiene, the randomly generated values used to calculate the upper fence ranged from 0.000 to 0.430. All of the values are adjusted to two significant figures. A summary of the study can be obtained at the NYSDOH's web site: http://www.health.state.ny.us/nysdoh/indoor/fuel_oil.htm.

C.2 EPA 2001: Building Assessment and Survey Evaluation (BASE) Database

From 1994 through 1996, the EPA conducted a study of indoor air quality referred to as the Building Assessment and Survey Evaluation (BASE '94-'96). The study included measurement of VOCs, radon, formaldehyde, carbon monoxide, carbon dioxide, and particulates in indoor and outdoor air at 100 randomly selected public and commercial office buildings across the United States. Each building was sampled for a one-week period in either winter or summer. Buildings had a targeted occupancy of no less than 50 full-time employees and were served by no more than two air handling units. Physical characteristics of the buildings such as size, age, construction and heating and ventilation parameters were recorded. Ambient sources of VOCs were also characterized for the entire building and in the individual sample locations. The study excluded any buildings with highly publicized indoor air quality complaints; therefore, data from the study should be representative of conventional office buildings.

Two methods were used to measure VOC concentrations in the BASE study. Air samples were collected into passivated, evacuated whole air canisters (SUMMA®, TO-Can®, etc.) from all 100 buildings. In addition, air samples were concurrently collected on multisorbent tubes from 70 of the 100 buildings. Six-liter canister air samples were collected over a nominal nine-hour period and analyzed by gas chromatography/mass spectroscopy using EPA Method TO-14. The multisorbent tubes were filled with glass beads, Tenax TA, Ambersorb XE-340, and activated carbon and 2.5 liters of ambient air were collected over an eight-hour period. The tube samples were thermally desorbed and analyzed by gas chromatography/mass spectrometry using EPA Method TO-1. Method reporting limits ranged from 0.2 to 7.0 mcg/m^3.

BASE '94-'96 VOC data was received from the EPA in late 2001. Minimum, maximum, means and the 25th, 50th, 75th, 90th, 95th and 99th percentile values were calculated. For data analysis, all voided samples, blank samples, and samples that could not be analyzed were removed. The result for any sample or analyte that was marked as below the detection limit was assigned the value of one half the detection limit. Buildings in the BASE '94-'98 study generally had three indoor air VOC samples and one VOC outdoor sample for each method. Table C2 provides a summary of the indoor and outdoor air samples analyzed by SUMMA® canisters only. The table will be revised after EPA releases their final version of the study.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

C.3 NYSDOH 1997: Control Home Database

From 1989-1996, the NYSDOH collected 228 indoor and outdoor air samples from 53 residences used as control homes in New York State investigations. Control homes were defined and selected to represent homes with neighborhood, construction, and occupancy similar to homes being investigated for VOC impacts on indoor air. Control homes also had no unusual source of VOCs, such as a past oil spill, recent refinishing or painting activities, or proximity to the VOC source being investigated.

Air samples in control homes were collected from the basement, a room considered a living space (such as a living room, dining room, or bedroom), and outdoors. An inventory of recent activities, stored household products and heating fuel type was made at the time of sampling. Air samples were collected by one of two methods: 6-liter pre-cleaned, passivated, evacuated whole air canisters (SUMMA®, TO-Can®, etc.), analyzed with Method TO-14 (EPA 1988), or Porapak adsorbent tubes, analyzed using NYSDOH method 311-6 (NYSDOH 1991). Through 1992, both methods were used about equally. After 1992, most samples were collected with Summa® canisters. About 20% of the samples were collected with a sampling time of 12 hours. The rest of the samples had sampling times of one to four hours. The NYSDOH Wadsworth Center Laboratories analyzed all samples.

The reporting limits for some compounds in samples from 1989 and 1990 were sometimes higher than 10 mcg/m^3. Analyses where compounds were reported as not detected with reporting limits greater than 10 mcg/m^3 were excluded from the database. In the 1990s reporting limits were lowered (due to improvements made in analytical equipment and methods) and some compounds were detected more frequently. Data from the later years of this study demonstrated that median levels of all compounds (except toluene) were less than 10 mcg/m^3.

The minimum, maximum, mean, median, 5^{th}, 25^{th}, 50th, 75^{th}, 95^{th} and 99^{th} percentiles were calculated. To calculate these descriptive statistics, compounds not detected in the samples and compounds reported as present but less than the reporting limit were assigned a value equal to one half the reporting limit. Table C3 provides a summary of these data.

C.4 EPA 1988: National Ambient Volatile Organic Compounds (VOCs) Data Base Update

This database is a compilation of available air data published for the EPA in 1988. The document includes data from the original EPA database published in 1983 (Brodzinsky and Singh, 1983), which was an evaluation of 241 published reports from the years 1970 to 1980. Additional published and unpublished data for VOCs were also evaluated and included through 1987. The database covers the concentrations of more than 300 VOCs in outdoor (urban, rural, remote, source-dominated) and indoor settings. Indoor air data are limited to residential and office space, and excludes studies of emissions or sources, solely health-related studies, laboratory or modeling studies, and industrial workplace studies. Outdoor air data are limited to locations beyond the fence line of industrial and commercial facilities releasing VOCs.

Each data record includes maximum and minimum concentrations; the total number of measurements included in the average and the number of those that were below the detection limit or equal to zero. The 25^{th}, 50^{th} (median) and 75^{th} percentiles were also calculated. Table C4 provides a summary of these data for a limited number of compounds reported in the publication.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

C.5 Health Effects Institute 2005: Relationship of Indoor, Outdoor and Personal Air

The Relationships of Indoor, Outdoor and Personal Air (RIOPA) study was designed to provide information in assessing the possible public health risks from air toxics and particulate matter in the urban environment for a large number of VOCs, carbonyl compounds and $PM_{2.5}$. The investigators measured indoor, outdoor and personal exposure concentrations of 16 VOCs, 10 carbonyls and PM during two 48-hour sampling periods in different seasons between the summer of 1999 and the spring of 2001. The study included 100 homes with 100 adult residents in each of three cities with different air pollution sources and weather conditions: Los Angeles, CA; Houston, TX; and Elizabeth, NJ. Children in each of the homes sampled were recruited to the best extent practical. Only 18 VOCs are summarized in this guidance document (Table C5). Refer to the original RIOPA report (Weisel *et al.*, 2005) for information about the carbonyl and particulate matter sampling and results.

The report (1) compares concentrations of the pollutants measured in indoor, outdoor and personal air, (2) examined the effects of city , season, type of home, and other variables on measured concentrations, and (3) quantified how much outdoor sources contributed to the indoor concentrations using measurements of outdoor-indoor air exchange rates.

All the VOC air samples were collected on 3M Brand Organic Vapor Monitor (OVM) badges. The badges are passive sampling devices that allow VOCs in air to pass through a diffusion membrane and are adsorbed onto carbon impregnated pads. A solvent is used to extract the VOCs from the pad and the extract is analyzed by gas chromatography/mass spectroscopy.

The published report provides descriptive summary statistics for all the tested compounds and parameters including: sample size, mean and standard deviation. Concentrations are also provided for the 1^{st}, 5^{th}, 50^{th} (median), 95^{th}, and 99^{th} percentile. Table C5 provides a summary of the indoor, outdoor, adult and child personal air data for 16 VOCs and 2 carbonyl compounds.

C.6 References

Brodzinsky, R., and H.B. Singh. 1983. "Volatile Organic Chemicals in the Atmosphere: an Assessment of Available Data" (EPA-600/3-83-027(A)). Environmental Sciences Research Laboratory, Research Triangle Park, NC.

New York State Department of Health. 1991. "Analytical Handbook. Method 311-6. Volatile Organics in Air by GC/PID/ELCD." Wadsworth Center for Laboratories and Research. Albany, NY.

New York State Department of Health. 1997. "Background Indoor/Outdoor Air Levels of Volatile Organic Compounds in Homes Sampled by the New York State Department of Health, 1989-1996." Bureau of Toxic Substance Assessment, Troy, NY.

United States Environmental Protection Agency. 1988. "Compendium Method TO-14. The Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Summa Passivated Canister Sampling and Chromatographic Analysis." Environmental Monitoring Systems Laboratory, Research Triangle Park, NC.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
United States Environmental Protection Agency. 2001. "Draft: A standard EPA protocol for characterizing indoor air quality in large buildings." Office of Air and Radiation, Washington, DC.

Weisel, C. P., J. Zhang, B. J. Turpin, M. T. Morandi, S. Colome, T. H. Stock, D. M. Spektor and Others. 2005. "Relationships of Indoor, Outdoor, and Personal Air (RIOPA)." Health Effects Institute, Boston, MA and National Urban Air Toxics Research Center, Houston, TX.

Table C1. NYSDOH 2003: Study of volatile organic chemicals in air of fuel oil heated homes

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR												
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max	Upper F
1,1,1-TRICHLOROETHANE	166	41.5%	400	2	<0.25	<0.25	0.3	1.1	3.1	6.9	41	110	2.5
1,1,2,2-TETRACHLOROETHANE	386	96.5%	400	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.8	2.7	0.4
1,1,2-TRICHLOROETHANE	384	96.0%	400	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1	6.2	0.4
1,1,2-TRICHLOROTRIFLUOROETHANE	178	44.5%	400	0.8	<0.25	<0.25	0.5	1.1	1.8	3.4	5.9	7.4	2.5
1,1-DICHLOROETHANE	396	99.0%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	4.4	0.4
1,1-DICHLOROETHENE	373	93.3%	400	1.4	<0.25	<0.25	<0.25	<0.25	<0.25	0.7	6.3	430	0.4
1,2,3-TRIMETHYLBENZENE	164	41.0%	400	1.2	<0.25	<0.25	0.4	1.1	2.7	5	11	37	2.5
1,2,4-TRICHLOROBENZENE	319	79.8%	400	1.3	<0.25	<0.25	<0.25	<0.25	3.4	6.3	26	37	0.5
1,2,4-TRIMETHYLBENZENE	49	12.3%	400	4.8	<0.25	0.7	1.9	4.3	9.5	18	35	260	9.8
1,2-DIBROMOETHANE	397	99.3%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1.1	0.4
1,2-DICHLOROBENZENE	315	78.8%	400	0.3	<0.25	<0.25	<0.25	<0.25	0.7	1	2.3	4.9	0.5
1,2-DICHLOROETHANE	394	98.5%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	4.9	0.4
1,2-DICHLOROPROPANE	391	97.8%	400	0.4	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	9	34	0.4
1,2-DICHLOROTETRAFLUOROETHANE	349	87.3%	400	1	<0.25	<0.25	<0.25	<0.25	0.5	1.2	23	120	0.4
1,3,5-TRIMETHYLBENZENE	100	25.0%	400	2	<0.25	0.3	0.6	1.7	3.6	6.5	25	97	3.9
1,3-DICHLOROBENZENE	316	79.0%	400	0.3	<0.25	<0.25	<0.25	<0.25	0.6	0.9	1.6	2.5	0.5
1,4-DICHLOROBENZENE	266	66.5%	400	3.7	<0.25	<0.25	<0.25	0.5	1.3	2.6	24	770	1.2
2,3-DIMETHYLPENTANE	129	32.3%	400	3.8	<0.25	<0.25	0.7	2.2	7.5	16	50	210	5.2
2,4-DIMETHYLPENTANE	143	35.8%	400	3.2	<0.25	<0.25	0.6	2	7.7	15	52	120	4.7
ACETONE	12	5.3%	227	42	<0.25	9.9	21	52	110	140	200	690	115
ALPHA-PINENE	79	19.8%	400	5.8	<0.25	0.3	1.5	4.4	14	27	63	91	10
BENZENE	28	7.0%	400	8.3	<0.25	1.1	2.1	5.9	15	29	120	460	13
BROMOMETHANE	308	77.0%	400	0.3	<0.25	<0.25	<0.25	<0.25	0.6	0.9	3.2	23	0.5
CARBON TETRACHLORIDE	201	50.3%	400	0.4	<0.25	<0.25	<0.25	0.6	0.8	1.1	3.2	4.2	1.3
CHLOROBENZENE	398	99.5%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.6	0.4
CHLOROETHANE	361	90.3%	400	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	0.6	0.9	4.5	0.4
CHLOROFORM	212	53.0%	400	0.9	<0.25	<0.25	<0.25	0.5	1.4	4.6	13	25	1.2
CHLOROMETHANE	184	46.0%	400	2	<0.25	<0.25	0.5	1.8	3.3	5.2	14	260	4.2
CIS-1,2-DICHLOROETHENE	364	91.0%	400	0.3	<0.25	<0.25	<0.25	<0.25	<0.25	1.2	4.6	7.4	0.4
CIS-1,3-DICHLOROPROPENE	388	97.0%	400	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	2.1	3.5	0.4
CYCLOHEPTANE	159	39.8%	400	1.2	<0.25	<0.25	0.5	1.3	3.1	5.1	11	23	2.9
CYCLOHEXANE	125	31.3%	400	6	<0.25	<0.25	0.8	2.6	8.1	19	88	510	6.3
DICHLORODIFLUOROMETHANE	215	53.8%	400	7.9	<0.25	<0.25	<0.25	4.1	15	26	180	300	10
d-LIMONENE	77	19.3%	400	8.9	<0.25	0.5	2.8	8.4	24	45	93	120	20
ETHYL ALCOHOL	3	1.3%	227	610	<0.25	27	160	540	1400	3000	6900	16000	1300
ETHYLBENZENE	58	14.5%	400	3.7	<0.25	0.4	1	2.8	7.3	13	26	340	6.4
ETHYLCYCLOHEXANE	149	37.3%	400	1.1	<0.25	<0.25	0.4	1.2	2.6	4.4	10	28	2.8

(Continued)

Table C1. NYSDOH 2003: Study of volatile organic chemicals in air of fuel oil heated homes -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR												
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max	Upper F
ETHYLMETHACRYLATE	215	94.7%	227	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	0.3	1	2.9	0.4
HEXACHLORO-1,3-BUTADIENE	304	76.0%	400	1.8	<0.25	<0.25	<0.25	<0.25	4.6	11	29	51	0.5
ISO-OCTANE	130	32.5%	400	5.5	<0.25	<0.25	0.6	2.1	6.5	14	63	870	5.0
ISOPRENE	44	11.0%	400	4.1	<0.25	0.8	2	4.3	8.8	15	43	81	9.5
ISOPROPYLBENZENE	259	64.8%	400	0.4	<0.25	<0.25	<0.25	0.4	0.9	1.3	2.7	27	0.8
M,P-XYLENE	54	13.5%	400	5.9	<0.25	0.5	1.5	4.6	12	21	46	550	11
METHYL ETHYL KETONE	20	8.8%	227	8.4	<0.25	1.4	3.4	7.3	16	39	79	180	16
METHYL ISOBUTYL KETONE	102	44.9%	227	1.2	<0.25	<0.25	0.3	0.9	2.2	5.3	16	36	1.9
METHYLCYCLOHEXANE	112	28.0%	400	4.9	<0.25	<0.25	0.7	1.9	6.4	12	32	620	4.5
METHYLENE CHLORIDE	89	22.3%	400	17	<0.25	0.3	1.4	6.6	22	45	310	2100	16
METHYLMETHACRYLATE	197	86.8%	227	0.6	<0.25	<0.25	<0.25	<0.25	0.4	1.1	5.3	66	0.4
METHYL-tert-BUTYL ETHER	69	30.4%	227	13	<0.25	<0.25	0.8	5.6	26	71	230	340	14
n-BUTYLBENZENE	222	55.5%	400	0.6	<0.25	<0.25	<0.25	0.5	1.2	2.1	4.9	33	1.1
n-DECANE	40	10.0%	400	7.7	<0.25	1.2	2.7	6.6	16	31	83	190	15
n-DODECANE	73	18.3%	400	5.6	<0.25	0.4	1.5	3.9	11	19	61	420	9.2
n-HEPTANE	19	4.8%	400	9.7	<0.25	1	2.8	7.6	19	33	72	670	18
n-HEXANE	50	12.5%	400	9.5	<0.25	0.6	1.6	5.9	18	35	93	950	14
n-NONANE	65	16.3%	400	3.8	<0.25	0.4	1.3	3.4	8.8	13	50	89	7.9
n-OCTANE	84	21.0%	400	1.9	<0.25	0.3	0.9	2.3	4.2	5.5	16	80	5.2
n-PROPYLBENZENE	206	51.5%	400	0.8	<0.25	<0.25	<0.25	0.7	1.7	2.8	8.2	41	1.5
n-UNDECANE	59	14.8%	400	5.4	<0.25	0.6	1.8	5	12	20	61	290	12
O-XYLENE	71	17.8%	400	3.8	<0.25	0.4	1.1	3.1	7.6	13	32	310	7.1
sec-BUTYLBENZENE	225	56.3%	400	0.5	<0.25	<0.25	<0.25	0.6	1.2	1.7	4.1	11	1.2
STYRENE	175	43.8%	400	0.8	<0.25	<0.25	0.3	0.6	1.3	2.3	6.2	50	1.4
tert-BUTYLBENZENE	228	57.0%	400	0.7	<0.25	<0.25	<0.25	0.6	1.6	2.8	5.3	36	1.3
TETRACHLOROETHENE	187	46.8%	400	1.3	<0.25	<0.25	0.3	1.1	2.9	4.1	20	51	2.5
TETRAHYDROFURAN	164	72.2%	227	2.1	<0.25	<0.25	<0.25	0.4	3.3	9.4	19	180	0.8
TOLUENE	25	6.3%	400	26	<0.25	3.5	9.6	25	58	110	300	510	57
TRANS-1,3-DICHLOROPROPENE	400	100.0%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NC
TRICHLOROETHENE	323	80.8%	400	0.4	<0.25	<0.25	<0.25	<0.25	0.5	0.8	7.4	25	0.5
TRICHLOROFLUOROMETHANE	42	10.5%	400	7.5	<0.25	1.1	2.9	5.4	17	30	95	190	12
VINYL CHLORIDE	387	96.8%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.8	1	0.4

(Continued)

Table C1. NYSDOH 2003: Study of volatile organic chemicals in air of fuel oil heated homes -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR												
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max	Upper F
1,1,1-TRICHLOROETHANE	125	62.5%	200	0.3	<0.25	<0.25	<0.25	0.3	0.6	0.7	3.8	8.4	0.6
1,1,2,2-TETRACHLOROETHANE	199	99.5%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.5	0.4
1,1,2-TRICHLOROETHANE	199	99.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	6.3	0.3
1,1,2-TRICHLOROTRIFLUOROETHANE	97	48.5%	200	0.9	<0.25	<0.25	0.5	1.1	1.9	3.6	6	11	2.5
1,1-DICHLOROETHANE	200	100.0%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NC
1,1-DICHLOROETHENE	199	99.5%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1	0.4
1,2,3-TRIMETHYLBENZENE	165	82.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.4	0.6	1.4	2.5	0.5
1,2,4-TRICHLOROBENZENE	168	84.0%	200	0.8	<0.25	<0.25	<0.25	<0.25	2.3	4.8	12	21	0.4
1,2,4-TRIMETHYLBENZENE	109	54.5%	200	0.9	<0.25	<0.25	<0.25	0.8	1.7	2.5	8.2	50	1.9
1,2-DIBROMOETHANE	199	99.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	8.2	0.4
1,2-DICHLOROBENZENE	166	83.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.6	0.9	1.6	6.1	0.4
1,2-DICHLOROETHANE	199	99.5%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.3	0.4
1,2-DICHLOROPROPANE	194	97.0%	200	0.4	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	11	22	0.4
1,2-DICHLOROTETRAFLUOROETHANE	169	84.5%	200	0.3	<0.25	<0.25	<0.25	<0.25	0.6	1.3	2.4	4.5	0.5
1,3,5-TRIMETHYLBENZENE	143	71.5%	200	0.3	<0.25	<0.25	<0.25	0.3	0.7	1	2.4	2.5	0.7
1,3-DICHLOROBENZENE	170	85.0%	200	0.3	<0.25	<0.25	<0.25	<0.25	0.5	0.7	1.6	10	0.4
1,4-DICHLOROBENZENE	164	82.0%	200	0.3	<0.25	<0.25	<0.25	<0.25	0.5	0.8	1.8	7.1	0.5
2,3-DIMETHYLPENTANE	147	73.5%	200	0.5	<0.25	<0.25	<0.25	0.3	1	2	8.6	13	0.7
2,4-DIMETHYLPENTANE	139	69.5%	200	0.7	<0.25	<0.25	<0.25	0.4	0.8	1.8	14	43	0.8
ACETONE	7	6.1%	114	16	<0.25	3.4	6.4	14	44	58	170	200	30
ALPHA-PINENE	122	61.0%	200	0.9	<0.25	<0.25	<0.25	0.5	2	3.8	12	18	1.2
BENZENE	18	9.0%	200	1.9	<0.25	0.6	1.3	2.2	4.3	5.8	13	17	4.8
BROMOMETHANE	162	81.0%	200	0.4	<0.25	<0.25	<0.25	<0.25	0.5	0.9	3.1	27	0.5
CARBON TETRACHLORIDE	108	54.0%	200	0.4	<0.25	<0.25	<0.25	0.6	0.8	1	3.3	3.6	1.2
CHLOROBENZENE	200	100.0%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NC
CHLOROETHANE	188	94.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	0.7	1.4	0.4
CHLOROFORM	168	84.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.4	0.5	0.8	1.3	0.5
CHLOROMETHANE	96	48.0%	200	1.3	<0.25	<0.25	0.5	1.8	3.2	4.6	7.6	13	4.3
CIS-1,2-DICHLOROETHENE	193	96.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1.8	2.7	0.4
CIS-1,3-DICHLOROPROPENE	195	97.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	2.4	3.3	0.4
CYCLOHEPTANE	148	74.0%	200	0.4	<0.25	<0.25	<0.25	0.3	0.7	1.1	4.8	12	0.6
CYCLOHEXANE	137	68.5%	200	1.5	<0.25	<0.25	<0.25	0.4	1.3	3	16	170	0.9
DICHLORODIFLUOROMETHANE	108	54.0%	200	2.8	<0.25	<0.25	<0.25	4.2	7.5	11	23	38	10
d-LIMONENE	155	77.9%	199	1	<0.25	<0.25	<0.25	<0.25	0.8	1.5	24	83	0.5
ETHYL ALCOHOL	1	0.9%	114	35	<0.25	3.3	6.9	16	31	220	610	930	34
ETHYLBENZENE	107	53.5%	200	0.8	<0.25	<0.25	<0.25	0.5	1.1	1.9	19	21	1.0
ETHYLCYCLOHEXANE	164	82.0%	200	0.4	<0.25	<0.25	<0.25	<0.25	0.5	1	5.7	14	0.5

(Continued)

Table C1. NYSDOH 2003: Study of volatile organic chemicals in air of fuel oil heated homes -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR												
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max	Upper F
ETHYLMETHACRYLATE	114	100.0%	114	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NC
HEXACHLORO-1,3-BUTADIENE	162	81.0%	200	1.2	<0.25	<0.25	<0.25	<0.25	2.3	7	20	27	0.5
ISO-OCTANE	139	69.5%	200	0.5	<0.25	<0.25	<0.25	0.3	0.9	2	7.5	11	0.7
ISOPRENE	111	55.5%	200	1.1	<0.25	<0.25	<0.25	0.9	2.8	4.6	13	21	2.0
ISOPROPYLBENZENE	182	91.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	0.7	0.9	0.4
M,P-XYLENE	110	55.0%	200	0.8	<0.25	<0.25	<0.25	0.5	1.4	3.1	17	20	1.0
METHYL ETHYL KETONE	8	7.0%	114	6.2	<0.25	0.8	1.3	2.6	6.3	17	180	210	5.3
METHYL ISOBUTYL KETONE	86	75.4%	114	0.8	<0.25	<0.25	<0.25	<0.25	0.9	2.9	21	24	0.5
METHYLCYCLOHEXANE	141	70.5%	200	0.5	<0.25	<0.25	<0.25	0.3	0.8	1.6	4.7	23	0.7
METHYLENE CHLORIDE	101	50.5%	200	0.8	<0.25	<0.25	<0.25	0.7	1.6	2.9	12	23	1.6
METHYLMETHACRYLATE	110	96.5%	114	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1.5	2.4	0.4
n-BUTYLBENZENE	53	46.5%	114	1	<0.25	<0.25	0.3	0.9	2.1	5.9	10	14	1.9
n-DECANE	174	87.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.3	0.4	1.2	8.8	0.4
n-DODECANE	65	32.5%	200	1.3	<0.25	<0.25	0.8	2	2.6	3.6	8.5	20	4.7
n-HEPTANE	94	47.0%	200	2.2	<0.25	<0.25	0.5	1.9	4.5	7.6	27	89	4.5
n-HEXANE	57	28.5%	200	1.5	<0.25	<0.25	0.5	1	2.6	5.1	20	67	2.2
n-NONANE	79	39.5%	200	1.1	<0.25	<0.25	0.4	0.9	1.6	3.6	19	26	2.0
n-OCTANE	131	65.5%	200	0.4	<0.25	<0.25	<0.25	0.4	0.8	1.2	5.1	13	0.7
n-PROPYLBENZENE	112	56.0%	200	1	<0.25	<0.25	<0.25	0.7	1.2	2.1	8.6	90	1.5
n-UNDECANE	184	92.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	0.5	2	8	0.4
O-XYLENE	105	52.5%	200	0.6	<0.25	<0.25	<0.25	0.7	1.7	2.3	5.8	6.8	1.5
O-XYLENE	120	60.0%	200	0.7	<0.25	<0.25	<0.25	0.6	1.7	2.5	8.9	10	1.2
sec-BUTYLBENZENE	160	80.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.4	0.5	1.2	3.8	0.5
STYRENE	158	79.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.4	0.6	2.3	3.6	0.5
tert-BUTYLBENZENE	177	88.5%	200	0.4	<0.25	<0.25	<0.25	<0.25	0.3	0.6	2.9	31	0.4
TETRACHLOROETHENE	143	71.5%	200	0.6	<0.25	<0.25	<0.25	0.3	0.8	1.6	12	20	0.7
TETRAHYDROFURAN	108	94.7%	114	0.3	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	4	8.5	0.4
TOLUENE	12	6.0%	200	11	<0.25	0.6	1.3	2.4	5.9	21	350	640	5.1
TRANS-1,3-DICHLOROPROPENE	200	100.0%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NC
TRICHLOROETHENE	177	88.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.3	0.5	1	1.3	0.4
TRICHLOROFLUOROMETHANE	70	35.0%	200	1.7	<0.25	<0.25	0.8	2.2	3.6	6.1	17	20	5.1
VINYL CHLORIDE	197	98.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	4.8	0.4

ND = Number of non-detects

ND (%) = Percentage of total number in sample that are non-detect

N = Total number of samples

* Non-detects were estimated at 1/2 the detection limit to calculate the mean

Min; Max = minimum and maximum value detected

Upper F = Upper Fence = The upper fence is calculated as 1.5 times the interquartile range (difference between the 25th and 75th percentile values) above the 75th percentile value.

NC = Upper Fence not calculated. Compound not detected in any sample.

Table C2. EPA 2001: Building assessment and survey evaluation (BASE) database, SUMMA® canister method

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
1,1,1-TRICHLOROETHANE	7	2.3%	298	16.2	<0.5	2.6	5.1	10.8	20.6	33.0	737.9	833.2
1,1,2-TRICHLOROETHANE	136	100.0%	136	0.6	<0.6	<1.0	<1.3	<1.4	<1.5	<1.6	<2.1	<2.3
1,1-DICHLOROETHANE	136	100.0%	136	0.2	<0.2	<0.4	<0.5	<0.5	<0.7	<0.8	<0.9	<0.9
1,1-DICHLOROETHENE	136	100.0%	136	0.5	<0.7	<0.9	<1.1	<1.2	<1.4	<1.6	<1.7	<1.8
1,2,4-TRICHLOROBENZENE	136	100.0%	136	1.1	<0.6	<0.9	<1.0	<1.2	<6.8	<7.2	<8.1	<8.2
1,2,4-TRIMETHYLBENZENE	52	17.7%	294	4.8	<0.4	1.7	2.8	5.1	9.5	13.7	39.0	91.0
1,2-DIBROMOETHANE	258	99.6%	259	0.6	<0.8	<1.1	<1.3	<1.4	<1.5	<1.6	<2.7	1.4
1,2-DICHLOROBENZENE	255	98.5%	259	0.6	<0.6	<0.8	<0.9	<1.0	<1.2	<1.3	10.5	11.2
1,2-DICHLOROETHANE	254	98.1%	259	0.9	<0.4	<0.5	<0.6	<0.7	<0.9	<1.0	24.8	84.9
1,2-DICHLOROPROPANE	136	100.0%	136	0.6	<0.5	<1.0	<1.4	<1.6	<1.6	<1.7	<2.3	<2.6
1,3,5-TRIMETHYLBENZENE	206	79.5%	259	1.6	<0.8	<1.3	<1.5	<4.6	3.7	4.6	9.0	16.6
1,3-BUTADIENE	39	100.0%	39	1.4	<2.1	<2.3	<2.5	<2.7	<3.0	<7.5	<7.9	<7.9
1,3-DICHLOROBENZENE	136	100.0%	136	0.6	<0.5	<0.7	<0.8	<1.1	<2.4	<2.5	<2.8	<2.9
1,4-DICHLOROBENZENE	212	71.1%	298	3.1	<0.5	<0.8	<1.2	1.4	5.5	12.5	80.5	87.1
1-BUTANOL	118	95.9%	123	42.7	<2.4	<3.6	<4.0	<4.3	<4.8	<7.9	35.3	4957.4
2-BUTANONE (MEK)	13	5.0%	259	6.2	<1.4	3.3	5.2	7.5	12.0	13.5	28.1	55.4
2-BUTOXYETHANOL	123	100.0%	123	4.0	<4.8	<7.2	<8.0	<8.6	<9.3	<10.4	<16.4	<16.8
2-ETHYL-1-HEXANOL	160	98.8%	162	3.2	<1.1	<5.0	<7.6	<8.4	<9.2	<9.7	8.2	8.4
2-METHYL-1-PROPANOL	30	76.9%	39	1.2	<0.9	<1.0	<1.1	<3.0	3.1	5.5	5.8	5.8
2-PROPANOL	8	20.5%	39	73.1	<1.3	6.6	30.0	56.0	250.0	475.0	580.0	580.0
3-METHYL PENTANE	125	48.3%	259	3.1	<0.9	<1.7	1.4	4.2	6.5	8.3	22.9	35.4
4-ETHYLTOLUENE	212	81.9%	259	1.7	<0.9	<1.5	<1.6	<3.1	3.6	5.9	9.8	16.4
4-METHYL-2-PENTANONE	153	59.1%	259	3.1	<0.7	<1.2	<1.5	3.0	6.0	8.1	58.4	72.5
ACETONE	0	0.0%	259	54.0	11.6	32.4	45.0	59.8	98.9	120.2	226.6	243.7
a-PINENE	238	79.9%	298	4.2	<0.5	<1.1	<1.2	<2.8	3.6	6.4	67.8	399.1
BENZENE	56	19.0%	294	4.5	<0.8	2.1	3.4	5.1	9.4	12.5	25.0	63.0
BENZYL CHLORIDE	136	100.0%	136	1.2	<0.8	<1.2	<1.4	<1.7	<6.8	<7.2	<8.1	<8.2
BROMOMETHANE	246	95.0%	259	0.6	<0.6	<0.8	<0.9	<1.1	<1.7	<2.1	3.6	4.6
BUTYL ACETATE	232	77.9%	298	2.9	<0.9	<1.5	<1.8	<5.2	4.5	15.8	35.3	50.6
CARBON DISULFIDE	134	51.7%	259	1.9	<0.5	<0.8	<1.3	2.1	4.2	6.4	14.8	24.5
CARBON TETRACHLORIDE	241	93.1%	259	0.5	<0.5	<0.8	<0.9	<1.1	<1.3	0.7	0.9	2.1
CHLOROBENZENE	255	98.5%	259	0.4	<0.4	<0.6	<0.7	<0.8	<0.9	<1.0	1.0	1.2
CHLOROETHANE	254	98.1%	259	1.1	<0.6	<0.8	<0.9	<1.0	<1.1	<1.3	47.9	56.7
CHLOROFORM	203	78.4%	259	0.5	<0.3	<0.4	<0.5	<1.2	1.1	1.4	4.8	12.1
CHLOROMETHANE	2	0.8%	259	2.9	<0.7	2.1	2.5	3.1	3.7	4.4	12.3	21.8
CIS-1,2-DICHLOROETHENE	136	100.0%	136	0.6	<0.6	<0.8	<1.0	<1.2	<1.9	<2.0	<2.2	<2.3

(Continued)

Table C2. EPA 2001: Building assessment and survey evaluation (BASE) database, SUMMA® canister method -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
CIS-1,3-DICHLOROPROPENE	136	100.0%	136	0.9	<1.2	<1.7	<1.9	<2.0	<2.3	<2.5	<2.9	<3.2
DICHLORODIFLUOROMETHANE	18	6.9%	259	13.8	<4.8	4.8	6.7	10.5	16.5	32.9	81.3	942.3
DICHLOROTETRAFLUOROETHANE	136	100.0%	136	1.6	<1.5	<2.2	<2.5	<3.0	<6.8	<7.4	<8.2	<11.3
DIMETHYL DISULFIDE	239	92.3%	259	2.0	<1.4	<2.1	<2.4	<2.7	<3.7	3.6	32.4	70.4
d-LIMONENE	74	24.8%	298	10.8	<0.7	2.5	5.3	11.3	22.5	43.7	136.7	148.0
DODECANE	107	35.9%	298	8.2	<1.7	<4.5	5.4	9.6	15.9	22.0	92.8	110.0
ETHANOL	3	7.7%	39	89.3	<1.2	26.0	79.0	140.0	210.0	290.0	300.0	300.0
ETHYL ACETATE	163	54.7%	298	3.0	<0.6	<1.0	<2.6	3.2	5.4	9.5	59.0	64.2
ETHYLBENZENE	144	49.0%	294	2.8	<0.9	<1.6	1.4	3.4	5.7	7.6	18.5	73.6
HEXACHLOROBUTADIENE	136	100.0%	136	1.5	<1.3	<1.8	<2.1	<2.5	<6.8	<7.2	<8.1	<8.2
HEXANAL	78	63.4%	123	6.8	<2.5	<3.9	<4.6	7.8	12.0	14.7	26.2	235.1
m & p-XYLENES	53	18.0%	294	10.8	<1.5	4.1	6.9	12.2	22.2	28.5	67.6	260.8
METHYL TERTIARY-BUTYL ETHER	198	76.4%	259	3.3	<1.0	<1.5	<1.7	<6.4	11.5	16.1	30.8	34.0
METHYLENE CHLORIDE	94	31.5%	298	21.2	<1.1	<1.7	2.9	5.0	10.0	16.0	1155.6	1496.9
NAPHTHALENE	254	85.8%	296	6.6	<1.4	<2.2	<2.5	<5.2	5.1	20.9	98.0	410.0
n-DECANE	58	19.5%	298	7.4	<0.7	3.0	4.6	8.4	17.5	22.4	48.6	54.8
n-HEPTANAL	36	92.3%	39	1.7	<1.2	<1.3	<1.5	<1.6	<3.6	3.1	34.9	34.9
n-HEXANE	26	16.0%	162	6.3	<.9	1.6	3.1	6.4	10.2	15.2	120.0	130.0
NONANAL	146	90.1%	162	6.8	<1.6	<5.1	<7.8	<8.6	<16.8	30.2	88.9	106.3
NONANE	101	39.0%	259	3.7	<0.5	<1.0	1.7	3.6	7.8	12.4	45.2	53.8
n-UNDECANE	25	9.7%	259	12.6	<1.1	5.1	8.9	16.4	22.6	27.4	68.7	169.6
OCTANE	155	52.0%	298	5.5	<0.4	<0.8	<2.5	2.0	4.5	8.6	47.9	921.7
o-XYLENE	81	27.6%	294	3.8	<0.7	<2.4	2.4	4.4	7.9	11.2	20.1	90.5
PENTANAL	111	90.2%	123	3.0	<2.4	<3.7	<4.1	<4.6	<7.3	7.0	20.0	57.3
STYRENE	251	85.4%	294	1.5	<0.6	<1.6	<1.8	<2.3	1.9	4.3	15.0	40.0
TETRACHLOROETHENE	103	34.6%	298	6.0	<0.9	<1.9	3.0	5.9	15.9	25.4	55.6	65.7
TOLUENE	0	0.0%	294	25.1	3.5	10.7	15.7	25.9	43.0	70.8	348.9	390.3
TRANS-1,3-DICHLOROPROPENE	136	100.0%	136	0.5	<0.5	<0.8	<1.1	<1.2	<1.3	<1.3	<1.8	<2.0
TRICHLOROETHENE	216	72.5%	298	2.6	<0.6	<1.2	<1.4	1.2	4.2	6.5	57.0	88.5
TRICHLOROFLUOROMETHANE	107	35.9%	298	19.4	<1.7	<3.7	3.9	6.7	18.1	54.0	860.6	1015.3
TRICHLOROTRIFLUOROETHANE	217	83.8%	259	2.0	<1.1	<1.7	<1.9	<3.0	3.5	9.4	19.7	30.9
VINYL CHLORIDE	257	99.2%	259	0.5	<0.6	<0.8	<0.9	<1.0	<1.9	<2.2	<2.6	7.5

(Continued)

Table C2. EPA 2001: Building assessment and survey evaluation (BASE) database, SUMMA® canister method -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
1,1,1-TRICHLOROETHANE	40	40.0%	100	1.3	<0.4	<0.6	0.8	1.7	2.6	3.8	8.4	8.7
1,1,2-TRICHLOROETHANE	46	100.0%	46	0.6	<0.6	<1.0	<1.2	<1.4	<1.6	<1.6	<1.8	<1.8
1,1-DICHLOROETHANE	46	100.0%	46	0.2	<0.4	<0.4	<0.4	<0.6	<0.6	<0.8	<0.8	<0.8
1,1-DICHLOROETHENE	46	100.0%	46	0.5	<0.8	<1.0	<1.0	<1.2	<1.4	<1.4	<1.6	<1.6
1,2,4-TRICHLOROBENZENE	46	100.0%	46	1.1	<0.6	<0.8	<1.0	<1.2	<6.4	<6.6	<7.8	<7.8
1,2,4-TRIMETHYLBENZENE	30	30.0%	100	2.6	<0.4	<1.6	1.8	3.1	5.8	7.1	19.1	24.2
1,2-DIBROMOETHANE	87	100.0%	87	0.6	<0.8	<1.2	<1.2	<1.4	<1.6	<1.6	<2.0	<2.0
1,2-DICHLOROBENZENE	86	98.9%	87	0.4	<0.6	<0.8	<1.0	<1.0	<1.2	<1.2	1.1	1.1
1,2-DICHLOROETHANE	86	98.9%	87	0.3	<0.4	<0.6	<0.6	<0.6	<0.8	<1.0	0.8	0.8
1,2-DICHLOROPROPANE	46	100.0%	46	0.6	<0.6	<1.2	<1.4	<1.6	<1.6	<1.8	<1.8	<1.8
1,3,5-TRIMETHYLBENZENE	69	79.3%	87	1.2	<0.8	<1.2	<1.4	<2.4	2.7	3.3	8.9	8.9
1,3-BUTADIENE	13	100.0%	13	1.5	<2.2	<2.4	<2.6	<2.8	<3.4	<7.6	<7.6	<7.6
1,3-DICHLOROBENZENE	46	100.0%	46	0.5	<0.6	<0.8	<0.8	<1.0	<2.2	<2.4	<2.8	<2.8
1,4-DICHLOROBENZENE	88	88.0%	100	0.7	<0.6	<0.8	<0.8	<1.4	1.2	1.7	5.4	6.1
1-BUTANOL	41	100.0%	41	2.0	<2.4	<3.4	<4.0	<4.4	<4.8	<5.2	<6.0	<6.0
2-BUTANONE (MEK)	5	5.7%	87	5.2	<1.2	2.2	3.7	5.7	11.3	14.8	43.1	43.1
2-BUTOXYETHANOL	41	100.0%	41	3.9	<4.6	<7.0	<8.0	<8.6	<9.6	<10.4	<11.8	<11.8
2-ETHYL-1-HEXANOL	53	98.1%	54	3.2	<1.2	<4.6	<7.2	<8.4	<9.6	<10.8	5.9	5.9
2-METHYL-1-PROPANOL	13	100.0%	13	0.6	<0.8	<1.0	<1.0	<1.2	<1.4	<3.0	<3.0	<3.0
2-PROPANOL	4	30.8%	13	6.4	<3.0	<4.2	4.7	6.6	16.5	23.5	23.5	23.5
3-METHYL PENTANE	55	63.2%	87	1.8	<1.0	<1.4	<1.6	2.0	4.4	6.6	10.5	10.5
4-ETHYLTOLUENE	75	86.2%	87	1.2	<1.0	<1.4	<1.6	<2.0	3.0	3.3	8.0	8.0
4-METHYL-2-PENTANONE	61	70.1%	87	1.3	<0.8	<1.0	<1.2	0.9	1.9	4.3	21.0	21.0
ACETONE	1	1.1%	87	26.5	<1.8	15.4	22.5	31.7	43.7	56.0	104.2	104.2
a-PINENE	92	92.0%	100	1.0	<0.6	<1.0	<1.2	<1.4	<6.2	3.7	6.8	8.1
BENZENE	22	22.0%	100	3.2	<1.2	1.2	2.7	3.7	6.6	9.6	12.6	13.0
BENZYL CHLORIDE	46	100.0%	46	1.2	<1.0	<1.2	<1.4	<1.6	<6.4	<6.6	<7.8	<7.8
BROMOMETHANE	82	94.3%	87	0.6	<0.6	<0.8	<1.0	<1.0	<1.6	1.0	4.5	4.5
BUTYL ACETATE	94	94.0%	100	1.4	<0.8	<1.4	<1.6	<1.8	<5.8	3.3	18.6	32.7
CARBON DISULFIDE	39	44.8%	87	2.1	<0.6	<0.8	0.9	2.2	3.7	8.3	22.0	22.0
CARBON TETRACHLORIDE	69	79.3%	87	0.5	<0.6	<0.8	<1.0	<1.0	0.7	0.7	1.5	1.5
CHLOROBENZENE	85	97.7%	87	0.4	<0.4	<0.6	<0.8	<0.8	<0.8	<1.0	1.1	1.1
CHLOROETHANE	84	96.6%	87	0.5	<0.6	<0.8	<0.9	<1.0	<1.2	<1.2	3.5	3.5
CHLOROFORM	77	88.5%	87	0.5	<0.2	<0.4	<0.4	<0.6	0.6	0.7	13.8	13.8
CHLOROMETHANE	0	0.0%	87	2.6	0.9	2.0	2.3	3.0	3.7	4.0	10.6	10.6
CIS-1,2-DICHLOROETHENE	45	97.8%	46	0.5	<0.6	<0.8	<1.0	<1.2	<1.8	<1.8	1.1	1.1

(Continued)

Table C2. EPA 2001: Building assessment and survey evaluation (BASE) database, SUMMA® canister method -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
CIS-1,3-DICHLOROPROPENE	46	100.0%	46	0.9	<1.4	<1.6	<1.8	<2.0	<2.2	<2.4	<2.6	<2.6
DICHLORODIFLUOROMETHANE	7	8.0%	87	7.3	<4.4	3.8	4.4	5.8	8.1	12.2	183.7	183.7
DICHLOROTETRAFLUOROETHANE	46	100.0%	46	1.6	<1.6	<2.2	<2.4	<3.0	<6.4	<6.6	<7.8	<7.8
DIMETHYL DISULFIDE	74	85.1%	87	1.7	<1.4	<2.0	<2.4	<2.8	2.4	4.5	16.4	16.4
d-LIMONENE	73	73.0%	100	1.5	<0.8	<1.0	<1.4	2.0	3.6	4.1	9.8	12.5
DODECANE	51	51.0%	100	4.6	<2.0	<2.6	<4.0	4.2	10.4	14.1	51.0	52.3
ETHANOL	0	0.0%	13	32.0	3.8	13.0	24.5	47.0	57.0	82.5	82.5	82.5
ETHYL ACETATE	89	89.0%	100	0.7	<0.6	<0.8	<1.0	<1.2	1.5	1.9	3.7	3.9
ETHYLBENZENE	59	59.0%	100	1.4	<0.8	<1.4	<1.8	1.6	3.5	4.3	7.6	7.8
HEXACHLOROBUTADIENE	46	100.0%	46	1.4	<1.4	<1.8	<2.0	<2.6	<6.4	<6.6	<7.8	<7.8
HEXANAL	30	73.2%	41	3.1	<2.4	<3.8	<4.2	2.7	3.3	3.8	36.0	36.0
m & p-XYLENES	26	26.0%	100	5.6	<1.4	<3.6	4.4	7.3	12.8	16.1	24.8	26.8
METHYL TERTIARY-BUTYL ETHER	67	77.0%	87	2.7	<1.0	<1.4	<1.8	<5.4	6.2	13.3	36.0	36.0
METHYLENE CHLORIDE	43	43.0%	100	3.7	<1.0	<1.8	1.3	3.0	6.1	10.3	63.0	78.5
NAPHTHALENE	86	86.0%	100	10.6	<1.4	<2.0	<2.4	<4.8	4.9	15.1	379.8	670.0
n-DECANE	35	35.0%	100	3.7	<0.6	<2.0	2.4	4.2	7.6	11.4	32.4	37.3
n-HEPTANAL	10	76.9%	13	3.0	<1.2	<1.5	<1.8	<2.2	2.2	26.8	26.8	26.8
n-HEXANE	16	29.6%	54	2.5	<.8	<1.2	1.4	2.7	6.4	11.4	15.3	15.3
NONANAL	41	75.9%	54	8.6	<1.6	<6.0	<7.8	<10.8	22.7	37.6	57.0	57.0
NONANE	49	56.3%	87	1.3	<0.4	<0.8	<1.0	1.7	2.8	4.0	15.3	15.3
n-UNDECANE	13	14.9%	87	7.0	<1.0	2.6	3.9	7.8	14.8	19.7	94.8	94.8
OCTANE	73	73.0%	100	0.9	<0.4	<0.6	<0.8	1.0	1.6	1.9	11.9	17.5
o-XYLENE	36	36.0%	100	2.0	<0.6	<1.4	1.4	2.6	4.6	6.0	9.6	11.1
PENTANAL	37	90.2%	41	3.5	<2.4	<3.4	<4.0	<4.4	<6.0	7.0	52.7	52.7
STYRENE	83	83.0%	100	1.7	<0.6	<1.4	<1.6	<2.0	1.3	3.6	34.1	58.0
TETRACHLOROETHENE	51	51.0%	100	2.7	<0.8	<1.4	<2.0	3.0	6.5	10.4	24.8	27.6
TOLUENE	0	0.0%	100	15.4	2.1	5.9	9.6	16.3	33.7	49.2	86.5	93.1
TRANS-1,3-DICHLOROPROPENE	46	100.0%	46	0.5	<0.6	<0.8	<1.0	<1.2	<1.4	<1.4	<1.4	<1.4
TRICHLOROETHENE	81	81.0%	100	1.0	<0.6	<1.0	<1.5	<1.6	1.3	2.6	11.2	13.5
TRICHLOROFLUOROMETHANE	41	41.0%	100	3.6	<2.0	<2.8	1.7	2.8	4.3	5.6	71.1	132.5
TRICHLOROTRIFLUOROETHANE	75	86.2%	87	1.0	<1.2	<1.6	<1.8	<2.0	1.6	1.8	5.4	5.4
VINYL CHLORIDE	87	100.0%	87	0.5	<0.6	<0.8	<1.0	<1.0	<1.8	<2.0	<2.6	<2.6

ND = Number of non-detects

ND (%) = Percentage of total number in sample that are non-detect

N = Total number of samples

* Non-detects were estimated at 1/2 the appropriate detection limit or quantification limit to calculate the mean

Min; Max = minimum and maximum value detected

Table C3. NYSDOH 1997: Control home database

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
1,1,1,2-TETRACHLOROETHANE	22	100.0	22	4.7727	<5	<10	<10	<10	<10	<10	<10	<10
1,1,1-TRICHLOROETHANE	51	38.3	133	9.17	<1	<5	4.5	6.7	14	29	180	197
1,1,2,2-TETRACHLOROETHANE	83	98.8	84	1.86	<1	<1.3	<1.6	<8.5	<10	<10	5	5
1,1,2-TRICHLOROETHANE	83	100.0	83	1.72	<1	<1	<1	<9	<10	<10	<10	<10
1,1,2-TRICHLOROTRIFLUOROETHANE (FREON-113)	45	100.0	45	0.95	<1	<1	<1	<1	<7.8	<7.8	<7.8	<7.8
1,1-DICHLOROETHANE	65	100.0	65	2.11	<1	<1	<1	<10	<10	<10	<10	<10
1,1-DICHLOROETHENE	41	100.0	41	0.68	<1	<1	<1	<1	<1	<1	<9	<9
1,1-DICHLOROPROPENE	22	100.0	22	4.77	<5	<10	<10	<10	<10	<10	<10	<10
1,2,3-TRICHLOROBENZENE	26	100.0	26	4.60	<5	<10	<10	<10	<10	<10	<10	<10
1,2,4-TRICHLOROBENZENE	65	100.0	65	2.32	<1.6	<1.6	<1.6	<10	<10	<10	<10	<10
1,2,4-TRIMETHYLBENZENE	31	47.7	65	6.28	<1	<4.4	5	7	14	20	43	43
1,2-DIBROMOETHANE (EDB)	39	100.0	39	0.80	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
1,2-DICHLOROBENZENE	90	100.0	90	2.02	<1.6	<1.6	<2	<6	<10	<10	<10	<10
1,2-DICHLOROETHANE	63	100.0	63	2.11	<1	<1	<1	<10	<10	<10	<10	<10
1,2-DICHLOROPROPANE	63	100.0	63	2.11	<1	<1	<1	<10	<10	<10	<10	<10
1,2-DICHLOROTETRAFLUOROETHANE	39	100.0	39	0.80	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
1,3,5-TRIMETHYLBENZENE	45	69.2	65	2.99	<1	<1	<5	5	5	5	14	14
1,3-DICHLOROBENZENE	86	95.6	90	2.10	<1.6	<1.6	<2	<8	<10	<10	5	5
1,4-DICHLOROBENZENE	77	85.6	90	9.23	<1.6	<1.6	<2	<10	5	5.1	425	425
4-ISOPROPYLTOLUENE (p-Cymene)	22	84.6	26	6.25	<5	<10	<10	<10	12	13	27	27
BENZENE	69	47.9	144	4.64	<1	<3.2	2.5	5	11	14	37	50
BENZYL CHLORIDE	39	100.0	39	0.50	<1	<1	<1	<1	<1	<1	<1	<1
BROMOBENZENE	26	100.0	26	4.60	<5	<10	<10	<10	<10	<10	<10	<10
BROMODICHLOROMETHANE	44	97.8	45	2.67	<0.6	<0.6	<5	<10	<10	<10	5	5
BROMOFORM	43	100.0	43	2.69	<1	<1	<5	<10	<10	<10	<10	<10
BROMOMETHANE	38	97.4	39	0.64	<1	<1	<1	<1	<1	<1	6	6
CARBON TETRACHLORIDE	113	85.6	132	2.17	<0.6	<1.6	<3.2	<6.2	5	5	5	5
CHLOROBENZENE	90	100.0	90	2.00	<1	<1	<2	<10	<10	<10	<10	<10
CHLOROETHANE	51	100.0	51	0.50	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROFORM	104	83.9	124	2.81	<1	<1	<4.8	<8.8	5	5	17	44
CHLOROMETHANE	63	79.7	79	1.08	<1	<1	<1	<2.6	2.5	2.7	4.5	4.5
CIS-1,2-DICHLOROETHENE	63	100.0	63	2.04	<1	<1	<1	<10	<10	<10	<10	<10
CIS-1,3-DICHLOROPROPENE	84	100.0	84	2.21	<1	<1	<5	<8.5	<10	<10	<10	<10
CYCLOPROPYLBENZENE	4	100.0	4	3.63	<5	<5.5	<7	<9	<10	<10	<10	<10

(Continued)

Table C3. NYSDOH 1997: Control home database -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
DIBROMOCHLOROMETHANE	45	100.0	45	2.66	<0.6	<0.6	<5	<10	<10	<10	<10	<10
DICHLORODIFLUOROMETHANE (FREON-12)	45	100.0	45	0.77	<1	<1	<1	<1	<5	<5	<5	<5
ETHYLBENZENE	83	63.4	131	3.21	<1	<3.4	<4.4	4.8	5	6.5	15	23
HEXACHLOROBUTADIENE (C-46)	43	100.0	43	1.24	<2	<2	<2	<2	<2	<6	<10	<10
HEXANE	51	63.8	80	3.75	<0.8	<1	<3.6	3.6	6.6	15	50	50
ISOPROPYLBENZENE (Cumene)	26	100.0	26	4.60	<5	<10	<10	<10	<10	<10	<10	<10
M-CHLOROTOLUENE	4	100.0	4	3.63	<5	<5.5	<7	<9	<10	<10	<10	<10
M/P-XYLENE	56	43.4	129	7.43	<1	<4.4	5	9.5	16	21	64	90
METHYLENE CHLORIDE (DICHLOROMETHANE)	76	56.3	135	13.28	<1	<3	<7	5.6	23	45	240	292
N-BUTYLBENZENE	26	100.0	26	4.60	<5	<10	<10	<10	<10	<10	<10	<10
N-PROPYLBENZENE	26	100.0	26	4.60	<5	<10	<10	<10	<10	<10	<10	<10
NAPHTHALENE	45	88.2	51	4.07	<2	<2	<10	<10	5	12	18	18
O-CHLOROTOLUENE	24	100.0	24	4.75	<5	<10	<10	<10	<10	<10	<10	<10
O-XYLENE	80	55.6	144	3.71	<1	<3.8	<5.2	5	6.4	7.9	18	25
P-CHLOROTOLUENE	24	100.0	24	4.75	<5	<10	<10	<10	<10	<10	<10	<10
SEC-BUTYLBENZENE	25	96.2	26	4.94	<5	<10	<10	<10	<10	<10	14	14
STYRENE	62	95.4	65	2.21	<1	<1	<1	<10	<10	<10	5	5
TERT-BUTYLBENZENE	26	100.0	26	4.60	<5	<10	<10	<10	5	5	5	5
TETRACHLOROETHENE	103	74.6	138	4.78	<0.6	<1.6	<3.8	<10	5.5	9.7	77	103
TOLUENE	16	11.0	146	18.52	<1	6.5	13	25	39	46	95	170
TRANS-1,2-DICHLOROETHENE	26	100.0	26	4.52	<4	<10	<10	<10	<10	<10	<10	<10
TRANS-1,3-DICHLOROPROPENE	84	100.0	84	2.21	<1	<1	<5	<8.5	<10	<10	<10	<10
TRICHLOROETHENE	116	92.8	125	2.17	<0.6	<1	<2.8	<5.4	<10	5	7.5	13
TRICHLOROFLUOROMETHANE (FREON-11)	40	70.2	57	2.08	<1	<1	<1	3.8	5.6	5.9	7.5	7.5
VINYL CHLORIDE	47	100.0	47	0.70	<0.6	<1	<1	<1	<2.6	<5	<5	<5

(Continued)

Table C3. NYSDOH 1997: Control home database -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
1,1,1,2-TETRACHLOROETHANE	10	100.0	10	4.75	<5	<10	<10	<10	<10	<10	<10	<10
1,1,1-TRICHLOROETHANE	45	68.2	66	2.93	<1	<2	<5.1	2.8	5	6.7	27	27
1,1,2,2-TETRACHLOROETHANE	41	100.0	41	1.75	<1	<1	<1.6	<5	<10	<10	<10	<10
1,1,2-TRICHLOROETHANE	41	100.0	41	1.61	<1	<1	<1	<5	<10	<10	<10	<10
1,1,2-TRICHLOROTRIFLUOROETHANE (FREON-113)	22	100.0	22	0.96	<1	<1	<1	<1	<7.8	<7.8	<7.8	<7.8
1,1-DICHLOROETHANE	31	100.0	31	2.02	<1	<1	<1	<10	<10	<10	<10	<10
1,1-DICHLOROETHENE	20	100.0	20	0.65	<1	<1	<1	<1	<1	<4	<7	<7
1,1-DICHLOROPROPENE	10	100.0	10	4.75	<5	<10	<10	<10	<10	<10	<10	<10
1,2,3-TRICHLOROBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
1,2,4-TRICHLOROBENZENE	32	100.0	32	2.33	<1.6	<1.6	<1.6	<10	<10	<10	<10	<10
1,2,4-TRIMETHYLBENZENE	29	90.6	32	2.24	<1	<1	<1.5	<10	<10	5	5	5
1,2-DIBROMOETHANE (EDB)	19	100.0	19	0.80	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
1,2-DICHLOROBENZENE	44	100.0	44	2.00	<1.6	<1.6	<2	<7	<10	<10	<10	<10
1,2-DICHLOROETHANE	30	100.0	30	2.02	<1	<1	<1	<10	<10	<10	<10	<10
1,2-DICHLOROPROPANE	30	100.0	30	2.02	<1	<1	<1	<10	<10	<10	<10	<10
1,2-DICHLOROTETRAFLUOROETHANE	19	100.0	19	0.80	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
1,3,5-TRIMETHYLBENZENE	31	96.9	32	2.17	<1	<1	<1	<10	<10	<10	5	5
1,3-DICHLOROBENZENE	44	100.0	44	2.00	<1.6	<1.6	<2	<7	<10	<10	<10	<10
1,4-DICHLOROBENZENE	44	100.0	44	2.00	<1.6	<1.6	<2	<7	<10	<10	<10	<10
4-ISOPROPYLTOLUENE (p-Cymene)	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
BENZENE	51	71.8	71	6.97	<1	<1.6	<3.2	5	6.6	8	242	242
BENZYL CHLORIDE	19	100.0	19	0.50	<1	<1	<1	<1	<1	<1	<1	<1
BROMOBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
BROMODICHLOROMETHANE	22	100.0	22	2.47	<0.6	<0.6	<2.8	<10	<10	<10	<10	<10
BROMOFORM	21	100.0	21	2.52	<1	<1	<1	<10	<10	<10	<10	<10
BROMOMETHANE	19	100.0	19	0.50	<1	<1	<1	<1	<1	<1	<1	<1
CARBON TETRACHLORIDE	55	84.6	65	2.25	<1.2	<1.6	<3.2	<6.2	5	5	5	5
CHLOROBENZENE	44	100.0	44	1.93	<1	<1	<2	<9	<10	<10	<10	<10
CHLOROETHANE	21	100.0	21	0.50	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROFORM	66	100.0	66	1.90	<1	<1	<2.4	<4.8	<10	<10	<10	<10
CHLOROMETHANE	34	75.6	45	1.08	<1	<1	<2	<2.8	2.2	2.6	3.1	3.1
CIS-1,2-DICHLOROETHENE	30	100.0	30	1.97	<1	<1	<1	<10	<10	<10	<10	<10
CIS-1,3-DICHLOROPROPENE	41	100.0	41	2.15	<1	<1	<5	<5	<10	<10	<10	<10
CYCLOPROPYLBENZENE	3	100.0	3	4.00	<6	<6	<8	<10	<10	<10	<10	<10

(Continued)

Table C3. NYSDOH 1997: Control home database -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
DIBROMOCHLOROMETHANE	22	100.0	22	2.47	<0.6	<0.6	<2.8	<10	<10	<10	<10	<10
DICHLORODIFLUOROMETHANE (FREON-12)	22	100.0	22	0.77	<1	<1	<1	<1	<5	<5	<5	<5
ETHYLBENZENE	63	91.3	69	2.16	<1	<1	<4.4	<5	<10	5	6.5	6.5
HEXACHLOROBUTADIENE (C-46)	22	100.0	22	1.41	<2	<2	<2	<2	<6	<8	<10	<10
HEXANE	38	86.4	44	1.79	<0.8	<1	<3.3	<3.6	3.7	5.8	9.2	9.2
ISOPROPYLBENZENE (Cumene)	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
M-CHLOROTOLUENE	3	100.0	3	4.00	<6	<6	<8	<10	<10	<10	<10	<10
M/P-XYLENE	52	76.5	68	3.63	<1	<1.4	<4.4	<10	9	13	19	19
METHYLENE CHLORIDE (DICHLOROMETHANE)	55	82.1	67	2.91	<0.8	<1	<3.4	<7.6	5	12	22	22
N-BUTYLBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
N-PROPYLBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
NAPHTHALENE	24	96.0	25	3.18	<2	<2	<7	<10	<10	<10	5	5
O-CHLOROTOLUENE	12	100.0	12	4.71	<5	<10	<10	<10	<10	<10	<10	<10
O-XYLENE	59	83.1	71	2.59	<1	<1	<4.4	<10	5.1	7.2	10	10
P-CHLOROTOLUENE	12	100.0	12	4.71	<5	<10	<10	<10	<10	<10	<10	<10
SEC-BUTYLBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
STYRENE	32	100.0	32	2.16	<1	<1	<1	<10	<10	<10	<10	<10
TERT-BUTYLBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
TETRACHLOROETHENE	60	87.0	69	2.59	<0.6	<1.6	<3.8	<6.8	5	5	16	16
TOLUENE	41	57.7	71	8.47	<1	<2	<5.6	6.1	21	58	93	93
TRANS-1,2-DICHLOROETHENE	12	100.0	12	4.42	<4	<8.5	<10	<10	<10	<10	<10	<10
TRANS-1,3-DICHLOROPROPENE	41	100.0	41	2.15	<1	<1	<5	<5	<10	<10	<10	<10
TRICHLOROETHENE	63	94.0	67	2.09	<0.6	<1	<3.4	<5.4	<10	5	11	11
TRICHLOROFLUOROMETHANE (FREON-11)	22	91.7	24	1.07	<1	<1	<1	<1	<5.6	3.9	3.9	3.9
VINYL CHLORIDE	23	100.0	23	0.70	<0.6	<1	<1	<1	<2.6	<5	<5	<5

ND = Number of non-detects

ND (%) = Percentage of total number in sample that are non-detect

N = Total number of samples

* Non-detects were estimated at 1/2 the detection limit to calculate the mean

Min; Max = minimum and maximum value detected

Table C4. EPA 1988: National ambient volatile organic compounds (VOCs) data base update

All results are micrograms per cubic meter (mcg/m^3).

Compound	Indoor Air					Outdoor Air				
	N	Mean	25th	50th	75th	N	Mean	25th	50th	75th
acetaldehyde	0					175	9.2	0	2.3	9.8
acetone	4	19	11	20	27	17	16	0	2.2	6.7
benzene	2128	16	3.3	10	21	5411	8.9	2	5.3	11
benzyl chloride	0					43	0.07	0.02	0.04	0.09
bromobenzene	0					26	1.4	0	0.15	1.1
bromodichloromethane	2120	0.05	0	0	0	495	0.01	0	0	0
bromoform	2120	0	0	0	0	496	0	0	0	0
bromomethane	0					358	12	0.18	0.7	12
butane	0					888	33	12	21	34
2-butanone (MEK)	4	27	12	21	42	280	1.9	0	0	0
n-butylbenzene	0					52	0.27	0	0	0
sec-butylbenzene	0					433	2.7	0.14	0.24	0.48
carbon disulfide	0					29	0.3	0.12	0.13	0.5
carbon tetrachloride	2120	2.5	0	0	0.83	4913	1	0.43	0.76	0.81
chlorobenzene	2126	0.19	0	0	0	1491	1.5	0	0.28	1.4
chloroethane	0					190	220	0.06	0.17	1.7
chloroform	2120	4.1	0	0.51	3.4	3658	3.1	0.05	0.28	0.88
chloromethane	0					706	1.5	1.3	1.3	1.5
o-chlorotoluene	0					309	0.59	0.05	0.21	0.67
p-chlorotoluene	0					310	1.1	0.1	0.47	1.5
dibromochloromethane	2120	0	0	0	0	510	0.27	0	0	0
1,2-dibromoethane (EDB)	585	0.008	0	0	0	1980	2.5	0	0	0.08
1,2-dichlorobenzene	2121	0.44	0	0	0	1052	7.8	0	0	0.23
1,3-dichlorobenzene	2121	24	0.32	1.7	5.6	646	5.3	0	0.18	1.2
1,4-dichlorobenzene	2121	24	0.32	1.7	5.6	947	6	0	0.25	1.2
dichlorodifluoromethane (Freon 12)	0					1080	2.2	1.6	1.7	1.7
1,1-dichloroethane	0					145	0.16	0	0.04	0.2
1,2-dichloroethane	2120	0.38	0	0	0	2044	1.6	0	0	0.22
1,1-dichloroethene	2120	79	0	0	0	1275	18	0	0	0
cis-1,2-dichloroethene	0					161	1.3	0	0.15	0.45
trans-1,2-dichloroethene	0					2	3	2.2	3	3.7
1,2-dichloropropane	0					714	0.74	0.05	0.1	0.3
cis-1,3-dichloropropene	0					148	110	34	110	160
1,2-dichlorotetrafluoroethane	2					171	0.31	0.16	0.21	0.27

(Continued)

Table C4. EPA 1988: National ambient volatile organic compounds (VOCs) data base update -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	Indoor Air					Outdoor Air				
	N	Mean	25th	50th	75th	N	Mean	25th	50th	75th
ethylbenzene	2278	13	2	4.8	9.6	2669	20	1	2.6	5.4
formaldehyde	315	60	23	51	88	629	10	2.3	5	12
heptane	4	5.2	4.5	5	6	1064	6.6	1.4	3.2	2.5
hexachlorobutadiene (C-46)	0					72	0.38	0.01	0.03	0.06
hexane	3	2	0	2	4	894	13	2.9	5.8	10
isopropylbenzene (cumene)	103	0.84	0	0	0.84	14	0	0	0	0
4-isopropyltoluene (p-cymene)	0					132	4	0.44	2.2	5
methane	0					244	1400	1050	1080	1410
methylene chloride (dichloromethane)	0					798	5.6	1.1	2.7	6.3
naphthalene	0					67	5.2	0.2	1.2	5.7
pentane	4	3.3	1.3	2.6	5.3	886	20	5.8	11	18
n-propylbenzene	1	0.64	0	0	0	758	1	0.39	0.79	1.3
styrene	2125	6	0	1.3	2.8	1123	1.5	0	0.51	1.4
1,1,1,2-tetrachloroethane	585	0.02	0	0	0	308	0.15	0	0	0.02
1,1,2,2-tetrachloroethane	585	0.1	0	0	0	1011	0.7	0	0	0.06
tetrachloroethene	2195	21	1.7	5	11	3226	5.8	0.82	2.4	5.9
toluene	101	0	0	32	0	4074	32	0.6	7.1	20
1,2,4-trichlorobenzene	0					18	1.3	0.74	0.74	1.5
1,1,1-trichloroethane	2120	270	3	10	30	2982	5	0.7	0.89	3.3
1,1,2-trichloroethane	0					886	6	0	0	0.14
trichloroethene	2132	7.2	0	0.67	4.5	3021	2.7	0.05	0.85	2.5
trichlorofluoromethane (Freon 11)	0					1507	1.4	1.1	1.1	1.2
1,1,2-trichlorotrifluoroethane (Freon 113)	0					184	2.7	0.46	1	2.5
1,2,4-trimethylbenzene	96	2.8	0.6	1.4	4	1018	6.7	2.8	4.6	7.4
1,3,5-trimethylbenzene	178	4.5	0	1.4	5.4	585	4	0.2	1	2.5
2,2,4-trimethylpentane	0					200	9.3	1	2	4.8
vinyl chloride	0					701	32	0	0	0.78
m-xylene	103	39	4.8	16	38	3146	50	2.5	6.1	14
o-xylene	2216	12	2	4.8	9.3	3592	33	1	3	6.5
p-xylene	2305	38	6.4	14	25	3518	46	2.3	6.8	14
m/p-xylenes (weighted)			4.3		18			2		11

N - Total number of samples

Table C5. Health Effects Institute 2005: Indoor, outdoor and personal air (RIOPA) data

All results are micrograms per cubic meter (mcg/m^3).

Compound	Indoor Air							Outdoor Air						
	N	Mean	Percentiles					N	Mean	Percentiles				
			Median (50th)	1st	5th	95th	99th			Median (50th)	1st	5th	95th	99th
Acetone	398	14	8.25	0.2	1.12	45.8	128	395	9.75	4.39	0.2	0.2	19.6	55.3
Acrolein (2-propenal)	398	1.71	0.62	0.07	0.07	5.27	14.8	395	6.28	0.47	0.06	0.07	4.6	11.9
a-Pinene	554	4.87	1.22	0.04	0.07	18.1	78.6	555	0.89	0.32	0.04	0.07	1.9	16.5
Benzene	554	3.5	2.19	0.48	0.48	10	36.4	555	2.15	1.68	0.41	0.48	5.16	11.1
b-Pinene	554	4.8	1.47	0.12	0.18	20.4	62.2	555	0.53	0.18	0.1	0.12	1.43	7.35
Carbon Tetrachloride	554	0.71	0.62	0.13	0.27	1.1	2.03	555	0.71	0.64	0.13	0.34	1.0	1.58
Chloroform	554	1.86	92	0.11	0.17	6.34	14.8	554	0.32	0.17	0.08	0.09	0.76	2.35
d-Limonene	554	31	9.67	1.1	1.27	103	273	555	2.39	1.27	0.24	0.28	6.54	37.8
Ethyl Benzene	554	2.52	1.46	0.32	0.36	7.62	26.7	555	1.29	0.93	0.15	0.3	3.04	7.05
m- & p-Xylene	554	7.33	4.07	0.25	0.7	22.2	75.2	555	3.57	2.49	0.25	0.53	10	19.1
Methylene Chloride	554	2.31	0.84	0.04	0.11	7.5	33.7	555	0.95	0.84	0.04	0.07	2.46	9.32
MTBE	553	11.8	5.98	0.44	44	36	196	555	8.1	5.32	0.43	0.44	22.1	22.1
o-Xylene	554	2.48	1.46	0.17	0.36	7.24	22.6	555	1.48	0.96	0.1	0.17	3.23	7.17
p-Dichlorobenzene	554	68.9	1.44	0.19	0.29	344	1790	555	2.25	0.72	0.09	0.19	3.66	18.3
Styrene	554	1.41	0.5	0.11	0.16	5.13	23.5	555	0.48	0.17	0.07	0.11	1.29	4.15
Tetrachloroethylene	554	1.81	0.56	0.1	0.11	6.01	20.9	555	1.0	0.56	0.09	0.11	3.17	7.75
Toluene	554	15.4	10.1	2.83	3.02	39.8	122	555	7.09	5.42	1.3	2.82	19.6	32
Trichloroethylene	554	0.46	0.12	0.04	0.05	1.36	7.84	555	0.3	0.12	0.04	0.05	0.79	1.9

Compound	Adult Personal Air							Child Personal Air						
	N	Mean	Percentiles					N	Mean	Percentiles				
			Median (50th)	1st	5th	95th	99th			Median (50th)	1st	5th	95th	99th
Acetone	409	25.9	8.36	0.2	1.74	57.7	700	169	29.1	11.5	1.41	4.25	81	759
Acrolein (2-propenal)	409	12.9	0.51	0.07	0.07	5.12	11.2	169	10.9	0.87	0.06	0.07	8.04	504
a-Pinene	544	4.21	1.21	0.05	0.07	17.6	39.4	209	3.48	1.42	0.06	0.08	15.3	25.4
Benzene	545	3.64	2.39	0.48	0.48	10.7	27.4	209	4.16	2.79	0.36	0.48	12	43.6
b-Pinene	545	5.48	1.65	0.11	0.18	22.4	72.4	209	5.32	2.85	0.18	0.18	18.2	29.8
Carbon Tetrachloride	545	0.79	0.61	0.13	0.27	1.08	2.0	209	0.56	0.56	0.13	0.21	0.83	0.97
Chloroform	542	4.2	1.04	0.14	0.17	6.34	17.4	209	2.03	1.14	0.14	0.17	7.47	7.47
d-Limonene	545	41.2	11.8	1.27	1.27	112	287	209	32.1	17.4	1.27	1.27	111	168
Ethyl Benzene	545	2.79	1.68	0.36	0.36	7.48	28.8	209	3.34	1.95	0.3	0.36	10.3	54.2
m- & p-Xylene	545	8.07	4.42	0.25	0.93	22.7	75.2	209	8.87	5.15	0.43	1.38	28.2	63.1
Methylene Chloride	545	3.04	0.84	0.04	0.13	7.39	32.9	209	1.66	0.69	0.04	0.06	5.25	16.7
MTBE	544	14.8	7.14	0.44	0.94	42.7	129	209	11.7	7.03	0.44	0.56	30.2	193
o-Xylene	545	2.89	1.73	0.17	0.47	8.14	23	209	2.91	1.96	0.11	0.52	7.97	22.2
p-Dichlorobenzene	545	56.7	1.88	0.18	0.35	314	1480	209	122	4.18	0.27	0.44	979	1460
Styrene	545	1.51	0.57	0.13	0.17	5.51	21.4	209	1.69	0.67	0.14	0.16	6.89	30.6
Tetrachloroethylene	545	7.14	0.61	0.1	0.13	7.21	57.4	209	2.81	0.56	0.09	0.12	7.34	81.8
Toluene	545	19.2	12.2	2.81	3.02	50.2	138	209	18.4	12.2	1.44	2.94	57.2	220
Trichloroethylene	545	3.64	0.13	0.04	0.05	1.88	13.3	209	0.31	0.12	0.04	0.04	0.89	7.08

N - Total number of samples

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix D

NYSDOH guidelines for chemicals in air — development overview

As discussed in Section 3.2.5, the NYSDOH has developed several guidelines for chemicals in air. An overview of how the NYSDOH develops guidelines is provided in this appendix.

In general, the development of air guidelines starts with **toxicity assessment** and **exposure assessment**. In toxicity assessment, the scientific data on the toxicity and pharmacokinetics (i.e., the processes of absorption, distribution, metabolism and excretion) of a contaminant are evaluated to understand a chemical's potential for causing a health effect. In exposure assessment, scientific data are evaluated to determine the amount of air an individual breathes on a daily basis and how frequently and how long an individual may be exposed to a contaminant in air. Criteria based on cancer effects are generally expressed as the air concentration associated with a specific, excess lifetime cancer risk. Criteria based on non-cancer effects are generally expressed as a reference concentration, which is an air concentration that is expected to be without an appreciable risk of non-cancer health effects. These quantitative criteria are not, in themselves, guidelines or standards. They are based solely on data and scientific judgments on the relationship between the level of contaminant in air and health risk, and do not reflect consideration of other factors, such as whether the concentration can be measured or whether the concentration is above background.

The first two steps of the toxicity assessment are

1. Hazard Identification: What are the known or potential human health effects of an air contaminant? and
2. Dose-Response Assessment: What is the potency (strength) of the contaminant to cause each type of known or potential human health effect?

All the relevant data are evaluated and summarized and a weight-of-evidence analysis is used to make these determinations. These determinations are then used to estimate numerical criteria (cancer risks and reference concentrations).

These estimations are carried out under the premises that

a. studies on effects in animals can be used to estimate the likelihood of effects in humans and
b. studies of effects of high exposure levels in humans or animals can be used to estimate the effects of low exposure levels.

Uncertainties present in these estimations include the following:

a. whether or not animals are good surrogates for humans,
b. whether or not the dose-response data provide reliable data on the critical effect and its lowest dose,
c. whether or not all critical effects have been identified (no data gaps), and
d. whether or not the methods used to extrapolate from the animals to humans and from high to low doses provide plausible estimates of risk at low doses.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

In an exposure assessment for air, information is used that describes how much contaminated air a person may breathe each day. Estimations are also made about how frequently and how long people are exposed. The NYSDOH air guidelines are based on the assumption that people are continuously exposed to a contaminant in air all day, every day for as long as a lifetime.

The degree of confidence in the hazard identification and dose-response assessment is then summarized as part of the risk characterization (the last step in the risk assessment process), which describes the nature, strength of evidence, and the likelihood of adverse health effects from particular exposures.

Once criteria are derived, air guidelines are generally set using a combination of risk assessment and risk management considerations. Guidelines should be health protective; thus, the starting point in the derivation of a guideline are the criteria based on the non-cancer and cancer effects of the chemical. However, the guideline is not necessarily one of the criteria. Other factors such as uncertainties in the toxicity and exposure information, information on the nature and extent of contamination, duration of potential exposure, other sources of contaminant exposures, analytical detection limits, and background concentrations are also considered.

The following two documents are included in this appendix to illustrate the development of a guideline:

- **TCE air guideline:** NYSDOH letter from N. Kim to D. Desnoyers, Division of Environmental Remediation, NYSDEC (October 31, 2003)
- **PCE air guideline:** Tetrachloroethene Health Effects. November 6, 1991. Appendix 1 of the Tetrachloroethene Ambient Air Criteria Document. Final Report. October 1997. Albany, NY: Bureau of Toxic Substance Assessment, Center for Environmental Health, New York State Department of Health.

For additional information on NYSDOH guidelines and criteria for these and other volatile chemicals in air (Section 3), please contact the NYSDOH's Bureau of Toxic Substance Assessment by calling 1-800-458-1158, or by emailing BTSA@health.state.ny.us, or by writing to the following address:

New York State Department of Health
Bureau of Toxic Substance Assessment
Flanigan Square, 547 River Street
Troy, NY 12180-2216

STATE OF NEW YORK
DEPARTMENT OF HEALTH

Flanigan Square, 547 River Street, Troy, New York 12180-2216

Antonia C. Novello, M.D., M.P.H., Dr.P.H.
Commissioner

Dennis P. Whalen
Executive Deputy Commissioner

October 31, 2003

Dale Desnoyers, Director
Division of Environmental Remediation
NYS Department of Environmental Conservation
625 Broadway
Albany, NY 12233-1080

Dear Mr. Desnoyers:

The New York State Department of Health has derived an air guideline for trichloroethene. Trichloroethene (TCE or trichloroethylene; CAS number 79-01-6) is a chemical commonly found in the environment, including the air (outdoor and indoor) that people breathe. This letter summarizes the important toxicological and epidemiological data we used to evaluate the potential health risks associated with exposure to TCE in air. We have followed the procedures outlined by the National Academy of Sciences and federal agencies such as the United States Environmental Protection Agency (US EPA), the United States Food and Drug Administration and the Agency for Toxic Substances and Disease Registry. These procedures are most recently described in US EPA documents (1994, 2000, 2002, 2003).

Human Non-Cancer Risks Associated with Exposure to TCE in Air

For non-cancer effects, points-of-departure (no-observed-effects levels or NOELs, lowest-observed-effects levels or LOELs, benchmark doses) were identified for target organs in humans and animals. Uncertainty factors were applied to the points-of-departure to estimate criteria for long-term exposure of the general population, including subpopulations that may be more vulnerable to TCE than other groups.

Typically, several uncertainty factors (generally, each is 3 or 10) are used to derive an exposure criterion from a point-of-departure. These uncertainty factors are intended to account for:

- the variation in sensitivity among the members of the human population;
- the uncertainty in extrapolating animal data to humans;
- the uncertainty in extrapolating from data obtained in a study with less-than-lifetime exposure to lifetime exposure;
- the uncertainty in extrapolating from a LOEL rather than from a NOEL; and
- the uncertainty associated with extrapolation of results from adult humans or animals to children.

In humans, the central nervous system appears to be a sensitive indicator of TCE exposure, and there is concern that pre-natal TCE exposure may affect fetal development. In animals, TCE damages the central nervous system, liver, and kidneys of adult animals, and disrupts normal fetal development when exposure occurs during gestation. The animal data also suggest that the kidney effects generally occur at higher exposure levels than the other effects noted above.

Central Nervous System

Information on the central nervous system effects of TCE comes from studies of occupationally exposed workers and from studies of animals under controlled experimental conditions. In some occupational studies (Okawa and Bodner, 1973; Rasmussen et al., 1993; Vandervort and Polakoff, 1973), exposure to TCE is associated with effects on the central nervous system, including dizziness, headache, drowsiness, nausea and motor dyscoordination. Confidence in these studies for evaluating dose-response relationships is low because the studies did not provide adequate information on long-term TCE exposure and because the small numbers of workers who were examined were also exposed to chemicals other than TCE. Consequently, these data were not used to derive a potential criterion.

When adult male rats were exposed to TCE at 50 parts per million (ppm or 270 milligrams per cubic meter, mg/m^3) or more for eight hours per day, five days per week for six weeks, there were electroencephalographic (EEG) changes indicative of decreased wakefulness (Arito et al., 1994). The lowest exposure level in the study was an effect level. This level becomes 64 mg/m^3 after adjustment of the experimental exposure level to an equivalent level under conditions of continuous exposure (270 mg/m^3 x 8 hours/24 hours x 5 days/7 days = 64 mg/m^3). Using methods consistent with those recommended in the US EPA (1994) guidelines for deriving air

criteria[1], the human adult equivalent concentration (HEC) is 64 mg/m^3. Adjusting the adult HEC to a child's HEC using a child's inhalation rate and body weight and applying an uncertainty factor of 3,000 to the child HEC suggests a potential criterion of about 9 microgram per cubic meter (9 mcg/m^3). The uncertainty factor was selected to compensate for use of a LOEL for an effect from a subchronic study in rats, human variability, and the potential increased sensitivity of children to TCE. Alternatively, applying a larger uncertainty factor to compensate for the observed effect (and an overall uncertainty factor of 10,000) suggests a potential criterion of 3 mcg/m^3.

Liver

Trichloroethene is also toxic to the liver of laboratory animals. Increases in absolute and relative liver weights were observed in male and female mice exposed continuously to 37 ppm (200 mg/m^3) or more for 30 days (Kjellstrand et al., 1983). We modeled the dose-response data for absolute liver weights and identified 13 ppm (70 mg/m^3) as the lowest air concentration corresponding to the lower bound on a 10% increase in liver effects in either male or female mice (essentially equivalent to a LOEL). Using methods consistent with those recommended in the US EPA (1994) guideline for deriving air criteria, the adult HEC is 70 mg/m^3. Adjusting the adult HEC to a child's HEC using a child's inhalation rate and body weight and applying an uncertainty factor of 3,000 to the child HEC suggests a potential criterion of about 9 mcg/m^3. The uncertainty factor was selected to compensate for use of a LOEL from a subchronic study in mice, human variability, and the potential increased sensitivity of children to TCE.

Developmental/Reproductive Effects

An epidemiological investigation (Goldberg et al., 1990) found an association between mothers living in areas where public drinking water wells were contaminated (primarily with TCE) and an increased incidence of cardiac malformations in their children. Whether or not prenatal TCE exposure played a role in producing these cardiac effects is unclear; however, this study raises concerns that developmental effects may be an important toxicological endpoint for TCE in humans.

In animals, Dawson et al. (1990, 1993) showed that exposure to TCE in drinking water during pregnancy caused a statistically significant increase in cardiac malformations in fetal rats at doses as low as 0.2 mg/kg/day. Applying an uncertainty factor of 1,000 to the animal LOEL and assuming

[1] For extrarespiratory effects of Type 3 chemicals such as TCE, the HEC equals the animal exposure concentration x an adjustment factor, which typically is a default value of 1 (US EPA, 1994).

that the inhaled and ingested doses of TCE (as mg/kg/day) are equivalent suggests a potential criterion of about 0.7 mcg/m^3. The uncertainty factor was selected to compensate for use of a LOEL in rats and human variability in the general population. Confidence in this potential criterion is lower than for those based on other animal studies.

Human Cancer Risks Associated with Exposure to TCE in Air

TCE is an animal carcinogen via the oral and inhalation routes of exposure, and evidence from occupational studies and drinking-water studies suggests that TCE is a risk factor for several types of cancer, including kidney, liver, and cancers of the lympho-hematopoietic systems (e.g., Non-Hodgkin's lymphoma (NHL) and Hodgkin's disease) (ATSDR, 1997; US EPA, 2001; Wartenberg et al., 2000). The National Toxicology Program has classified TCE as "*reasonably anticipated to be a human carcinogen*." Similarly, the International Agency for Research on Cancer classifies TCE "*as probably carcinogenic to humans.*" In both cases, the determination was based on "limited evidence" of carcinogenicity from studies in humans and "sufficient evidence" of carcinogenicity from studies in experimental animals. In short, epidemiological studies suggest, but do not conclusively prove, that TCE increases the incidence of some types of cancer in humans, animal bioassay studies show unequivocally that oral or inhaled doses of TCE cause cancer at several sites in rats and mice, and mode-of-action data suggest that the way TCE causes cancer in animals may be relevant to humans.

For cancer effects, we identified the important human and animal studies on the carcinogenicity of TCE in air, and determined the appropriateness of each study for use in estimating the human TCE air concentration associated with an excess lifetime human cancer risk of one-in-one million. In both the qualitative and quantitative evaluation, we used procedures and methods consistent with the US EPA guidelines for carcinogen risk assessment (US EPA, 2003).

We evaluated four epidemiological studies to determine their usefulness to estimate the TCE air level (mcg/m^3) associated with an excess lifetime human cancer risk of 1×10^{-6} (i.e., a TCE 1×10^{-6} air level). Three of the studies (Anttila et al., 1995; Cohn et al., 1994; Henschler et al., 1995) did not meet minimal requirements (see Hertz-Picciotto, 1995) for use in dose-response assessment, largely because each study did not characterize adequately the duration and/or magnitude of exposure to TCE. The fourth study (Hansen et al., 2001) provided estimates of TCE air levels in the workplace and of the average duration of occupational exposures and was used to derive estimates of TCE 1×10^{-6} air levels.

Using the relative risk data (from Hansen et al., 2001), exposure data from occupational studies (Hansen et al., 2001; Raaschou-Nielsen et al., 2002) and an average relative risk model recommended by the World Health Organization (WHO, 1996), our estimates of the TCE 1×10^{-6} air levels range from about 0.06 to about 1 mcg/m^3 under a standard exposure scenario (continuous exposure for 70 years, 70-kg person, and inhalation rate of 20 m^3/day), and vary with choice of cancer site, measure of relative risk, the TCE workplace air level, and years of employment. Confidence in these estimates is low because of the small number of cases, the inability to adequately control the potential influence of confounders, unavoidable uncertainties in the exposure estimates, and the lack of clear dose-response relationship. Thus, these estimates were used to check the plausibility of animal-based estimates of 1×10^{-6} TCE air level (see below).

Inhalation studies using laboratory animals provide scientifically-sound, dose-response datasets showing a statistically significant relationship between TCE exposure levels and an increased incidence of tumors (Fukuda et al., 1983; Henschler et al., 1980; Maltoni et al., 1986). These data have been used by the US EPA (1987, 2001), CA EPA (1999, 2002), WHO (1996), Health Canada (1993), and Rhomberg (2000) to derive estimates of the TCE 1×10^{-6} air level.

We evaluated published estimates and derived additional estimates based on considerations of the quality of the animal data and the use of recommended dose metrics and cross-species extrapolation factors. The estimates considered in our evaluation were based on dose-response data from rats and mice for four cancer sites (liver, lung, testes, and lymph system) using three dose metrics (lifetime average daily exposure as TCE mg/m^3; lifetime average daily metabolized TCE dose as mg TCE metabolized/kg/day; or lifetime average daily internal dose of trichloroacetic acid (TCA) in plasma or tissue as TCA-area-under-curve (mg-hr)/liter), and two cross-species scaling methods (equal risk at equal exposure or equal risk at exposure scaled by body weight$^{0.75}$). The range of estimates of the TCE 1×10^{-6} air level is about 0.2 to about 4 mcg/m^3 under a standard exposure scenario (continuous exposure for 70 years, 70-kg person, and inhalation rate of 20 m^3/day). Because there is a lack of scientific consensus on the appropriate animal surrogate and cancer sites, dose metric, and the method for scaling dose across species, no single estimate is preferred. These estimates are similar to the estimates obtained from the human data.

Summary

We have evaluated the non-cancer effects associated with TCE exposure in air, and focused our attention on those studies that identified sensitive human and animal responses to TCE exposures. Three types of effects observed in animals were used: central nervous system (Arito et al., 1994), liver (Kjellstrand et al., 1983), and developmental (Dawson et al., 1990, 1993). Using methods consistent with latest US EPA guidelines, the potential criteria range from about 1 mcg/m^3 to about 10 mcg/m^3.

In developing these potential criteria, uncertainties that limit our ability to estimate the human non-cancer effects of low-dose exposures (i.e., use of subchronic studies to evaluate chronic exposures, use of an effect level rather than a no-observed-effect level, interspecies extrapolations, and human variability) and factors necessary when considering children (respiration rate and body weight of children and the potential increased sensitivity of children to TCE exposures) were taken into account.

We have evaluated the cancer effects associated with TCE exposure in air, and focused our attention on those human and animal studies that showed significant relationships between estimated or measured TCE exposure and increased rates of cancers. We did not find any human studies strong enough to support potential criteria (i.e., TCE 1 x 10^{-6} air levels) based on cancer effects, although one study (Hansen et al., 2001) was used for checking the plausibility of criteria based on animal studies.

We derived estimates of the TCE air level associated with an excess lifetime human cancer risk of 1 x 10^{-6} using data from inhalation studies using animals (Fukuda et al., 1983; Henschler et al., 1980; Maltoni et al., 1986). Given the lack of consensus on the appropriate data, we developed estimates based on two different species, four cancer sites, three different methods of estimating dose, and two different methods for scaling dose across species. Using methods consistent with latest US EPA guidelines, the potential criteria range from about 0.2 to about 4 mcg/m^3. This range reflects the uncertainty surrounding our ability to estimate the human cancer effects of low-dose exposures. The animal-based estimates are similar to the human-based estimates.

After reviewing the data on the non-cancer and cancer effects of TCE and the potential criteria for long-term exposure of the general populations based on these effects, the New York State Department of Health has set an air guideline for TCE of 5 mcg/m^3. The margins-of-exposure between this guideline and the TCE air levels known to cause non-cancer effects in animals are consistent with recommended procedures and are adequate when

considered in conjunction with the limitations of the different studies. Similarly, the estimated increased human cancer risks associated with lifetime continuous exposure to 5 mcg/m^3 are in the risk range (1×10^{-6} to 1×10^{-4}) that is generally used by regulatory agencies when making decisions. We continue to update, review, and refine our evaluation of the potential health risks associated with TCE.

Sincerely,

Nancy K. Kim

Nancy K. Kim, Ph.D., Director
Division of Environmental Health Assessment

Enclosure
cc: R. Tramontano
C. Johnson

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FINAL REPORT

TETRACHLOROETHENE AMBIENT AIR CRITERIA DOCUMENT

OCTOBER 1997

New York State Department of Health

CENTER FOR ENVIRONMENTAL HEALTH
BUREAU OF TOXIC SUBSTANCE ASSESSMENT

2 University Place
Albany, NY 12203-3399

APPENDIX 1

TETRACHLOROETHENE
HEALTH EFFECTS

November 6, 1991

NEW YORK STATE DEPARTMENT OF HEALTH

TETRACHLOROETHENE HEALTH EFFECTS

November 6, 1991

In evaluating the health risks from tetrachloroethene exposure, the New York State Department of Health followed the procedures outlined by the National Academy of Sciences (NAS, 1977, 1987) and federal agencies such as the U.S. Food and Drug Administration, the U.S. Environmental Protection Agency, and the Agency for Toxic Substances and Disease Registry (Dourson and Stara, 1983; US EPA 1988, 1989). We've identified either no-observed-effect levels or lowest-observed-effect levels for target organs in humans and animals. When developing exposure guidelines for long-term exposure of the general population from human data, uncertainty factors are used because effect or no-effect levels can be based on studies using healthy adults (frequently only men), short exposure times, small sample sizes and limited information on exposure levels. These same limitations may exist when using animal data, but additional uncertainty is introduced when extrapolating results from animals to humans. Uncertainty factors that are usually applied include a factor of ten for a short-term study, ten for using a lowest-observed-effect level rather than a no-observed-effect level and ten in going from a limited study in adults to the general population. Consideration may also be made for the quality and quantity of the available data.

Information on central nervous system effects comes from human controlled-chamber exposures and from epidemiological studies. The controlled studies used healthy adults and short exposure times. The epidemiological studies involved longer exposure times, but the exposure levels are less certain than for the controlled studies.

In controlled exposure studies, Stewart et al. (1970) and Hake and Stewart (1977) reported central nervous system effects when adult males and females were exposed to 100 ppm (690 milligrams per cubic meter--mg/m^3) for 7 or 7.5 hours per day for five days. Effects were not detected in adults exposed to 20 ppm (140 mg/m^3) for 7.5 hours per day for 5 days.

Workers exposed to tetrachloroethene have also been evaluated for possible central nervous system effects. A study by Lauwerys et al. (1983) did not detect adverse effects on the central nervous system of Belgian workers at dry cleaning shops who were exposed to a time weighted average (TWA) tetrachloroethene level of 21 ppm (145 mg/m^3). Seeber (1989) summarized a series of studies which evaluated such endpoints as perceptual speed, digit reproduction and sensorimotor and coordination functions in German dry cleaning workers. The performance of both the high-exposed (reported TWA 360 mg/m^3) and low-exposed (reported TWA 83 mg/m^3) groups differed significantly from the control group for some tests; however, the two exposed groups did not differ from each other.

A guideline for central nervous system effects for the general population can be derived from the no-observed-effect level in controlled chamber experiments or from the worker studies. The no-observed-effect level for central nervous system effects in the controlled chamber studies is 20 ppm (140 mg/m^3). Because this study was on healthy adults and of limited duration, an uncertainty factor of 100 is applied after averaging the concentration over 24 hours. This suggests a guideline of 0.4 mg/m^3. The lowest effect level in the worker studies was 83 mg/m^3. Because effects were observed and the study was on healthy adults, an uncertainty factor of 100 is needed after averaging the concentration over 24 hours. This suggests a guideline of 0.25 mg/m^3.

The liver is also a target organ for tetrachloroethene, particularly in mice. Case reports of liver effects have also been reported in humans who were exposed to high concentrations, sometimes under severe circumstances. The lowest-observed-effect level for mice is 60 mg/m^3, when continuously exposed for 30 days (Kjellstrand et al., 1984). Liver weights were significantly elevated. Using an inhaled dose to extrapolate the results from mice to humans and applying a thousand-fold uncertainty factor would suggest a guideline of about 0.25 mg/m^3 for liver effects.

The kidney is also a target organ in rats. Effects were seen in rats exposed to 200 ppm (1,400 mg/m^3) for 6 hours per day, 5 days per week for 2 years (NTP, 1986). These effects included nucleus enlargement and tubular cell hyperplasia. Using an inhaled dose to extrapolate from rats to humans and applying a thousand-fold uncertainty factor would suggest a guideline of about 0.5 mg/m^3 for kidney effects.

Exposure to tetrachloroethene caused liver tumors in mice and mononuclear cell leukemias and kidney tumors in rats. The exact mechanisms by which these tumors were induced are not known. Because of the uncertainty, a conservative estimate of the tetrachloroethene air concentration corresponding to the upper bound on risk and associated with a one in one million excess lifetime human oncogenic risk is 0.00005 mg/m^3. This estimate is based on the assumptions that the delivered dose of the active carcinogenic agent is linearly proportional to the inhaled dose of tetrachloroethene across all doses and that surface area is the appropriate parameter for dose extrapolation. Confidence in this estimate is limited by the data which indicate that linearity across all doses does not hold for the potential oncogenic agents (tetrachloroethene or its metabolites) and by the degree to which the results of empirical observations on the toxic effects of anti-neoplastic drugs (the source of the surface area rule) are applicable to chemicals which are metabolized differently.

Correlations between the metabolic and carcinogenic data can be used to support the hypothesis that the metabolic products of the mixed function oxidase pathway for tetrachloroethene are responsible for its carcinogenicity in mice. If the available data are used with physiologically-based pharmacokinetic modeling, an estimate of the air level corresponding to the upper bound on risk and associated with a one in one million excess lifetime human carcinogenic risk is 0.0005 mg/m^3 (if humans and mice are assumed to be equally sensitive to the same delivered dose). Confidence in this estimate is limited by the validity of the initial assumptions and the accuracy of the model in compensating for non-linearity when extrapolating from high to low doses and in compensating for differences in the capacity of mice and humans to metabolize tetrachloroethene by the mixed function oxidase pathway.

Correlations using urinary excretion data for tetrachloroethene metabolites can also be used to estimate an excess human cancer risk from the mouse liver tumor data. Using this method (US EPA, 1990), the tetrachloroethene air concentration corresponding to an upper bound on risk and associated with a one in one million excess lifetime human cancer risk is 0.002 mg/m^3.

The New York State Department of Health recommends, based on an evaluation of the non-carcinogenic effects of tetrachloroethene, that the average ambient air level in a residential community not exceed 0.25 mg/m^3 for adults, considering continuous lifetime exposure. If a child's inhalation rate and body weight are used, the guideline becomes 0.1 mg/m^3. Furthermore, we recommend that the uncertainty factor not be reduced by more than an order of magnitude when considering the need to take immediate action. We also recommend that exposure to tetrachloroethene be minimized to the extent practical; e.g. regardless of the levels, solvent containers should not be left opened. The potential carcinogenic risks of tetrachloroethene will be considered further as regulations are developed for the dry cleaning industry.

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EXPOSURE ASSUMPTIONS USED TO DERIVE 1991 GUIDELINES

The exposure assumptions used to derive the non-carcinogenic guidelines are provided below.

Group	Body Weight	Daily Inhalation Rate
adult	70 kg	20 m^3/day
child	20.5 kg*	14.5 m^3/day*
mouse	0.035 kg	0.039 m^3/day
rat	0.40 kg	0.24 m^3/day

*see Table 12 of Criteria Document for age-specific data

The methods and assumptions used to derive the carcinogenic guidelines based on metabolized dose are found in Table 17 of Criteria Document.

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NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix E

ASTM's *Standard Practice for Residential Radon Mitigation*

Reference:
EPA's web site at http://www.epa.gov/radon/pubs/mitstds.html
(Thursday, September 7th, 2006, posting)

EPA's Recommended Residential Radon Mitigation Standard of Practice

EPA recommends the ***Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings**** for residential radon mitigation. This voluntary, consensus-based standard was developed and issued by the American Society for Testing and Materials International, and is identified as **ASTM E-2121**.

The Agency first cited **ASTM E-2121** in 2003 as a national consensus standard appropriate for reducing radon in homes as far as practicable below the national action level of 4 picocuries per liter (pCi/L) in indoor air. As of May 2006, EPA no longer recommends, and will no longer distribute its own, superseded *Radon Mitigation Standards* (EPA 402-R-93-078, Revised April 1994).

- A single free copy of the **ASTM E-2121** standard is available from EPA's National Service Center for Environmental Publications - http://yosemite.epa.gov/ncepihom/nsCatalog.nsf/SearchPubs?OpenForm, or the Agency's IAQ-Info hotline, 1-800-438-4318.

- Copies of the standard may be purchased from ASTMI at www.astm.org/cgi-bin/SoftCart.exe/index.shtml?E+mystore, or from the American National Standards Institute (ANSI) at www.ansi.org/.

*E-2121-03 (February 10, 2003), American Society for Testing and Materials (ASTM) International; an American National Standards Institute (ANSI) approved consensus standard.

If you have questions concerning this policy, contact either Philip Jalbert jalbert.philip@epa.gov or Eugene Fisher fisher.eugene@epa.gov.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

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NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix F

EPA's *Model Standards and Techniques for Control of Radon in New Residential Buildings*

Reference:
United State Environmental Protection Agency. "Model Standards and Techniques for Control of Radon in New Residential Buildings" (EPA 402-R-94-009; March 1994).

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

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"Model Standards and Techniques for Control of Radon in New Residential Buildings"

U.S. Environmental Protection Agency, Air and Radiation (6604-J)
EPA 402-R-94-009, March 1994

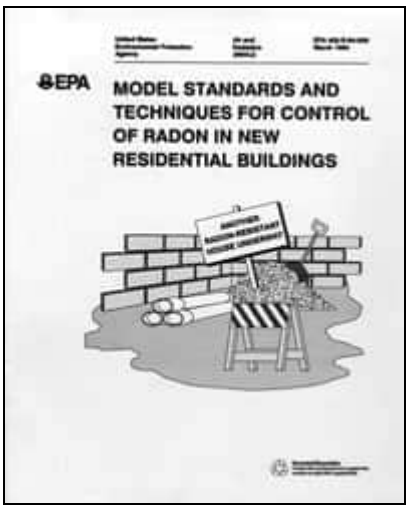


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DISCLAIMER

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NOTE: EPA closed its National Radon Proficiency Program on 9/30/98, see epa.gov/radon/proficiency.html for ways to find a "qualified" radon service provider.

FORWARD

This document is intended to serve as a model for use by the Model Code Organizations, States and other jurisdictions as they develop and adopt building codes, appendices to codes, or standards specifically applicable to their unique local or regional radon control requirements.

This document is responsive to the requirements set forth in Section 304 of Title III of the Toxic Substances Control Act (TSCA), 15 U.S.C. 2664, commonly referred to as the Indoor Radon Abatement Act (IRAA) of 1988. It is anticipated that future editions of this document will be prepared as additional experience is gained in constructing new radon-resistant residential buildings.

1.0 Scope

1.0.1 This document contains model building standards and techniques applicable to controlling radon levels in new construction of one- and two-family dwellings and other residential buildings three stories or less in height as defined in model codes promulgated by the respective Model Code Organizations.

1.0.2 The model building standards and techniques are also applicable when additions are made to the foundations of existing one- and two-family dwellings that result in extension of the building footprint.

1.0.3 This document is not intended to be a building code nor is it required that it be adopted verbatim as a referenced standard.

1.0.4 It is intended that the building standards and techniques contained in section 9.0 of this document, the construction method in section 7.0, and the recommended procedures for applying the standards and construction method in section 8.0, serve as a model for use by the Model Code Organizations and authorities within states or other jurisdictions that are responsible for regulating building construction as they develop and adopt building codes, appendixes to codes, or standards and implementing regulations specifically applicable to their unique local or regional radon control requirements.

1.0.5 The preferential grant assistance authorized in Section 306(d) of the Indoor Radon Abatement Act of 1988 (Title III of the Toxic Substances Control Act, TSCA, 15 U.S.C. 2666) will be applied for states where appropriate authorities who regulate building construction are taking action to adopt radon-resistant standards in their building codes.

1.0.6 Model building standards and techniques contained in this document are not intended to supersede any radon-resistant construction standards, codes or regulations previously adopted by local jurisdictions and authorities. However, jurisdictions and authorities are encouraged to review their current building standards, codes, or

regulations and their unique local or regional radon control requirements, and consider modifications, if necessary.

1.0.7 This document will be updated and revised as ongoing and future research programs suggest revisions of standards, identify ways to improve the model construction techniques, or when newly tested products or techniques prove to be equivalent to or more effective in radon control. Updates and revisions to the model building standards and techniques contained in section 9.0 will undergo appropriate peer review.

1.0.8 EPA is committed to continuing evaluation of the effectiveness of the standards and techniques contained in section 9.0 and to research programs that may identify other more effective and efficient methods.

2.0 Limitations

2.0.1 The Indoor Radon Abatement Act of 1988 (Title III of TSCA) establishes a long-term national goal of achieving radon levels inside buildings that are no higher than those found in ambient air outside of buildings. While technological, physical, and financial limitations currently preclude attaining this goal, the underlying objective of this document is to move toward achieving the lowest technologically achievable and most cost effective levels of indoor radon in new residential buildings.

2.0.2 Preliminary research indicates that the building standards and techniques contained in section 9.0 can be applied successfully in mitigating radon problems in some existing nonresidential buildings. However, their effectiveness when applied during construction of new nonresidential buildings has not yet been fully demonstrated. Therefore, it is recommended that, pending further research, these building standards and techniques not be used at this time as a basis for changing the specific sections of building codes that cover nonresidential construction.

2.0.3 Although radon levels below 4 pCi/L have been achieved in all types of residential buildings by using these model building standards and techniques, specific indoor radon levels for any given building cannot be predicted due to different site and environmental conditions, building design, construction practices, and variations in the operation of buildings.

2.0.4 These model building standards and techniques are not to be construed as the only acceptable methods for controlling radon levels, and are not intended to preempt, preclude, or restrict the application of alternative materials, systems, and construction practices approved by building officials under procedures prescribed in existing building codes.

2.0.5 Elevated indoor radon levels caused by emanation of radon from water is of potential concern, particularly in areas where there is a history of groundwater with high radon content. This document does not include model construction standards or

techniques for reducing elevated levels of indoor radon that may be caused by the presence of high levels of radon in water supplies. EPA has developed a suggested approach (see paragraph 8.3.2) that state or local jurisdictions should consider as they develop regulations concerning private wells. EPA is continuing to evaluate the issue of radon occurrence in private wells and the economic impacts of testing and remediation of wells with elevated radon levels.

2.0.6 While it is not currently possible to make a precise prediction of indoor radon potential for a specific building site, a general assessment, on a statewide, county, or grouping of counties basis, can be made by referring to EPA's Map of Radon Zones and other locally available data. It should be noted that some radon potential exists in all areas. However, EPA recognizes that based on available data, there is a lower potential for elevated indoor radon levels in some states and portions of some states, and that adoption of building codes for the prevention of radon in new construction may not be justified in these areas at this time. There is language in paragraph 8.2.3 of this document recommending that jurisdictions in these areas review all available data on local indoor radon measurements, geology, soil parameters, and housing characteristics as they consider whether adoption of new codes is appropriate.

3.0 Reference Documents

References are made to the following publications throughout this document. Some of the references do not specifically address radon. They are listed here only as relevant sources of additional information on building design, construction techniques, and good building practices that should be considered as part of a general radon reduction strategy.

3.1 "Building Foundation Design Handbook," ORNL/SUB/86-72143/1, May 1988.

3.2 "Building Radon Resistant Foundations - A Design Handbook," NCMA, 1989.

3.3 "Council of American Building Officials (CABO) Model Energy Code, 1992.

3.4 "Design and Construction of Post-Tensioned Slabs on Ground," Post Tensioning Institute Manual.

3.5 "Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings," ASHRAE Standard 90.1-1989.

3.6 "Energy Efficient Design of New Low-Rise Residential Buildings," Draft ASHRAE Standard 90.2 (Under public review).

3.7 "Homebuyer's and Seller's Guide to Radon," EPA 402-R-93-003, March 1993.

3.8 "Guide to Residential Cast-in-Place Concrete Construction," ACI 332R.

3.9 "Indoor Radon and Radon Decay Product Measurement Device Protocols." EPA 402-R-92-004, July, 1992.

3.10 "Protocols For Radon and Radon Decay Product Measurements in Homes." EPA 402-R-92-003, June, 1993.

3.11 "Permanent Wood Foundation System - Basic Requirements, NFPA Technical Report No.7."

3.12 "Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings," ASTM Standard Guide, E1465-92.

3.13 "Radon Handbook for the Building Industry," NAHB-NRC, 1989.

3.14 "USEPA Map of Radon Zones," Dec. 1993. www.epa.gov/radon/zonemap.html

3.15 "Radon Reduction in New Construction, An Interim Guide." OPA-87-009, August 1987.

3.16 "Radon Reduction in Wood Floor and Wood Foundation Systems." NFPA, 1988.

3.17 "Radon Resistant Construction Techniques for New Residential Construction. Technical Guidance." EPA/625/2-91/032, February 1991.

3.18 "Radon-Resistant Residential New Construction." EPA/600/8-88/087, July 1988.

3.19 "Guide for Concrete Floor and Slab Construction," ACI 302.1R-89.

3.20 "Ventilation for Acceptable Indoor Air Quality," ASHRAE 62-1989.

4.0 Description of Terms

For this document, certain terms are defined in this section. Terms not defined herein should have their ordinary meaning within the context of their use. Ordinary meaning is as defined in "Webster's Ninth New Collegiate Dictionary."

ACTION LEVEL: A term used to identify the level of indoor radon at which remedial action is recommended. (EPA's current action level is 4 pCi/L.)

AIR PASSAGES: Openings through or within walls, through floors and ceilings, and around chimney flues and plumbing chases, that permit air to move out of the conditioned spaces of the building.

COMBINATION FOUNDATIONS: Buildings constructed with more than one foundation type; e.g., basement/crawlspace or basement/slab-on-grade.

DRAIN TILE LOOP: A continuous length of drain tile or perforated pipe extending around all or part of the internal or external perimeter of a basement or crawlspace footing.

GOVERNMENTAL: State or local organizations/agencies responsible for building code enforcement.

MAP OF RADON ZONES: A USEPA publication depicting areas of differing radon potential in both map form and in state specific booklets.

MECHANICALLY VENTILATED CRAWLSPACE SYSTEM: A system designed to increase ventilation within a crawlspace, achieve higher air pressure in the crawlspace relative to air pressure in the soil beneath the crawlspace, or achieve lower air pressure in the crawlspace relative to air pressure in the living spaces, by use of a fan.

MODEL BUILDING CODES: The building codes published by the 4 Model Code Organizations and commonly adopted by state or other jurisdictions to control local construction activity.

MODEL CODE ORGANIZATIONS: Includes the following agencies and the model building codes they promulgate:

- Building Officials and Code Administrators International, Inc. (BOCA National Building Code/1993 and BOCA National Mechanical Code/1993);
- International Conference of Building Officials (Uniform Building Code/1991 and Uniform Mechanical Code/1991);
- Southern Building Code Congress, International, Inc. (Standard Building Code/1991 and Standard Mechanical Code/1991);
- Council of American Building Officials (CABO One- and Two-Family Dwelling Code/1992 and CABO Model Energy Code/1993).

pCi/L: The abbreviation for "picocuries per liter" which is used as a radiation unit of measure for radon. The prefix "pico" means a multiplication factor of one trillionth. A Curie is a commonly used measurement of radioactivity.

SOIL GAS: The gas present in soil which may contain radon.

SOIL-GAS-RETARDER: A continuous membrane or other comparable material used to retard the flow of soil gases into a building.

STACK EFFECT: The overall upward movement of air inside a building that results from heated air rising and escaping through openings in the building super structure, thus causing an indoor pressure level lower than that in the soil gas beneath or surrounding the building foundation.

SUB-SLAB DEPRESSURIZATION SYSTEM (ACTIVE): A system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a fan-powered vent drawing air from beneath the slab.

SUB-SLAB DEPRESSURIZATION SYSTEM (PASSIVE): A system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a vent pipe routed through the conditioned space of a building and connecting the sub-slab area with outdoor air, thereby relying solely on the convective flow of air upward in the vent to draw air from beneath the slab.

SUB-MEMBRANE DEPRESSURIZATION SYSTEM: A system designed to achieve lower sub-membrane air pressure relative to crawlspace air pressure by use of a fan-powered vent drawing air from under the soil-gas-retarder membrane.

5.0 Principles for Construction of Radon-Resistant Residential Buildings

5.1 The following principles for construction of radon-resistant residential buildings underlie the specific model standards and techniques set forth in section 9.0.

5.1.1 Residential buildings should be designed and constructed to minimize the entrance of soil gas into the living space.

5.1.2 Residential buildings should be designed and constructed with features that will facilitate post-construction radon removal or further reduction of radon entry if installed prevention techniques fail to reduce radon levels below the locally prescribed action level.

5.2 As noted in the limitations section (paragraph 2.0.2), construction standards and techniques specifically applicable to new nonresidential buildings (including high-rise residential buildings), have not yet been fully demonstrated. Accordingly, the specific standards and techniques set forth in section 9.0 should not, at this time, be considered applicable to such buildings. There are, however, several general conclusions that may be drawn from the limited mitigation experience available on large nonresidential construction. These conclusions are summarized below to provide some initial factors for consideration by builders of nonresidential buildings.

5.2.1 HVAC systems should be carefully designed, installed and operated to avoid depressurization of basements and other areas in contact with the soil.

5.2.2 As a minimum, use of a coarse gravel or other permeable base material beneath slabs, and effective sealing of expansion joints and penetrations in foundations below the ground surface will facilitate post-construction installation of a sub-slab depressurization system, if necessary.

5.2.3 Limited mitigation experience has shown that some of the same radon reduction systems and techniques used in residential buildings can be scaled up in size, number, or performance to effectively reduce radon in larger buildings.

6.0 Summary of the Model Building Standards and Techniques

The model building standards and techniques listed in section 9.0 are designed primarily for control of radon in new one- and two family dwellings and other residential buildings three stories or less in height.

6.1 Basement and Slab-on-Grade Foundations.

The model building standards and techniques for radon control in new residential buildings constructed on basement and slab-ongrade foundations include a layer of permeable sub-slab material, the sealing of joints, cracks, and other penetrations of slabs, floor assemblies, and foundation walls below or in contact with the ground surface, providing a soil-gas-retarder under floors and installing either an active or passive sub-slab depressurization system (SSD). Additional radon reduction techniques are prescribed to reduce radon entry caused by the heat induced "stack effect." These include the closing of air passages (also called thermal by-passes), providing adequate makeup air for combustion and exhaust devices, and installing energy conservation features that reduce non-required airflow out of the building superstructure.

6.2 Crawlspace Foundations.

The model building standards and techniques for radon control in new residential buildings constructed on crawlspace foundations include those systems that actively or passively vent the crawlspace to outside air, that divert radon before entry into the crawlspace, and that reduce radon entry into normally occupied spaces of the building through floor openings and ductwork.

6.3 Combination Foundations.

Radon control in new residential buildings constructed on a combination of basement, slab-on-grade or crawlspace foundations is achieved by applying the appropriate construction techniques to the different foundation segments of the building. While each foundation type should be constructed using the relevant portions of these model building standards and techniques, special consideration must be given to the points at which different foundation types join, since additional soil-gas entry routes exist in such locations.

7.0 Construction Methods

The model construction standards and techniques described in section 9.0 have proved to be effective in reducing indoor radon levels when used to mitigate radon problems in existing homes and when applied in construction of new homes. In most cases,

combinations of two or more of these standards and techniques have been applied to achieve desired reductions in radon levels. Because of success achieved in reducing radon levels by applying these multiple, interdependent techniques, limited data have been collected on the singular contribution to radon reduction made by any one of the construction standards or techniques. Accordingly, there has been no attempt to classify or prioritize the individual standards and techniques as to their specific contribution to radon reduction. It is believed that use of all the standards and techniques (both passive and active) will produce the lowest achievable levels of indoor radon in new homes (levels below 2 pCi/L have been achieved in over 90 percent of new homes). It is also believed that use of only selected (passive) standards and techniques will produce indoor radon levels below the current EPA action level of 4 pCi/L in most new homes, even in areas of high radon potential.

7.1 It is recommended that all the passive standards and techniques listed in section 9.0 (including a roughed-in passive radon control system) be used in areas of high radon potential, as defined by local jurisdictions or in EPA's Map of Radon Zones. Based on more detailed analysis of locally available data, jurisdictions may choose to apply more or less restrictive construction requirements within designated portions of their areas of responsibility. To ensure that new homes are below the locally prescribed action level, in those cases where only passive radon control systems have been installed, occupants should have their homes tested to determine if passive radon control systems need to be activated. In addition, it is recommended that periodic retests be conducted to confirm continued effectiveness of the radon control system.

7.2 Any radon testing referenced in this document should be conducted in accordance with EPA Radon Testing Protocols or current EPA guidance for radon testing in real estate transactions as referenced in paragraph 3.0. It is recommended that all testing be conducted by companies listed in EPA's Radon Measurement Proficiency Program (RMP) or comparable State certification programs. [Note: EPA closed its National Radon Proficiency Program on 9/30/98, see epa.gov/radon/proficiency.html for ways to find a "qualified" radon service provider.]

7.3 The design and installation of radon control systems should be performed or supervised by individuals (i.e., builders, their representatives, or registered design professionals such as architects or engineers) who have attended an EPA-approved radon training course, or by an individual listed in the EPA Radon Contractor Proficiency Program. [Note: EPA closed its National Radon Proficiency Program on 9/30/98, see epa.gov/radon/proficiency.html for ways to find a "qualified" radon service provider.]

8.0 Recommended Implementation Procedures

The following procedures are recommended as guidelines for applying the model building standards and techniques and construction methods contained in this document. These procedures are based on the rationale that a passive radon control system and features to facilitate any necessary post-construction radon reduction

should be routinely built-in to new residential buildings in areas having a high radon potential.

8.1 State, county, or local jurisdictions that use these model building standards and techniques as a basis for developing building codes for radon resistant construction should classify their area by reference to the Zones in EPA's Map of Radon Zones or by considering other locally available data. While EPA believes that the Map of Radon Zones and accompanying state-specific booklets are useful in setting general boundaries of areas of concern, EPA recommends that state and local jurisdictions collect and analyze local indoor radon measurements, and assess geology, soil parameters and housing characteristics --in conjunction with referring to the EPA radon maps -- to determine the specific areas within their jurisdictions that should be classified as Zone 1.

8.2 State, county, or local jurisdictions that use these model building standards and techniques as a basis for developing building codes for radon-resistant construction should specify the construction methods applicable to their jurisdictional area.

8.2.1 In areas classified as Zone 1 in the Map of Radon Zones, or by local jurisdiction, application of the construction method in paragraph 7.1 is recommended.

8.2.2 In areas classified as Zone 2, home builders may apply any of the radon-resistant construction standards and techniques that contribute to reducing the incidence of elevated radon levels in new homes and that are appropriate to the unique radon potential that may exist in their local building area.

8.2.3 In those areas where state and local jurisdictions have analyzed local indoor radon measurements, geology, soil parameters, and housing characteristics and determined that there is a low potential for indoor radon, application of radon-resistant construction techniques may not be appropriate. In these areas, radon-resistant construction techniques may not be needed, or limited use of selected techniques may be sufficient.

8.3 It is recognized that specific rules, regulations, or ordinances covering implementation of construction standards or codes are developed and enforced by state or local jurisdictions. While developing the model construction standards and techniques contained in this document, EPA also developed several approaches to regulation that states or local jurisdictions may find useful and appropriate as they develop rules and regulations that meet their unique requirements. For example:

8.3.1 In areas where the recommended construction method or comparable prescriptive methods are mandated by state or local jurisdictions, regulations would need to include, as part of the inspection process, a review of the radon-resistant construction features by inspectors who have received additional training, to ensure that the radon-resistant construction features are properly installed during construction. It would also be necessary to establish requirements for those building officials who review and approve

construction plans and specifications to become proficient in identifying and approving planned radon-resistant construction features.

8.3.2 In any area where surveys have shown the existence of high levels of radon in groundwater, or in areas where elevated levels of indoor radon have been found in homes already equipped with active radon control systems, well water may be the source. In such areas, authorities responsible for water regulation should consider establishing well water testing requirements that include tests for radon.

9.0 Model Building Standards and Techniques

9.1 Foundation and Floor Assemblies. The following construction techniques are intended to resist radon entry and prepare the building for post-construction radon mitigation, if necessary. These techniques, when combined with those listed in paragraph 9.2, meet the requirements of the construction method outlined in paragraph 7.1. (See also the construction methods listed in ASTM Standard Guide, E-1465-92.)

9.1.1 A layer of gas permeable material shall be placed under all concrete slabs and other floor systems that directly contact the ground and are within the walls of the living spaces of the building, to facilitate installation of a sub-slab depressurization system, if needed. Alternatives for creating the gas permeable layer include:

a. A uniform layer of clean aggregate, a minimum of 4 inches thick. The aggregate shall consist of material that will pass through a 2-inch sieve and be retained by a 1/4-inch sieve.

b. A uniform layer of sand, a minimum of 4 inches thick, overlain by a layer or strips of geotextile drainage matting designed to allow the lateral flow of soil gases.

c. Other materials, systems, or floor designs with demonstrated capability to permit depressurization across the entire subfloor area.

9.1.2 A minimum 6-mil (or 3-mil cross laminated) polyethylene or equivalent flexible sheeting material shall be placed on top of the gas permeable layer prior to pouring the slab or placing the floor assembly to serve as a soil-gas-retarder by bridging any cracks that develop in the slab or floor assembly and to prevent concrete from entering the void spaces in aggregate base material. The sheeting should cover the entire floor area, and separate sections of sheeting should be overlapped at least 12 inches. The sheeting shall fit closely around any pipe, wire or other penetrations of the material. All punctures or tears in the material shall be sealed or covered with additional sheeting.

9.1.3 To minimize the formation of cracks, all concrete floor slabs shall be designed, mixed, placed, reinforced, consolidated, finished, and cured in accordance with standards set forth in the Model Building Codes. The American Concrete Institute publications, "Guide for Concrete Floor and Slab Construction," ACI 302.1R, "Guide to Residential Cast-in-Place Concrete Construction," ACI 332R, or the Post Tensioning

Institute Manual, "Design and Construction of Post-Tensioned Slabs on Ground" are references that provide additional information on construction of concrete floor slabs.

9.1.4 Floor assemblies in contact with the soil and constructed of materials other than concrete shall be sealed to minimize soil gas transport into the conditioned spaces of the building. A soil-gas-retarder shall be installed beneath the entire floor assembly in accordance with paragraph 9.1.2.

9.1.5 To retard soil gas entry, large openings through concrete slabs, wood, and other floor assemblies in contact with the soil, such as spaces around bathtub, shower, or toilet drains, shall be filled or closed with materials that provide a permanent airtight seal such as non-shrink mortar, grouts, expanding foam, or similar materials designed for such application.

9.1.6 To retard soil gas entry, smaller gaps around all pipe, wire, or other objects that penetrate concrete slabs or other floor assemblies shall be made air tight with an elastomeric joint sealant, as defined in ASTM C920-87, and applied in accordance with the manufacturer's recommendations.

9.1.7 To retard soil gas entry, all control joints, isolation joints, construction joints, and any other joints in concrete slabs or between slabs and foundation walls shall be sealed. A continuous formed gap (for example, a "tooled edge") which allows the application of a sealant that will provide a continuous, airtight seal shall be created along all joints. When the slab has cured, the gap shall be cleared of loose material and filled with an elastomeric joint sealant, as defined in ASTM C920-97, and applied in accordance with the manufacturer's recommendations.

9.1.8 Channel type (French) drains are not recommended. However, if used, such drains shall be sealed with backer rods and an elastomeric joint sealant in a manner that retains the channel feature and does not interfere with the effectiveness of the drain as a water control system.

9.1.9 Floor drains and air conditioning condensate drains that discharge directly into the soil below the slab or into crawlspaces should be avoided. If installed, these drains shall be routed through solid pipe to daylight or through a trap approved for use in floor drains by local plumbing codes.

9.1.10 Sumps open to soil or serving as the termination point for sub-slab or exterior drain tile loops shall be covered with a gasketed or otherwise sealed lid to retard soil gas entry. (Note: If the sump is to be used as the suction point in an active sub-slab depressurization system, the lid should be designed to accommodate the vent pipe. If also intended as a floor drain, the lid shall also be equipped with a trapped inlet to handle any surface water on the slab.)

9.1.11 Concrete masonry foundation walls below the ground surface shall be constructed to minimize the transport of soil gas from the soil into the building. Hollow

block masonry walls shall be sealed at the top to prevent passage of air from the interior of the wall into the living space. At least one continuous course of solid masonry, one course of masonry grouted solid, or a poured concrete beam at or above finished ground surface level shall be used for this purpose. Where a brick veneer or other masonry ledge is installed, the course immediately below that ledge shall also be sealed.

9.1.12 Pressure treated wood foundations shall be constructed and installed as described in the National Forest Products Association (NFPA) Manual, "Permanent Wood Foundation System - Basic Requirements, Technical Report No. 7." In addition, NFPA publication, "Radon Reduction in Wood Floor and Wood Foundation Systems" provides more detailed information on construction of radon-resistant wood floors and foundations.

9.1.13 Joints, cracks, or other openings around all penetrations of both exterior and interior surfaces of masonry block or wood foundation walls below the ground surface shall be sealed with an elastomeric sealant that provides an air-tight seal. Penetrations of poured concrete walls should also be sealed on the exterior surface. This includes sealing of wall tie penetrations.

9.1.14 To resist soil gas entry, the exterior surfaces of portions of poured concrete and masonry block walls below the ground surface shall be constructed in accordance with water proofing procedures outlined in the Model Building Codes.

9.1.15 Placing air handling ducts in or beneath a concrete slab floor or in other areas below grade and exposed to earth is not recommended unless the air handling system is designed to maintain continuous positive pressure within such ducting. If ductwork does pass through a crawlspace or beneath a slab, it should be of seamless material. Where joints in such ductwork are unavoidable, they shall be sealed with materials that prevent air leakage.

9.1.16 Placing air handling units in crawlspaces, or in other areas below grade and exposed to soil-gas, is not recommended. However, if such units are installed in crawlspaces or in other areas below grade and exposed to soil gas, they shall be designed or otherwise sealed in a durable manner that prevents air surrounding the unit from being drawn into the unit.

9.1.17 To retard soil gas entry, openings around all penetrations through floors above crawlspaces shall be sealed with materials that prevent air leakage.

9.1.18 To retard soil gas entry, access doors and other openings or penetrations between basements and adjoining crawlspaces shall be closed, gasketed or otherwise sealed with materials that prevent air leakage.

9.1.19 Crawlspaces should be ventilated in conformance with locally adopted codes. In addition, vents in passively ventilated crawlspaces shall be open to the exterior and be of noncloseable design.

9.1.20 In buildings with crawlspace foundations, the following components of a passive sub-membrane depressurization system shall be installed during construction: (Exception: Where local codes permit mechanical crawlspace ventilation or other effective ventilation systems, and such systems are operated or proven to be effective year round, the sub-membrane depressurization system components are not required.)

9.1.20.1 The soil in both vented and nonvented crawlspaces shall be covered with a continuous layer of minimum 6-mil thick polyethylene sheeting or equivalent membrane material. The sheeting shall be sealed at seams and penetrations, around the perimeter of interior piers, and to the foundation walls. Following installation of underlayment, flooring, plumbing, wiring, or other construction activity in or over the crawlspace, the membrane material shall be inspected for holes, tears, or other damage, and for continued adhesion to walls and piers. Repairs shall be made as necessary.

9.1.20.2 A length of 3- or 4-inch diameter perforated pipe or a strip of geotextile drainage matting should be inserted horizontally beneath the sheeting and connected to a 3- or 4-inch diameter "T" fitting with a vertical standpipe installed through the sheeting. The standpipe shall be extended vertically through the building floors, terminate at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings.

9.1.20.3 All exposed and visible interior radon vent pipes shall be identified with at least one label on each floor level. The label shall read: "Radon Reduction System."

9.1.20.4 To facilitate installation of an active sub-membrane depressurization system, electrical junction boxes shall be installed during construction in proximity to the anticipated locations of vent pipe fans and system failure alarms.

9.1.21 In basement or slab-on-grade buildings the following components of a passive sub-slab depressurization system shall be installed during construction.

9.1.21.1 A minimum 3-inch diameter PVC or other gas-tight pipe shall be embedded vertically into the sub-slab aggregate or other permeable material before the slab is poured. A "T" fitting or other support on the bottom of the pipe shall be used to ensure that the pipe opening remains within the sub-slab permeable material. This gas tight pipe shall be extended vertically through the building floors, terminate at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings. (Note: Because of the uniform permeability of the sub-slab layer prescribed in paragraph 9.1.1, the precise positioning of the vent pipe through the slab is not critical to system

performance in most cases. However, a central location shall be used where feasible.) In buildings designed with interior footings (that is, footings located inside the overall perimeter footprint of the building) or other barriers to lateral flow of sub-slab soil gas, radon vent pipes shall be installed in each isolated, nonconnected floor area. If multiple suction points are used in nonconnected floor areas, vent pipes are permitted to be manifolded in the basement or attic into a single vent that could be activated using a single fan.

9.1.21.2 Internal sub-slab or external footing drain tile loops that terminate in a covered and sealed sump, or internal drain tile loops that are stubbed up through the slab are also permitted to provide a roughed-in passive sub- slab depressurization capability. The sump or stubbed up pipe shall be connected to a vent pipe that extends vertically through the building floors, terminates at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings.

9.1.21.3 All exposed and visible interior radon vent pipes shall be identified with at least one label on each floor level. The label shall read: "Radon Reduction System."

9.1.21.4 To facilitate installation of an active sub-slab depressurization system, electrical junction boxes shall be installed during construction in proximity to the anticipated locations of vent pipe fans and system failure alarms.

9.1.21.5 In combination basement/crawlspace or slab-on-grade/crawlspace buildings, the sub-membrane vent described in paragraph 9.1.20.2 may be tied into the sub-slab depressurization vent to permit use of a single fan for suction if activation of the system is necessary.

9.2 Stack Effect Reduction Techniques.

The following construction techniques are intended to reduce the stack effect in buildings and thus the driving force that contributes to radon entry and migration through buildings. As a basic principle, the driving force decreases as the number and size of air leaks in the upper surface of the building decrease. It should also be noted that in most cases, exhaust fans contribute to stack effect.

9.2.1 Openings around chimney flues, plumbing chases, pipes, and fixtures, ductwork, electrical wires and fixtures, elevator shafts, or other air passages that penetrate the conditioned envelope of the building shall be closed or sealed using sealant or fire resistant materials approved in local codes for such application.

9.2.2 If located in conditioned spaces, attic access stairs and other openings to the attic from the building shall be closed, gasketed, or otherwise sealed with materials that prevent air leakage.

9.2.3 Recessed ceiling lights that are designed to be sealed and that are Type IC rated shall be used when installed on top-floor ceilings or in other ceilings that connect to air passages.

9.2.4 Fireplaces, wood stoves, and other combustion or vented appliances, such as furnaces, clothes dryers, and water heaters shall be installed in compliance with locally adopted codes, or other provisions made to ensure an adequate supply of combustion and makeup air.

9.2.5 Windows and exterior doors in the building superstructure shall be weather stripped or otherwise designed in conformance with the air leakage criteria of the CABO Model Energy Code.

9.2.6 HVAC systems shall be designed and installed to avoid depressurization of the building relative to underlying and surrounding soil. Specifically, joints in air ducts and plenums passing through unconditioned spaces such as attics, crawlspaces, or garages shall be sealed.

9.3 Active Sub-Slab/Sub-Membrane Depressurization System.

When necessary, activation of the roughed-in passive sub-membrane or sub-slab depressurization systems described in paragraphs 9.1.20 and 9.1.21 shall be completed by adding an exhaust fan in the vent pipe and a prominently positioned visible or audible warning system to alert the building occupant if there is loss of pressure or air flow in the vent pipe.

9.3.1 The fan in the vent pipe and all positively pressurized portions of the vent pipe shall be located outside the habitable space of the building.

9.3.2 The fan in the vent pipe shall be installed in a vertical run of the vent pipe.

9.3.3 Radon vent pipes shall be installed in a configuration and supported in a manner that ensures that any rain water or condensation accumulating within the pipes drains downward into the ground beneath the slab or soil-gas-retarder.

9.3.4 To avoid reentry of soil gas into the building, the vent pipe shall exhaust at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings.

9.3.5 To facilitate future installation of a vent fan, if needed, the radon vent pipe shall be routed through attics in a location that will allow sufficient room to install and maintain the fan.

9.3.6 The size and air movement capacity of the vent pipe fan shall be sufficient to create and maintain a pressure field beneath the slab or crawlspace membrane that is lower than the ambient pressure above the slab or membrane.

9.3.7 Under conditions where soil is highly permeable, reversing the air flow in an active sub-slab depressurization system and forcing air beneath the slab may be effective in reducing indoor radon levels. (Note: The long-term effect of active sub-slab depressurization or pressurization on the soil beneath building foundations has not been determined. Until ongoing research produces definitive data, in areas where expansive soils or other unusual soil conditions exist, the local soils engineer shall be consulted during the design and installation of sub-slab depressurization or pressurization systems.)

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NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix G

Community outreach tools — additional information

[This appendix is a modified version of Appendix A from the New York State Department of Environmental Conservation Division of Environmental Remediation's "Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook" (June 1998).]

Additional information about several of the community outreach tools discussed in Section 5 of the guidance document is provided in this appendix. These tools are as follows:

Appendix G.1 Contact List
Appendix G.2 Fact Sheet
Appendix G.3 Public Meeting
Appendix G.4 Availability Session
Appendix G.5 Toll-free "800" Numbers
Appendix G.6 Door-to-door Visits
Appendix G.7 Document Repository

The additional information provided for each tool includes the following:

Description — Summarizes what the technique is and what it achieves.

Suggestions for Planning and Conducting — Offers basic ideas to develop and implement the technique successfully.

Benefits and Limitations — Describes specific benefits the technique can help achieve, and potential impediments to its effectiveness.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.1 Contact List

G.1.1 Description

A contact list contains names, addresses and telephone numbers of individuals and organizations with interest or involvement in the site. They may be affected by or interested in the site, or have information that staff need to make effective remedial decisions. Contact lists typically include residents near the site, elected officials, appropriate federal, state, and local government contacts, local media, organized environmental groups and responsible party, as well as local business, civic and recreational groups.

The site contact list is a critical communications tool that needs to be prepared *before* other activities can be conducted. In some ways, a site-specific citizen participation program will only be as effective as its contact list, which more or less determines who gets the project information prepared, as well as invitations to participate and provide input. Development and revision of the contact list are ongoing activities throughout the site's remediation.

It is recommended that an internal distribution list be developed while preparing the external contact list. The distribution list should include all staff (NYSDEC, NYSDOH, county health department, etc.) involved in the site. This list will help ensure that all staff involved with the project will receive the same information about all phases of the site's remediation.

Note: The checklist on page G-6 will help to identify who may need to be included in a particular site's contact list.

Contact lists are used to

- send a fact sheet announcing a major project decision or proposal, project status or progress, or a public meeting or availability session;
- issue summaries of draft/final documents and announce availability of full documents;
- send a response to public questions and comments;
- transmit a request to the public for information needed by project staff;
- send summaries of information exchanged at public meetings, forums, availability sessions and other public gatherings; and
- identify individuals, groups and organizations by affiliation, interest or geographic location to help to target communication and outreach as appropriate.

G.1.2 Suggestions for Creating an Effective Contact List

Several factors help to determine the size and make up of a site's contact list, including the following:

- the nature and size of the community, whether rural, urban, densely or sparsely populated;
- the nature of hazardous waste contamination, whether confined to an area or environmental medium or more ubiquitous (and thus involving air issues, municipal well contamination, etc.);
- real or perceived impacts of site contamination on the environment, property values, and human health;
- specifics of the proposed remedial solution, especially where there are real or perceived off-site impacts (such as dust, noise, air quality);
- the stage of the remedial process and the specific issues and audiences involved;

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- characteristics of the involved audience;
- the information that needs to be exchanged; and
- program resources.

The contact list will change as a remedial program progresses. These changes reflect increasing or declining interest by different individuals, groups and organizations in various aspects of the program.

G.1.2.1 Some categories are a "given" for every contact list

Some individuals, organizations and representatives should be included in *every* contact list:

- those who are directly affected, such as residents, property owners, and commercial establishments next to the site;
- local elected officials (mayors, supervisors, council members, clerks);
- local emergency services officials;
- local media; and
- relevant business, civic, and environmental organizations.

G.1.2.2 Apply criteria to determine who else should be included

Additional individuals, groups and organizations often are included in site contact lists. The following questions about the site will help determine whether the contact list is complete:

- Who has been — or currently is — affected by site contamination, or by investigation and remediation of the site?
- Who *perceives* that he/she has been — or currently is — affected by site contamination or by investigation and remediation of the site?
- Who is likely to be affected or interested as remediation progresses?
- Who has demonstrated past interest — or currently is showing interest — in the site or the remedial process?
- Who may need information about site contamination or the remedial program who is not currently on the contact list?
- Who may have information that project staff needs who is not currently on the contact list?

G.1.2.3 Build upon existing information

For many sites, an initial list of adjacent residents and local officials is developed when the NYSDEC sends classification or reclassification letters, etc. This list can be checked for accuracy and updated as needed. It can serve as a core group for the contact list.

G.1.2.4 Include people who have shown interest

Review project files to identify people who have historically demonstrated interest in the site. Review sign-in sheets from public meetings and availability sessions; include people who have written letters about the site to the state or other party, or who have called project staff or the NYSDEC or NYSDOH's toll-free information numbers.

G.1.2.5 Ask other staff

Ask staff from the state, county or other agencies to share contacts they have had with individuals, groups and organizations affected by or interested in the site.

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G.1.2.6 Consult resource people and published lists

Ask municipal clerks and public works department staff (sewer or water system user lists); consult telephone or municipal directories, tax rolls and tax maps.

G.1.2.7 Ask the involved public

Ask the public with whom you are already communicating about the site to identify other individuals and organizations you should include.

G.1.2.8 Monitor media accounts

This includes newspaper, radio and television reports about the site, which often identify individuals and organizations interested in the site.

G.1.2.9 Make use of site visits

Use site visits as an opportunity to evaluate the community from the following points of view: Who is affected? Who is interested?

G.1.2.10 Organize the contact list into categories

This is particularly useful, especially when a list is large. You may need to target specific sub-groups for communication (for example, adjacent residents and local officials). Groups may be categorized based on geography (proximity to the site, political boundaries); by affiliation (unit of government, adjacent residents, environmental civic or business group) or by interest (e.g., remedial alternatives, future site use, off-site impacts, etc.).

G.1.2.11 Key contacts

Consider creating a short list of individuals and organizations likely to play an important participation role, or who need to be notified of project developments on short notice. *It is especially important to keep this list current and accurate.*

G.1.2.12 Update

Review and update the contact list regularly as changes, additions and deletions are obtained. Individuals and organizations may gain or lose interest or change roles in the program at different remedial stages. The need for information from certain members of the public at different stages may also change. A contact person for an organization may change if he or she is an elected official.

G.1.3 Benefits and Limitations

- A contact list helps to identify the affected and interested public, and their affiliations, locations and levels of interest.
- When categorized, a contact list helps project staff to deliver specific information to particular affected and interested individuals, groups and organizations and to plan specific communication activities.
- A contact list helps to inform public directly, without media and others filtering the information.
- A contact list helps to make written and telephone contact with the public systematic and efficient. It gives project staff confidence that affected/interested public is receiving important site information.
- A contact list, particularly a large one, requires staff time to create, update and maintain in useful form. An outdated or deficient contact list is worthless and erodes the effectiveness of the entire site-specific outreach program.

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Checklist for Site Contact List

Adjacent/Nearby Affected Parties:

- ❑ Residents/property owners/commercial establishments
- ❑ Owners of rights-of-way (utilities, etc.)
- ❑ Neighborhood association
- ❑ Residents/property owners affected by remedial activity (truck routes, water line extensions)
- ❑ Municipal water suppliers

Local Officials, Committees and Boards:

- ❑ Mayor/supervisor
- ❑ City council/town board members
- ❑ Municipal clerk
- ❑ Planning board/zoning board
- ❑ School boards, officials, PTAs
- ❑ Municipal engineer/public works official
- ❑ Municipal attorney
- ❑ Police/fire/emergency services officials
- ❑ Conservation Advisory Committee

County/Regional Officials, Boards and Organizations:

- ❑ County Administrator
- ❑ County Legislator(s) for site's district
- ❑ County clerk
- ❑ County Health Department
- ❑ Environmental Management Council
- ❑ Soil and Water Conservation District
- ❑ Cooperative Extension
- ❑ Farm Bureau

State Official and Agencies:

- ❑ State senators and Assembly members
- ❑ NYSDEC
- ❑ NYSDOH
- ❑ NYS Department of Law
- ❑ NYS Department of State
- ❑ NYS Department of Transportation
- ❑ Governor's office

Federal Officials and Agencies:

- ❑ U.S. Senators, U.S. Representatives
- ❑ Environmental Protection Agency
- ❑ Occupational Safety and Health Adm.
- ❑ Office of Technology Assessment
- ❑ Department of Defense
- ❑ Department of Energy

Civic/Environmental/Recreational Groups:

- ❑ Outdoor/recreational groups (rod & gun clubs, hiking, biking, boating, birding interests)
- ❑ Local/regional citizens groups
- ❑ Rotary/VFW/American Legion/Lion's Club
- ❑ League of Women Voters
- ❑ Citizens Environmental Coalition, NYPIRG, Audubon, Trout Unlimited, etc.

Economic Interests:

- ❑ Responsible party
- ❑ Title 3 grant recipient
- ❑ Financial institutions/lenders
- ❑ Real estate developers/agencies
- ❑ Chamber of commerce
- ❑ Local economic development board

Local/Regional Media:

- ❑ Newspapers (daily, weekly)
- ❑ Radio and television stations

Geographic-specific Government Bodies and Subdivisions:

- ❑ Community boards established by New York City charter
- ❑ Adirondack Park Agency
- ❑ Tug Hill Plateau Commission
- ❑ New York City Department of Sanitation
- ❑ Adjacent state
- ❑ Canada
- ❑ Native American Nation

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G.2 Fact Sheet

G.2.1 Description

A fact sheet is a written summary of important information about a hazardous waste site and its remedial program. It presents information in clear, concise terms for the affected and interested community. It may focus on remedial activities, legal or health issues and citizen participation opportunities.

Fact sheets ensure that site information is distributed consistently and that citizens understand the salient issues associated with the site's remedial program.

A fact sheet is a versatile tool that can be used for many purposes. It can do the following:

- announce a milestone in the site's remedial program or important site findings;
- describe major changes in the type, scope or schedule or previously announced site program activities;
- provide a "status report" during long periods of investigation or remedial construction;
- describe results or remediation efforts;
- announce availability of a document;
- publicize a public comment period or other opportunities for public input;
- announce an upcoming public meeting or availability session;
- supplement or follow up door-to-door visits; and
- complement presentations at a public meeting.

G.2.2 Suggestions for Creating a Fact Sheet

Preparation of a fact sheet can be divided into several general steps that include *planning, development and distribution*.

Note: A checklist that summarizes these major steps is on page G-12.

PLANNING THE FACT SHEET

G.2.2.1 Planning by asking questions

Before writing a fact sheet, answer the following questions to help guide your effort:

- What do readers need to know and remember? Why?
- Who is the audience for the fact sheet?
- Why should the audience read the fact sheet?
- Do you want the audience to *do* something, or *provide* something to you?
- Is the information "time-sensitive"? If so, how will this influence the way in which you distribute the fact sheet?

G.2.2.2 Identifying the message

What are the one or two *main* points that you need to communicate to the reader? These could include site findings or results, a program milestone, beginning of field work, a comment period or other opportunity for the public to provide input about the project, a public meeting, or a major change in the program. The points you identify become the focus of the fact sheet.

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Besides the issues important to project staff, what issues are important to the audience? Consider acknowledging and addressing them; otherwise, the fact sheet may deter readers who will conclude that the material is irrelevant to their concerns.

In addition to the few key points you wish to emphasize, a site fact sheet always should describe

- the site's history and why it is being investigated or remediated;
- upcoming citizen participation opportunities;
- the site's document repository; and
- staff contacts and ways for readers to obtain additional information.

G.2.2.3 Defining the audience

Determine who in the affected/interested community should receive the fact sheet. Part or all of the contact list? Specific categories of people such as adjacent residents or local officials? The information contained in the fact sheet helps to identify appropriate recipients.

G.2.2.4 Distribution and logistics

Determine how to get the fact sheet into the hands of the people who need to read it. A fact sheet can be

- mailed to all or part of the site's contact list (see Appendix G.1 for a discussion about developing a site contact list);
- distributed at a public meeting or availability session;
- placed in document repositories; and
- provided to residents during door-to-door visits.

Note: The site's contact list, if you use it, should be complete and up-to-date. Be sure to include people who have attended site public meetings, or who have called or written letters about the site. Make any necessary changes based on recent local, regional or statewide elections.

During the planning stage, determine who will reproduce the fact sheet, generate labels, stuff envelopes and oversee mailing or other distribution.

G.2.2.5 Allocating responsibilities

While it is generally best to designate a point person with overall responsibility for the fact sheet, determine during planning who else needs to participate in writing, review or distribution. Be sure all necessary staff are informed and brought into the fact sheet development process in a timely way.

G.2.2.6 Timing

Does the fact sheet announce imminent remedial field work (major onsite sampling or an interim remedial action or remedial construction)? Is a major site document being made available for public review, has a public meeting been scheduled, or is a comment period about to begin?

These questions highlight cases in which timely distribution of the fact sheet is particularly important. In such situations, the fact sheet's value is twofold: a) it provides the public with information and b) invites the public's action before the important site activity begins. This means that you should build sufficient time into the fact sheet development schedule to ensure its distribution well ahead of time.

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G.2.2.7 Outline

Begin writing by constructing a skeletal summary of the information, from most to least important. If it is difficult to get started, the following suggestions may help jump start the process:

- Write a summary using the *Who, What, When, Where, How, Why* method. Then add facts and details. Don't worry about writing polished text at this point;
- Try writing a headline or a simple declarative sentence proclaiming the most important fact you want to convey to the reader. For example: "State to Begin Cleanup of Hazardous Waste Contamination at Chem-Spill Site." Then begin hanging important facts on the sentence, regardless of the order in which they will ultimately appear in the text.

G.2.2.8 Selecting a format

Write clearly and concisely. Wherever possible, avoid jargon and acronyms; if they are essential to your explanation, define them clearly. This is especially important if you, for example, incorporate a test from a technical report written for specialists into a fact sheet intended for a general audience.

G.2.2.9 Capturing the reader's attention

The fact sheet must compete with all the other mail that readers have to wade through every day. Assume there are only a few seconds available to attract and hold a reader's attention to the message. Here are a few ways to do it:

- Grab the reader's attention with an informative headline.
- The lead paragraph (or at the very least the first page) of the fact sheet should contain the essence of what readers most need to know. This will help to ensure that even the most casual reader will capture the essentials of your message, even if he or she fails to turn the page or "recycles" the fact sheet after reading just the opening paragraph.
- Condense important information to essentials. If more detail is necessary, guide the reader to additional information within the fact sheet, but do not begin with background or historical information; such information, although useful, should never be the most important news for your reader. The fact sheet should lead with the most important piece of information that readers should know.
- Maps and graphics improve and increase reader understanding. The fact sheet should include a site map to help readers pinpoint the site's location, especially those who are not nearby residents. Can a simplified schematic diagram to depict the remedial technology you may be discussing be included?

G.2.2.10 Reviewing and rewriting

Make the material concise, accurate and readable, taking care to include information that should be part of every fact sheet: ways to obtain additional information, public involvement opportunities and repository information. Delete information that does not contribute to the reader's knowledge or understanding included.

Note: Staff who contributed information to the fact sheet, or who wrote portions of the fact sheet, or whose program responsibilities are described in the fact sheet, should be encouraged to review the draft before it is finalized. This includes staff from other agencies. Build enough time into the development schedule not only for reviewing and commenting, but also for incorporating important comments into the draft.

It helps to have someone not familiar with the site read the draft fact sheet for clarity and understanding. An "outsider" can provide a fresh perspective.

DISTRIBUTING THE FACT SHEET

Distribution involves the following: *who* will handle logistics, *how* distribution is conducted and *timing*.

G.2.2.11 Determining who does what

Who will handle photocopying, envelope stuffing and mailing or other distribution? Who will develop mailing labels? Don't leave these decisions until the last minute, especially if the fact sheet contains time-sensitive information. Decide during the planning stage.

G.2.2.12 Selecting method of distribution

Will all or part of the site contact list be used? If so, be sure it is up to date. Have the names from the most recent public meeting sign-in sheets been added? Did officials change after the last election?

Alternatives to mailing the fact sheet include the following: dispensing at public meetings and availability sessions, distributing during door-to-door visits, and inserting in another mailing.

G.2.2.13 Timing

The information contained in the fact sheet is time-sensitive if it announces the following:

- an upcoming public meeting (people should receive the fact sheet two weeks before the meeting so they can clear their calendars and avoid conflicts with other events);
- the start and end dates of an upcoming public comment period (the public should receive the fact sheet *before* the comment period begins; otherwise a 30-day comment period becomes, in reality, a 25-day comment period);
- imminent field investigation or construction work (e.g., workers in protective gear in the field, or a street closed or full of traffic, or the water supply to be shut off); and
- availability of an important site document for public comment, or that staff will discuss at an upcoming public meeting (people need to know in a timely way, for example, that the document is at the repository, or that it will be the focus of the public meeting).

Sufficient time should be allowed in the development and review schedule to ensure that the fact sheet is distributed, *and that it is received*, before the critical activity takes place.

G.2.3 Benefits and Limitations

- A fact sheet can effectively summarize important facts about a site's remedial program. It can also invite the public's participation in the site's decision-making process. A fact sheet often can be developed relatively quickly and distributed to a specific audience.

- Information can be provided directly to the audience without having to rely on coverage by local news media. Though local media should always be included in the intended readership, they may use some, all or none of the information contained in the fact sheet.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

- A fact sheet can supplement or emphasize information provided at meetings and other forums, or can be used as a follow-up to other activities.

- When sent to the affected community throughout a site's remedial process, fact sheets can help a community stay informed and involved and demonstrate the state's commitment to public involvement.

- Sometimes a fact sheet can take significant time to plan and develop. It often requires careful coordination among staff.

- Instead of increasing public understanding, a poorly written fact sheet may mislead and confuse. Unless the fact sheet's message is clear and immediately apparent, the reader may quickly lose interest.

- If the fact sheet does not acknowledge issues that are important to the community, readers may dismiss the information as irrelevant.

- It may be difficult to determine, short of polling the audience, how many of the read the fact sheet, and how much information they retain. The fact sheet must compete with a lot of other mail for the attention of people who have limited free time to read.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Checklist to Plan, Develop and Distribute a Fact Sheet

- ❑ Determine purpose and message of fact sheet
- ❑ Identify audience and recipients
- ❑ Determine method of distribution
  - ❑ Update contact list (if mailing)
- ❑ Develop schedule for development and distribution
- ❑ Develop outline of fact sheet
  - ❑ Coordinate with project staff
  - ❑ Collect information
  - ❑ Assemble appropriate graphics
- ❑ Write draft fact sheet. Incorporate information and graphics.
- ❑ Coordinate project staff review
- ❑ Arrange reproduction of fact sheet in appropriate quantity
- ❑ Distribute fact sheet
  - ❑ Generate mailing labels, stuff envelopes and mail **and/or**
  - ❑ Insert fact sheet in separate mailing **and/or**
  - ❑ Distribute at public meeting or availability session **and/or**
  - ❑ Hand out during door-to-door visits **and**
  - ❑ Mail to document repository(ies)
- ❑ If fact sheet contains "time-sensitive" information about field work, a comment period, release of project document or other upcoming activity, ensure distribution before the start of the activity.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.3 Public Meeting

G.3.1 Description

A public meeting brings together project staff with affected and interested citizens. Staff generally present information and answer questions, while citizens are encouraged to ask questions and provide comments.

A public meeting usually is held at a milestone in a site's remedial program, or to describe progress during a lengthy remedial stage. The meeting generally has a well-defined structure, spelled out in a formal agenda. Discrete time periods generally are defined for presentations, questions and answers, and public comment.

A public meeting helps

- ensure that important information about a site's remedial program is delivered in a consistent way to a large audience;
- identify issues and concerns important to the affected/interested community;
- ask the community for information about site history and conditions before beginning major investigation activity;
- gather public comment about a specific issue; and
- demonstrate to an emotionally-charged community that environmental officials are accessible and accountable. In such cases a public meeting should be supplemented with other outreach activities designed to help work through emotion and contribute to problem-solving. A meeting should *not* be held simply to encourage the public to vent.

G.3.2 Suggestions for Planning and Conducting a Public Meeting

Note: A checklist that summarizes major steps to plan and conduct a public meeting is on page G-19.

G.3.2.1 Identifying the need for a public meeting

- Define the status of the site's overall remedial and decision making process;
- Identify, in specific terms, the needs of the project staff and the community regarding information and involvement. How do those needs relate to the site's overall remedial process? Define objectives to meet those needs.
- Is a public meeting required at this point in the site's remedial process, or is it being considered as an optional activity to supplement the public outreach effort?
- Have other kinds of outreach activities been reviewed to determine whether any of them could more effectively accomplish the objectives?

If it is determined that a public meeting is required or appropriate at this time, proceed with organizing the meeting.

G.3.2.2 Objectives and participants

Public meetings often are conducted because of a remedial milestone or to report progress during a lengthy remedial stage. Answers to questions such as the following will help to define the goals and objectives of the meeting:

- What must be accomplished at the meeting?
- What important information must be given to or gathered from attendees? Ideally, who should these attendees be?

- What issues, questions and concerns are attendees likely to raise, whether or not related to the issues and information the project staff will discuss?

Identify program staff who have appropriate expertise and knowledge to provide the information identified and to address public comments and questions. At a minimum, staff should participate who have the program responsibilities for the remedial activities that will be the focus of the meeting.

G.3.2.3 Framework and format

Project staff should develop an agenda based on the goals of the meeting. The agenda should identify presentations to be made to the audience, the major points and the presenters. Develop handouts and other necessary supporting materials; at a minimum, these should include the agenda or a summary of the main points to be discussed, as well as a fact sheet.

Other useful supporting materials include slides and overheads (transparencies), maps and charts, cutaway sketches, blueprints, photographs, tools and instruments and even samples of liner material or other remedial equipment.

Be sure each participating staff person understands which items they are responsible for, as well as the timetable for their development.

Although slides and overheads are useful support tools, they should not overwhelm the presentation. A few suggestions:

- Use only as many slides or overheads as necessary. An AV extravaganza usually detracts from your message — the audience can be worn out, confused or overwhelmed by a myriad of charts, graphs and tables.
- Focus the message. Each slide and overhead should deal with one idea or concept. Use key words, phrases, and illustrations. Avoid undefined acronyms and technical language. Avoid the temptation to pull an entire page of text or an elaborate chart of sampling results from a technical report and throw it onto a screen. Extract the most significant statistics onto a simple overhead. Every second your audience must wade through a detailed overhead is a second spent not listening to you.
- Use large size typeface. People in the back of the room need to be able to read the material.
- Consider providing attendees with paper copies of your overheads, so they can follow along from their seats.
- After you're through with a slide or overhead, turn off the projector, or remove or cover the image. Otherwise, the audience will be distracted by the image long after you have moved on to new material.

G.3.2.4 Eliciting input

The agenda should describe the methods to be used to gather public input, whether at the meeting itself or as part of a public comment period. Furthermore, the agenda should describe the kind of input desired, from comments about a proposal, to community issues and concerns, to information about a site's history or conditions.

G.3.2.5 Planning for the number of attendees

Consider the history of public involvement related to the site. How many people are affected by or interested in the issues you will discuss at the meeting? How many people have turned out for previous sessions? If this is the site's first public meeting, you can try to gauge public interest through other means, including media coverage, letters and phone calls to project staff, and political interest at the local or state level.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.3.2.6 Selecting a date, time and place

Choose a location, date and time conducive to public attendance. Check with the municipal clerk and school officials to be sure that your public meeting does not conflict with other meetings that could draw members of the community away.

The location should be an easily accessible building familiar to residents, such as a municipal hall, school, fire station or library. Local residents and officials can usually suggest an appropriate venue. Because locations may vary greatly in size, it is important to estimate attendance. It is better to overestimate when in doubt.

The facility should be accessible to people with disabilities. If you expect that most attendees will drive to the public meeting, there should be adequate parking. If the public meeting is being held in a large urban area, the facility should be reachable via public transportation.

Follow up on the arrangements made with a letter to the facility contact person, confirming the date and time of the meeting, and the subject of the session.

G.3.2.7 Publicity

Notify the community at least two weeks before the date of the public meeting. This allows interested people to clear their calendars and avoid conflicts with other events.

The public meeting may be publicized in many ways. Examples include the following:

- send a fact sheet or meeting announcement to part or all of the site contact list (be sure the contact list is up-to-date). Include the meeting agenda as well as highlights of the proposal or issues to be discussed. This is important because, even if people do not attend, they will receive information you want them to know.
- send a media release or a fact sheet to local newspapers and radio stations;
- telephone key individuals, organizations and officials;
- post notices at highly visible points in the community; and
- announce the upcoming public meeting at another forum, such as a town council or school board meeting.

Regardless of the methods you choose, emphasize the reasons for the meeting, the agenda, and the importance of public participation.

G.3.2.8 Coordinating with staff

Coordinate with participating staff before the public meeting to ensure that everyone understands the agenda and how the meeting will be conducted. Be sure that participating staff have developed their presentations and support materials.

Staff should try to rehearse their presentations ahead of time; they can benefit from a constructive critique about content and style. It is also useful to brainstorm questions and comments you are likely to hear at the public meeting, and to assess who is most qualified to address a particular question or issue, and whether there is sufficient information for a response. Remember to consider questions staff may want to ask the public.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.3.2.9 Packing up and heading out

Remember the materials you will need for the meeting, such as

- fact sheets, agendas and other handouts (e.g., remedial program brochures);
- sign-in materials;
- directional signs;
- tape, pens, markers;
- support materials (slides, overheads, maps, charts, blueprints);
- equipment (slide projector, overhead projector, projection screen, tape recorder, flip chart stand and pad);
- extra projector bulbs; and
- extension cords (the nearest outlet may be 50 feet away).

G.3.2.10 Preparing the location

Arrive well ahead of time in order to get ready for the meeting:

- place directional signs as needed;
- establish a place for sign-in sheets and handout materials. Be sure that people sign in as they arrive, and use the information to update the site's contact list;
- set up equipment and support materials, such as projector or overhead, screen, flipchart, maps, tape recorder and other items; and
- set up podiums or platforms for speakers — move chairs and tables for presenters and audience as appropriate.

Try to greet people as they arrive, and introduce staff participants. A few pleasant words of greeting can help to set at ease those who may be uncomfortable in a public forum. Establish a climate that enables constructive communication.

G.3.2.11 Taking notes

A staff person who is not making a presentation should be selected ahead of time to take detailed notes of the meeting. Other staff should take notes as time and their responsibilities allow. Good notes help staff keep track of the public's questions and comments, as well as items for follow-up.

G.3.2.12 Beginning the meeting

Begin the meeting by welcoming the audience, and thanking them for taking the time to attend. Tell them about the purpose of the meeting and why it is important. Review the agenda with the audience (everyone should have a copy). State the ground rules up front and in simple terms.

G.3.2.13 Presenting information

In order to allow time for audience participation, especially questions and answers (Q & A), try to keep presentations as short as is possible. Be sure everyone can see the slides or overheads, and encourage people to move closer if they cannot.

G.3.2.14 Encouraging feedback

Adhering to the ground rules, facilitate public comments and questions during, between or after presentations. Everyone who wants to speak should have the opportunity. Be sure to ask if anyone has written comments.

Here are some tips for working effectively with the audience. Two dynamics operate at a public meeting: a) the issues and information to be exchanged; and b) the relationship

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between staff and audience brought to, or forged at, the meeting. The quality of the second dynamic, the relationship, usually rules the day. The importance of the information, or the craftsmanship of your presentations, will not matter if

- the prior relationship with the public has been non-productive or non-existent;
- the public distrusts the sincerity of project staff, or their motives;
- the public doubts the ability of project staff to address issues that concern them; or
- the public brings a different agenda to the meeting, or tries to obstruct the process.

It is impossible, within the confines of a single meeting, to remedy a long-standing dysfunctional relationship with the public. However, a few steps can be taken to increase trust and improve communication:

- Write the public's questions and comments on a flip-chart. This is a simple graphic demonstration that you have heard what the audience has said.
- During Q & A restate each speaker's question or comment for the entire audience. This shows the speaker that he or she has been understood, and ensures that everyone at the meeting understands what will be responded to.
- Tell the audience how their comments and input will be considered and how their overall involvement fits in the site decision-making process.
- If someone in the audience monopolizes Q & A or the comment period to the exclusion of others, gently but firmly remind the audience of the ground rules they agreed to. If the person persists, sound out the audience; sometimes an audience is its own best enforcer.
- If the meeting becomes heated or emotional, staff may feel that they are being attacked personally. Remember that people sometimes feel the need to vent and speak their piece. They may have been living with the effects of a hazardous waste site for years; or they may perceive public agencies to be slow, uncaring or mysterious, especially if the meeting is their first contact with the agencies.
- If the answer to a question is not known, say so plainly and simply. Tell the speaker an answer will be obtained and relayed as soon as possible. Be sure to follow up back at the office!
- Always tell the audience where the site remedial process is headed: what the next steps are; when they will hear from staff again and what they can expect to be told; when the public will have another opportunity to provide input.
- If the audience is not asking questions or providing comments about the information provided or the proposal outlined, staff should have several questions ready to ask the audience. The questions should be designed to break the ice and stimulate useful discussion.
- Encourage attendees to contact staff whenever they have questions, concerns or ideas outside of the meeting. Provide contact names, telephone numbers and addresses.

G.3.2.15 <u>After the meeting</u>

Try to allot a few minutes after the meeting to speak informally with people who need detailed answers to questions, or who prefer to ask questions privately.

G.3.2.16 <u>Debriefing and following up</u>

Review the substance of the meeting with all participating staff. Follow up on the public's questions and requests for information, as well as any commitments staff made. Share information with staff involved with the project that did not participate. Consider following up with another fact sheet or a responsiveness summary, but do not limit the mailing only

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
to those who attended the meeting. Update the site's contact list with the names on the sign-in sheet.

G.3.3 Benefits and Limitations

- Public meetings help to ensure that important site information and proposals are provided to the affected and interested public.

- Public meetings encourage direct contact and communication between the public and project decision makers.

- Public meetings help reveal issues important to the public, or elicit feedback and comments staff want about the site, the surrounding community, or staff's site efforts and proposals.

- Public meetings usually require extensive preparation time, staff and resources. Presentations and supporting materials need to be prepared. Logistics for planning, conducting and following-up a large meeting can be comprehensive and time-consuming.

- Some staff are uncomfortable making presentations before large audiences. Training and rehearsal can help to increase staff confidence and effectiveness.

- Limited personal interaction can take place at a large public meeting. The setting often is formal and impersonal. Some people are not comfortable speaking out at public meetings, so it is possible that a broad spectrum of public opinion may go unheard.

- The positions which attendees take from their real or underlying interests may be difficult to distinguish. Often people feel compelled to take firm stands, or to posture for their constituents, peers or the media.

- When staff determine that they need to reach out to the community, they often decide to conduct a large public meeting. However, many public outreach and information objectives can be achieved more effectively through activities other than large group meetings. Availability sessions, meetings targeted to specific groups or interests, and fact sheets often are effective ways to provide information or encourage public input.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Checklist to Plan and Conduct a Public Meeting

- ❑ Determine purpose (s) and subject(s): _____
- ❑ Identify location for public meeting
  - ❑ Facility name & location: _____
  - ❑ Contact person/phone number at facility: _____
  - ❑ Accessibility
    - ❑ People with disabilities and
    - ❑ Adequate parking and/or
    - ❑ Convenient to public transportation
- ❑ Choose date and time of the public meeting: _____
- ❑ Confirm arrangements with follow up letter to facility contact person
- ❑ Identify staff to participate in public meeting
- ❑ Scope information to be presented (agenda, presentations, etc.)
- ❑ Identify/prepare support materials (handouts, slides/transparencies)
- ❑ Publicize the upcoming public meeting
  - ❑ Send fact sheet to all/part of site contact list and/or
  - ❑ Send fact sheet and/or media release to local media and/or
  - ❑ Telephone key individuals, organizations, officials and/or
  - ❑ Post notices in the community and/or
  - ❑ Announce the upcoming public meeting in another forum
- ❑ Hold staff pre-meeting to finalize content and coordination

- ❑ Conduct the public meeting
  - ❑ Bring and use signs, sign-in sheets and support materials
  - ❑ Collect/record comments and questions for program use or follow-up

- ❑ Follow up activities to the public meeting
  - ❑ Provide necessary follow-up to public questions/comments
  - ❑ Update contact list with sign-in sheets
  - ❑ Consider additional follow up

G.4 Availability Session

G.4.1 Description

An availability session is a scheduled gathering of project staff with the affected/interested public. The session is held in a casual setting, without a formal agenda or presentations. Staff generally conduct an availability session about a specific aspect of a site's remedial program, which it publicizes ahead of time. The format promotes detailed individual or small group discussion between staff and the public.

An availability session is an appropriate tool

- to provide information to, and address the concerns of, the affected community about specific aspects of a site's remedial program. For example, if remedial construction is about to begin, staff may wish to discuss with community members the general construction schedule, specific on-site activities, and the effects of remedial activity on the local community, such as road closures, truck traffic, dust and noise;
- to supplement a formal public meeting or other outreach activity by providing interested members of the public additional opportunity for individual, detailed discussions about the site's remediation;
- when larger crowds would discourage certain members of the public from engaging project staff or asking questions; or
- when staff do not have time or resources needed to plan and conduct a formal, large group public meeting.

G.4.2 Suggestions for Planning and Conducting an Availability Session

Note: A checklist that summarizes major steps to plan and conduct an availability session is on page G-24.

G.4.2.1 Determining the focus of the session

Define the focus of the availability session. What must be communicated? What questions and concerns are attendees likely to raise? Identify project staff who have information needed to prepare for the availability session. Determine which project staff should participate in the session. At a minimum, project staff should attend who have responsibility for the activity that will be the focus of the session.

Availability sessions generally require fewer project staff to participate than at a formal public meeting. At a minimum, however, at least two staff should participate at the availability session. To help determine the appropriate number of staff participants, consider the kind of information likely to be discussed, the estimated number of public attendees, and available staff resources.

G.4.2.2 Planning for the number of attendees

Depending on the number of people expected to attend, two sessions may be appropriate: one in the afternoon and one in the evening. If only one session is possible, extend the evening hours or bring additional staff. The availability session is designed to foster individual and small-group discussion. Try to ensure that attendees talk to staff with minimal waiting, and that staff will talk to small groups.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.4.2.3 Selecting a date, time and location

Choose a location, date and time that encourage attendance. An evening session will accommodate people who work during normal business hours. Check with the municipal clerk and school officials to be sure the session does not conflict with other meetings that could draw members of the community away.

The location should be in an easily accessible building familiar to residents, such as a library, municipal hall, school, fire hall or local meeting room. Local residents and officials can usually suggest an appropriate venue. Because an availability session generally involves a small number of people, there is more flexibility in choosing a location than for a large, formal public meeting.

The facility should be accessible to citizens with disabilities. If it is expected that most attendees will drive to the availability session, there should be adequate parking. If the availability session is being held in a large urban area, the facility should be reachable via public transportation.

Follow up on the arrangements with a letter to the facility contact person, confirming the date, time and subject of the session.

G.4.2.4 Supporting materials

Many materials may be suitable for an availability session: maps, schematic drawings, cutaway sketches, blueprints, photographs of the pertinent remedial technology, tools and instruments, documents, sampling results — even pieces of synthetic liner material or filter fabric. All can potentially be used to help answer the public's questions and to focus discussion.

It is generally appropriate to develop a fact sheet that covers the essential points of the discussion for distribution at the availability session.

G.4.2.5 Publicity

Notify the community at least two weeks before the date of the availability session. This allows interested people to clear their calendars and avoid conflicts with other events.

The session may be publicized in many ways. Examples include the following:

- send a fact sheet or session announcement to part or all of the site contact list (be sure the contact list is up-to-date). Include the agenda as well as highlights of the proposal or issues to be discussed. This is important because, even if people do not attend, they will receive information you want them to know.
- send a media release or a fact sheet to local newspapers and radio stations;
- telephone key individuals, organizations and officials;
- post notices at highly visible points in the community; and
- announce the upcoming session at another forum, such as a town council or school board meeting.

Regardless of the methods you choose, emphasize the reasons for the session, the agenda, and the importance of public participation.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

When explaining the format of an availability session, emphasize how it differs from a public meeting:

- project staff will be available for a specific time period to answer questions, address concerns and discuss aspects of the site's remediation with individuals or small groups;
- there is no set agenda or formal presentations; and
- the public can drop by anytime during the availability session.

G.4.2.6 Coordinating with staff

Coordinate with participating staff before the availability session to ensure that everyone understands the topics for discussion and how the session will be conducted. Be sure that staff have developed and reviewed their support materials.

G.4.2.7 Conducting the availability session

Arrive well ahead of time in order to get ready for the meeting:

- place directional signs as needed;
- establish a place for sign-in sheets and handout materials. Be sure that people sign in as they arrive, and use the information to update the site's contact list; and
- set up all supporting materials.

Try to greet people as they arrive, and introduce staff participants. A few pleasant words of greeting can help to set at ease those who may be uncomfortable in a public forum. Establish a climate that enables constructive communication.

Connect people with particular questions or comments and staff with the appropriate expertise. Note comments and questions that require follow-up by project staff.

G.4.2.8 Debriefing and following up

Review the substance of the session with all participating staff. Follow up on the public's questions and requests for information, as well as any commitments staff made. Share information with staff involved with the project that did not participate. Consider following up with another fact sheet or a responsiveness summary, but do not limit the mailing only to those who attended the session. Update the site's contact list with the names on the sign-in sheet.

G.4.3 Benefits and Limitations

- A face-to-face discussion is perhaps the most efficacious form of public outreach. It encourages an exchange of information with people directly affected by site contamination, investigation activities, or remediation. The individual and small-group dialogue can help build mutual credibility between the affected community and project staff —credibility that is more difficult to achieve in other settings.

- Availability sessions stretch limited program resources. They do not require prepared presentations and are significantly faster, easier and less resource-intensive to plan and conduct than formal public meetings.

- Quicker and easier planning and implementation create flexibility to conduct an availability session in locations and for reasons that other public outreach activities could not accommodate.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

- An availability session often attracts a small audience, but attendees usually bring intense rather than casual interest in a site's remediation. This heightened interest and modest attendance actually enhances direct dialogue between the public and project staff.

- When held within a day or two of a formal public meeting, an availability session can offer the public an additional forum to interact with project staff. As a result, people attending the formal public meeting may not feel pressed to compete for limited opportunities for input in a forum that must accommodate formal presentations, a large audience, and many levels of interest and understanding.

- An availability session encourages those who might be intimidated or uncomfortable in a large group setting to talk to project staff in a more intimate setting.

- After the availability session, follow-up activities may require widely varying amounts of time and resources.

- Some community members may express suspicion that availability sessions are designed to divide and conquer the affected public, and prevent the community from demonstrating unity and resolve. In such circumstances consider using the availability session to supplement other outreach activities that promote interaction with the affected community.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Checklist to Plan and Conduct an Availability Session

- ❑ Determine purpose (s) and subject(s): _____
- ❑ Identify location for availability session
  - ❑ Facility name & location: _____
  - ❑ Contact person/phone number at facility: _____
  - ❑ Accessibility
    - ❑ People with disabilities and
    - ❑ Adequate parking and/or
    - ❑ Convenient to public transportation
- ❑ Choose date and time of the availability session: _____
- ❑ Confirm arrangements with follow up letter to facility contact person
- ❑ Identify staff to participate in public meeting
- ❑ Review information to be discussed with the public
- ❑ Identify/prepare support materials (maps, blueprints, handouts, etc.)
- ❑ Publicize the upcoming public meeting
  - ❑ Send fact sheet to all/part of site contact list and/or
  - ❑ Send fact sheet and/or media release to local media and/or
  - ❑ Telephone key individuals, organizations, officials and/or
  - ❑ Post notices in the community and/or
  - ❑ Announce the upcoming public meeting in another forum
- ❑ Conduct the availability session
  - ❑ Bring and use signs, sign-in sheets and support materials
  - ❑ Record comments and questions for program use or follow-up
- ❑ Follow up activities to the availability session
  - ❑ Provide necessary follow-up to public questions/comments
  - ❑ Update contact list with sign-in sheets
  - ❑ Consider additional follow up

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.5 Toll-free "800" Numbers

G.5.1 Description

Toll-free information numbers are a convenient means for people with questions, comments or concerns about a hazardous waste site to obtain information, particularly those who cannot or will not participate in other outreach activities. In addition to building credibility with the public, toll-free numbers can address minor problems and concerns before they escalate into larger ones that demand greater expenditures of time and resources.

G.5.2 Suggestions for Using Toll-free "800" Numbers

G.5.2.1 Publicizing "800" numbers

Use fact sheets, media releases, public meetings, availability sessions, letters and other public contact information to announce the project's toll-free number(s). Encourage interested people to use the toll-free number(s) to contact project staff with questions or concerns at any time during the remedial process.

Publicize the NYSDEC (for central office-lead sites) and NYSDOH toll-free numbers for site-related and health-related questions, concerns and comments:

NYSDEC	**NYSDOH**
Division of Environmental Remediation Toll-free Information Line 1-800-342-9296	Bureau of Environmental Exposure Investigation Toll-free Information Line 1-800-458-1158, ext. 27850

NOTE: "800" numbers are typically information lines — not a "hotline" — because weeknight and weekend callers may not receive immediate responses. Avoid public misunderstanding: identify the number as an "information-only" line when it is publicized.

G.5.2.2 Managing toll-free number(s)

Whenever the "800" numbers are publicized in a fact sheet, meeting announcement or newsletter, be sure that a copy of the material has been provided to staff managing to "800" numbers. This helps to prevent staff from being blindsided: with the publicity material site in hand, they can often answer calls directly, or immediately know to which staff members to forward calls.

G.5.2.3 Following up

It may be appropriate to follow up a toll-free call by sending a letter or other written material to satisfy a caller's more detailed questions.

G.5.2.4 Involving project staff

To provide a complete answer to a caller's questions or information requests, all appropriate staff should be involved in reviewing the response.

G.5.2.5 Sharing information

As appropriate, be sure to share with other staff involved with the site the questions and concerns being received from the toll-free number(s). This information may assist other staff as they communicate with the public about the site.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.5.3 Benefits and Limitations

- Can be an effective way to interact with many people to gather comments and answer questions.

- Helps to build and maintain credibility by improving public access to project staff and information.

- Timely response to calls is important. Delayed or inadequate response can damage credibility and increase public frustration or cynicism.

- Despite all the best efforts, some people may believe the toll-free information number is a "hotline" and may expect immediate response.

- The NYSDEC toll-free number can only be called from within New York State, so care should be used when publicizing it at a site that may border an adjacent state or Canada.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.6 Door-to-door Visits

G.6.1 Description

Door-to-door visits involve gathering or distributing site information by meeting individuals at their residences or businesses. Project staff visit residents near a site to provide information, answer questions or obtain permissions for activities on private properties.

Door-to-door visits may be appropriate when

- on-site investigation or remediation activity is imminent, and there is not enough time for mailings or public meetings (for example, an impending emergency removal action or a time-sensitive interim remedial measure);
- there is a need to reach a particular group of people for a particular purpose, such as obtaining signatures to allow access to properties near the site;
- public concern about site contamination or other site-related issues is extremely high; and
- personal contact could effectively supplement other outreach efforts.

G.6.2 Suggestions for Conducting Door-to-door Visits

Door-to-door visits require specialized techniques applied within well-defined circumstances, such as those listed above. When planned and conducted properly, visits can be extremely effective in reaching their designated audience.

G.6.2.1 Preparation

Identify as specifically as possible the information that needs to be provided or gathered. What site issues or activities are driving these needs? Establish the time-frame for the visits, especially when there is a deadline. Be sure that door-to-door visits are the appropriate method of outreach.

G.6.2.2 Identifying the area and audience

Determine the residences and businesses that need to be visited (this is influenced largely by the site issues or activities and whom they affect). Be sure that there are sufficient staff and resources to cover the designated area.

G.6.2.3 Planning with project staff

Defining the information that needs to be provided or gathered will indicate which remedial, health or consultant staff should participate in the door-to-door visits. If these staff are unavailable, they should still help plan the visits and brief other staff with answers to anticipated questions.

Be sure all participating staff clearly understand the information to be discussed with the public, so that they provide consistent, accurate information throughout the area to be visited.

G.6.2.4 Reviewing the message

The information provided or gathered during door-to-door visits should be

- specific — pertinent to a particular issue or activity of the site;
- timely —involving a situation or activity soon to occur or which has already begun; and
- clear — staff should know what is needed from the residents, while residents should understand what staff need to tell them.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.6.2.5 Written summaries

Develop a written summary (essentially a short fact sheet) that encapsulates the information to be provided or requested during the door-to-door visits. Distribute this summary to the occupants, even when no one is present.

Be sure the written material meets the standards of specificity, timeliness, and clarity, and lists ways for residents to contact staff with questions or comments.

G.6.2.6 Conducting the visits

Allow sufficient time to cover the designated area and to account for lengthy discussions that may occur. Staff should always

- wear or carry identification;
- tell residents why they are conducting the visits;
- present and request information consistently at all addresses called upon;
- distribute the written summary at all addresses visited;
- note all information provided by residents;
- note areas covered; and
- note names and addresses of people who have requested additional information.

Based on the particulars of the site and the area being visited, it may be advisable for staff to pair up when conducting visits. This will help to ensure that staff with varied expertise are available to answer a range of questions.

G.6.2.7 Following up

Staff participants should meet after the visits to discuss their experiences and compare notes. Be sure to respond promptly to requests for information that was not provided during the visits. Consider sending a follow-up letter or fact sheet to all residents in the designated area.

G.6.3 Benefits and Limitations

- Project staff can meet directly with the people that they need to communicate with about specific issues or activities.

- Door-to-door visits help to distribute information quickly, when time is of the essence and when other activities such as mailing cannot accomplish the task during the identified time frame.

- Door-to-door visits demonstrate a commitment to the community when other, less direct outreach seems insufficient to deal with community concerns effectively.

- Despite best intentions, door-to-door visits can foster unfavorable cliches (e.g., "We're from the government and we're here to help.")

- Door-to-door visits can be time-consuming. In addition, some project staff may not be comfortable with the technique or have appropriate training to conduct the activity effectively. As a result, the technique should be used only if other outreach cannot be used or will likely be ineffectual.

- If there are concerns for the safety and security of staff, even more resources may be required to conduct visits than usual.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.7 Document Repository

G.7.1 Description

A document repository is a collection of documents and other information developed during the investigation and remediation of a waste site. It is located in a convenient public facility, such as a library, so that interested members of the public can easily access and review important information about the site and the site's remedial program. A repository is maintained through the site's operation and maintenance phase, or until its release from the applicable remedial program.

A site document repository is helps the public review

- documents about which the state is seeking public comment;
- studies, reports and other information;
- complete versions of documents summarized in fact sheets, meeting presentations or media releases (summaries should note the location(s) of a local repository where the complete documents are available).

G.7.2 Suggestions for Establishing a Document Repository

The appropriate regional NYSDEC office often generates or receives documents developed during a site's investigation and remediation. However, most people don't live near a regional office. The selection of a local repository becomes very important.

G.7.2.1 Determining the location

The repository should be located near the site and the affected and interested community. Residents, municipal clerks, local officials and school officials can to help identify a suitable location.

If possible, a location should be selected to can accommodate people who work during normal business hours. In addition, the availability of public transportation in locations where parking or automobile travel is inconvenient should be considered. Access for disabled people and the availability of photocopying should be determined.

A local public library usually is a suitable location. Alternatives include municipal offices, public health offices and schools.

G.7.2.2 Contact the potential repository

Be sure to contact the potential repository *before* sending documents. Most librarians and municipal clerks are more than willing to help make documents available to the public. They don't appreciate receiving a box full of reports with an explanatory letter out of the blue.

When calling a library, the reference librarian is a good first contact. Explain that you would like to have site program documents maintained in an accessible spot for public review and copying. Because space may be limited, the librarian may ask for an estimate of the total volume of documents you will be sending over a given time.

Follow up the conversation with a courtesy letter confirming the agreed-upon terms and conditions for the repository. Be sure to restate your understanding of who the repository contact person will be and where the documents will be maintained.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.7.2.3 Depositing documents and other information

Send studies, reports, information sheets and other suitable materials to the repository. Consider providing several copies of documents that are likely to be of great interest to the public.

G.7.2.4 Accommodating the repository host

When sending a document to the repository, transmit it with a cover letter that describes what the document is, why it was produced and which briefly summarizes its contents. This will help the host maintain an ordered file and will help the public locate documents of interest. For documents about which the state is seeking public comment, provide information about how the public is to comment, such as the length of the comment period, and where to send comments.

G.7.2.5 Publicizing the repository and its contents

It is important to remind the public about the repository as often as possible. Take advantage of the public contact tools you use during the public outreach program. Use fact sheets, media releases, public meetings, availability sessions, door-to-door visits, letters and telephone calls to tell people about the repository, its contents, and why public review is important. Provide the repository's location, days and hours of operation and the repository contact person.

G.7.2.6 Special consideration for time-sensitive documents

Some documents are placed in a repository for public review during a prescribed comment period. Be sure that documents for public comment are in the repository when the comment period starts. This affords the public maximum opportunity for review and comment.

G.7.2.7 Updating the repository

Send materials as soon as possible after they are developed. Remove/replace outdated materials. Provide finalized and revised versions of documents.

G.7.2.8 Consider providing additional copies of documents

As mentioned earlier, consider sending additional copies of documents to a repository when sustained public interest is anticipated. In addition, consider providing copies of appropriate documents to local officials, involved organizations and others who have demonstrated a keen interest in the site and its remedial program.

G.7.3 Benefits and Limitations

- A repository makes detailed, timely information available to residents, officials and others in the community affected by or interested in the site and the remedial program. In particular, the repository serves community members interested in additional details beyond summaries provided in fact sheets and public meeting presentations.
- A repository should be maintained to ensure timely availability of current information. It should be checked occasionally to ensure that materials are available.
- Even when a local repository is established to improve access to project information, most people do not read complete documents.
- A repository supports — but cannot substitute for — two-way communication between project staff and the community.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

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NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix H

NYSDOH fact sheets related to soil vapor intrusion

As introduced in Section 5, fact sheets are often used to share information with the public in a variety of ways: mailed to all or part of the site's contact list, distributed at a public meeting or availability session, placed in document repositories, provided to residents during door-to-door visits, and/or included in letters transmitting sampling results.

Copies of the following fact sheets, which are commonly used to supplement discussions related to soil vapor intrusion, are provided in this appendix:

What is exposure? Information Sheet

- describes how a person may come into contact with chemicals in the environment

Soil Vapor Intrusion: Frequently Asked Questions Sheet

- describes the process referred to as "soil vapor intrusion"

PCE Fact Sheet

- provides information on tetrachloroethene (PCE) and the NYSDOH guideline for PCE in air

TCE Fact Sheet

- provides information on trichloroethene (TCE) and the NYSDOH guideline for TCE in air

Radon: Frequently Asked Questions Sheet

- provides information on this gas, commonly found in many areas of New York State, that may also migrate into buildings from the subsurface

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

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New York State Department of Health

What is Exposure?

Exposure is contact. No matter how dangerous a substance or activity, without exposure, it cannot harm you.

Information Sheet



Amount of exposure:

Over 400 years ago, a scientist said "...nothing [is] without poisonous qualities. It is only the dose that makes a thing poison." The **dose** is the amount of a substance that enters or contacts a person. An important factor to consider in evaluating a dose is body weight. If a child is exposed to the same amount of chemical as an adult, the child (who weighs less) can be affected more than the adult. For example, children are given smaller amounts of aspirin than adults because an adult dose is too large for a child's body weight.

The greater the amount of a substance a person is exposed to, the more likely that health effects will occur. Large amounts of a relatively harmless substance can be toxic. For example, two aspirin tablets can help to relieve a headache, but taking an entire bottle of aspirin can cause stomach pain, nausea, vomiting, headache, convulsions or death.



Routes of exposure:

There are three major means by which a toxic substance can come into contact with or enter the body. These are called routes of exposure.

Inhalation (breathing) of gases, vapors, dusts or mists is a common route of exposure. Chemicals can enter and irritate the nose, air passages and lungs. They can become deposited in the airways or be absorbed through the lungs into the bloodstream. The blood can then carry these substances to the rest of the body.

Direct contact (touching) with the skin or eyes is also a route of exposure. Some substances are absorbed through the skin and enter the bloodstream. Broken, cut or cracked skin will allow substances to enter the body more easily.

Ingestion (swallowing) of food, drink, or other substances is another route of exposure. Chemicals that get in or on food, cigarettes, utensils or hands can be swallowed. Children are at greater risk of ingesting substances found in dust or soil because they often put their fingers or other objects in their mouths. Lead in paint chips is a good example. Substances can be absorbed into the blood and then transported to the rest of the body.
The route of exposure can determine whether or not the toxic substance has an effect. For example, breathing or swallowing lead can result in health effects, but touching lead is not usually harmful because lead is not absorbed particularly well through the skin.



Length of exposure:

Short-term exposure is called **acute exposure**. Long-term exposure is called **chronic exposure**. Either may cause health effects that are immediate or health effects that occur days or years later.

Acute exposure is a short contact with a chemical. It may last a few seconds or a few hours. For example, it might take a few minutes to clean windows with ammonia, use nail polish remover or spray a can of paint. The fumes someone might inhale during these activities are examples of acute exposures.

Chronic exposure is continuous or repeated contact with a toxic substance over a long period of time (months or years). If a chemical is used every day on the job, the exposure would be chronic. Over time, some chemicals, such as PCBs and lead, can build up in the body and cause long-term health effects.

Chronic exposures can also occur at home. Some chemicals in household furniture, carpeting or cleaners can be sources of chronic exposure.



Sensitivity:

All people are not equally **sensitive** to chemicals, and are not affected by them in the same way. There are many reasons for this.

- People's bodies vary in their ability to absorb and break down or eliminate certain chemicals due to **genetic differences.**

- People may become **allergic** to a chemical after being exposed. Then they may react to very low levels of the chemical and have different or more serious health effects than nonallergic people exposed to the same amount. People who are allergic to bee venom, for example, have a more serious reaction to a bee sting than people who are not.

- Factors such as **age, illness, diet, alcohol use, pregnancy and medical or nonmedical drug use** can also affect a person's sensitivity to a chemical. Young children are often more sensitive to chemicals for a number of reasons. Their bodies are still developing and they cannot get rid of some chemicals as well as adults. Also, children absorb greater amounts of some chemicals (such as lead) into their blood than adults.

For more information:

New York State Department of Health
Center for Environmental Health
Flanigan Square
547 River Street, Room 316
Troy, NY 12180-2218
1-800-458-1158 (ext. 2-7530)

March 2001

NEW YORK STATE
DEPARTMENT OF HEALTH

SOIL VAPOR INTRUSION

Frequently Asked Questions

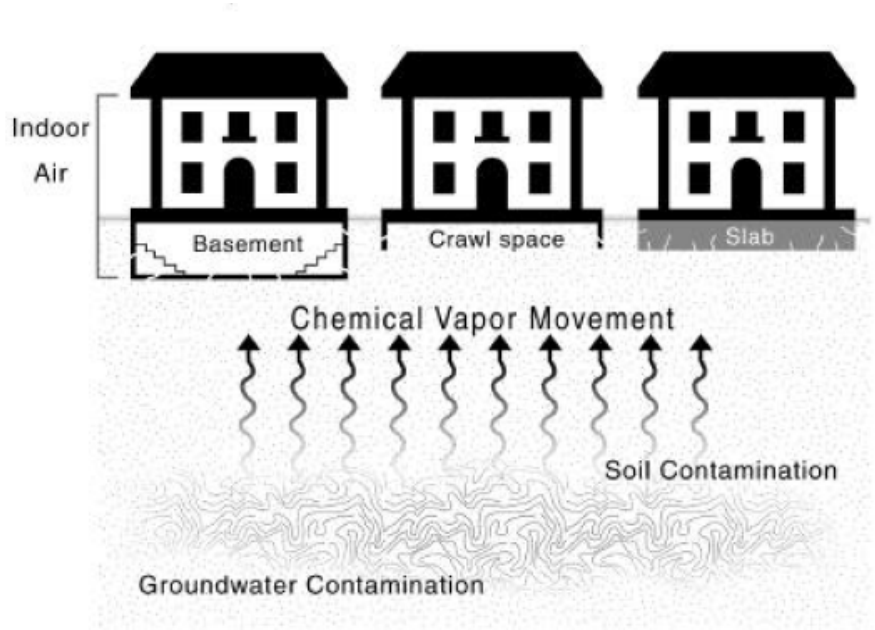
What is soil vapor intrusion?

The phrase "soil vapor intrusion" refers to the process by which volatile chemicals move from a subsurface source into the indoor air of overlying buildings.

Soil vapor, or soil gas, is the air found in the pore spaces between soil particles. Because of a difference in pressure, soil vapor enters buildings through cracks in slabs or basement floors and walls, and through openings around sump pumps or where pipes and electrical wires go through the foundation. Heating, ventilation or air-conditioning systems may create a negative pressure that can draw soil vapor into the building. This intrusion is similar to how radon gas seeps into buildings.

Soil vapor can become contaminated when chemicals evaporate from subsurface sources and enter the soil vapor. Chemicals that readily evaporate are called "volatile chemicals." Volatile chemicals include volatile organic compounds (VOCs). Subsurface sources of volatile chemicals may include contaminated soil and groundwater, or buried wastes. If soil vapor is contaminated, and enters a building as described above, indoor air quality may be affected.

When contaminated vapors are present in the zone directly next to or under the foundation of the building, vapor intrusion is possible. Soil vapor can enter a building whether it is old or new, or whether it has a basement, a crawl space, or is on a slab (as illustrated in the figure).



[Source: United States Environmental Protection Agency, Region 3]

How am I exposed to chemicals through soil vapor intrusion?

Humans can be exposed to soil vapor contaminated with volatile chemicals when vapors from beneath a building are drawn through cracks and openings in the foundation and mix with the indoor air. Inhalation is the route of exposure, or the manner in which the volatile chemicals actually enter the body, once in the indoor air.

Current exposures are when vapor intrusion is documented in an occupied building. *Potential* exposures are when volatile chemicals are present, or are accumulating, in the vapor phase beneath a building, but have not affected indoor air quality. Potential exposures also exist when there is a chance that contaminated soil vapors may move to existing buildings not currently affected or when there is a chance that new buildings can be built over existing subsurface vapor contamination. Both current and potential exposures are considered when evaluating soil vapor intrusion at a site that has documented subsurface sources of volatile chemicals.

In general, exposure to a volatile chemical does not necessarily mean that health effects will occur. Whether or not a person experiences health effects depends on several factors, including inhalation exposure, the length of exposure (short-term or acute versus long-term or chronic), the frequency of exposure, the toxicity of the volatile chemical, and the individual's sensitivity to the chemical.

What types of chemicals associated with environmental contamination may be entering my home via soil vapor intrusion?

Volatile organic compounds, or VOCs, are the most likely group of chemicals found in soil vapor, and which can move through the soil and enter buildings. Solvents used for dry cleaning, degreasing and other industrial purposes (e.g., tetrachloroethene, trichloroethene, 1,1,1-trichloroethane and Freon 113) are examples of VOCs. Examples of petroleum-related VOCs from petroleum spills are benzene, toluene, ethyl benzene, xylenes, styrene, hexane and trimethylbenzenes.

Is contaminated soil vapor the only source of volatile chemicals in my indoor air?

No. Volatile chemicals are also found in many household products. Paints, paint strippers and thinners, mineral spirits, glues, solvents, cigarette smoke, aerosol sprays, mothballs, air fresheners, new carpeting or furniture, hobby supplies, lubricants, stored fuels, refrigerants and recently dry-cleaned clothing all contain VOCs. Household products are often more of a source of VOCs in indoor air in homes than contaminated soil vapor.

Indoor air may also become affected when outdoor air containing volatile chemicals enters your home. Volatile chemicals are present in outdoor air due to their widespread use. Gasoline stations, dry cleaners, and other commercial/industrial facilities are important sources of VOCs to outdoor air.

What should I expect if soil vapor intrusion is a concern near my home?

If you live near a site that has documented soil, groundwater and/or soil vapor contaminated with volatile chemicals, you should expect that the potential for vapor intrusion is being, or has been, investigated. You may be contacted by the site owner or others working on the cleanup with information about the project. Your cooperation and consent would be requested before any testing/sampling would be done on your property. You may ask the person contacting you any questions about the work being done. You can also contact the NYSDOH's project manager for the site at 1-800-458-1158 (extension 2-7850) for additional information.

How is soil vapor intrusion investigated at sites contaminated with volatile chemicals?

The process of investigating soil vapor intrusion typically requires more than one set of samples to determine the extent of vapor contamination. Furthermore, four types of environmental samples are collected: soil vapor samples, sub-slab vapor samples, indoor air samples and outdoor air (sometimes referred to as "ambient air") samples.

Soil vapor samples are collected to characterize the nature and extent of vapor contamination in the soil in a given area. They are often collected before sub-slab vapor and/or indoor air samples to help identify buildings or groups of buildings that need to be sampled. Soil vapor samples are used to determine the *potential* for human exposures. *Soil vapor* samples are not the same as *soil* samples.

Sub-slab vapor samples are collected to characterize the nature and extent of vapor contamination in the soil immediately beneath a building with basement foundations or a slab. Sub-slab vapor results are used to determine the potential for *current* and *future* human exposures. For example, an exposure could occur in the future if cracks develop in the building's foundation or changes in the operation of the building's heating, ventilation or air-conditioning system are made that make the movement of contaminated soil vapor into the building possible.

Indoor air samples are collected to characterize the nature and extent of air contamination within a building. Indoor air sample results help to evaluate whether there are *current* human exposures. They are also compared to sub-slab vapor and outdoor air results to help determine where volatile chemicals may be coming from (indoor sources, outdoor sources, and/or beneath the building).

Outdoor air samples are collected to characterize site-specific background air conditions. Outdoor air results are used to evaluate the extent to which outdoor sources, such as automobiles, lawn mowers, oil storage tanks, gasoline stations, commercial/industrial facilities, and so forth, may be affecting indoor air quality.

What should I expect if indoor air samples are collected in my home?

You should expect the following:

- Indoor air samples are generally collected from the lowest-level space in a building, typically a basement, during the heating season. Indoor air samples may also be collected from the first floor of living space. Indoor air is believed to represent the greatest exposure potential with respect to soil vapor intrusion.
- Sub-slab vapor and outdoor air samples are usually collected at the same time as indoor air samples to help determine where volatile chemicals may be coming from (indoor sources, outdoor sources, and/or beneath the building).
- More limited sampling may be performed outside of the heating season. For example, sub-slab vapor samples without indoor air or outdoor air samples may be collected to identify buildings and areas where comprehensive sampling is needed during the heating season.
- An indoor air quality questionnaire and building inventory will be completed. The questionnaire includes a summary of the building's construction characteristics; the building's heating, ventilation and air-conditioning system operations; and potential indoor and outdoor sources of volatile chemicals. The building inventory describes products present in the building that might contain volatile chemicals. In addition, we take monitoring readings from a real-time organic vapor meter (also known as a photoionization detector or PID). The PID is an instrument that detects many VOCs in the air. When indoor air samples are collected, the PID is used to help determine whether

products containing VOCs might be contributing to levels that are detected in the indoor air.

What happens if soil vapor contamination or soil vapor intrusion is identified during investigation of a site?

Depending on the investigation results, additional sampling, monitoring or mitigation actions may be recommended. Additional sampling may be performed to determine the extent of soil vapor contamination and to verify questionable results. Monitoring (sampling on a recurring basis) is typically conducted if there is a significant potential for vapor intrusion to occur should building conditions change. Mitigation steps are taken to minimize exposures associated with soil vapor intrusion. Mitigation may include sealing cracks in the building's foundation, adjusting the building's heating, ventilation and air-conditioning system to maintain a positive pressure to prevent infiltration of subsurface vapors, or installing a sub-slab depressurization system beneath the building.

What is a sub-slab depressurization system?

A sub-slab depressurization system, much like a radon mitigation system, essentially prevents vapors beneath a slab from entering a building. A low amount of suction is applied below the foundation of the building and the vapors are vented to the outside (see illustration). The system uses minimal electricity and should not noticeably affect heating and cooling efficiency. This mitigation system also essentially prevents radon from entering a building, an added health benefit. The party responsible for cleaning up the source of the soil vapor contamination is usually responsible for paying for the installation of this system. If no responsible party is available, New York State will install the system. Once the contamination is cleaned up, the system should no longer be needed. In areas where radon is a problem, the NYSDOH recommends that these systems remain in place permanently.

What else can I do to improve my indoor air quality?

Household products and other factors, such as mold growth, carbon monoxide, and radon, can degrade the quality of air in your home. Consider the following tips to improve indoor air quality:

- Be aware of household products that contain VOCs. Do not buy more chemicals than you need at a time.
- Store unused chemicals in tightly-sealed containers in a well-ventilated location, preferably away from the living space in your home.
- Keep your home properly ventilated. Keeping it too air-tight may promote build up of chemicals in the air, as well as mold growth due to the build up of moisture.
- Fix all leaks promptly, as well as other moisture problems that encourage mold growth.
- Make sure your heating system, hot water, dryer and fireplaces are properly vented and in good condition. Have your furnace or boiler checked annually by a professional.
- Test your home for radon; take actions to reduce radon levels if needed.
- Install carbon monoxide detectors in your home; take immediate actions to reduce carbon monoxide levels if needed.

Where can I get more information?

For additional information about soil vapor intrusion, contact the NYSDOH's Bureau of Environmental Exposure Investigation at 1-800-458-1158 (extension 2-7850).

Sub-Slab Depressurization System

(commonly called a radon mitigation system)



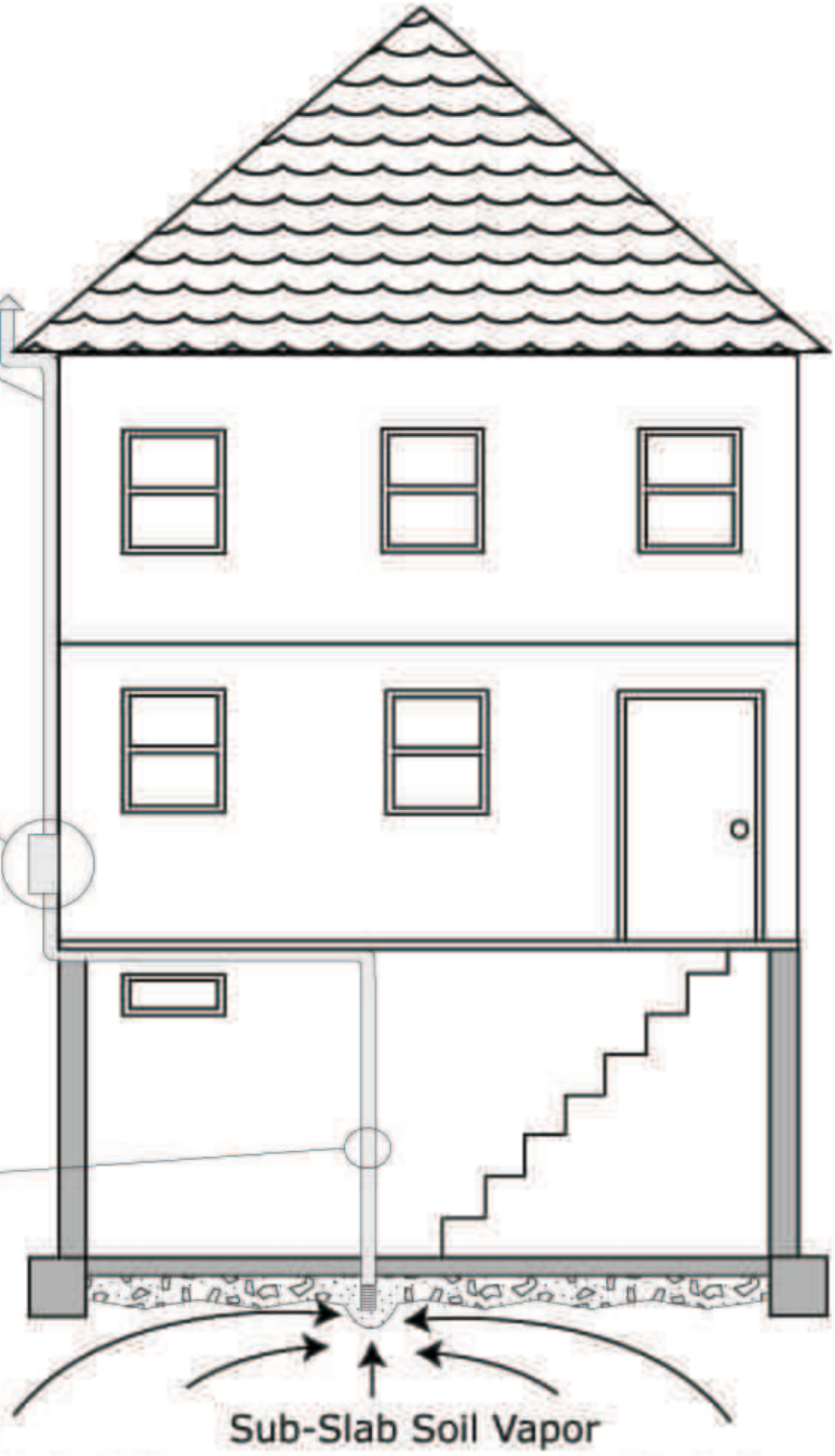
The vent pipe is routed up the side of the structure to a location above the roof line.



A fan is used to draw soil vapor from beneath the slab.



A liquid gauge, or manometer is used to verify that the system is operating properly



A sub-slab depressurization system vents contaminated soil vapor before it enters a structure. The fan draws vapor from beneath the building outside to the roof line where it is released to the outside air.

TETRACHLOROETHENE (PERC) IN INDOOR AND OUTDOOR AIR

SEPTEMBER 2013 FACT SHEET

This fact sheet answers questions about a chemical called tetrachloroethene (PERC), which is widely used to dry-clean clothes. It provides information on health effects seen in humans exposed to PERC in air. It also provides information about the New York State Department of Health's new guideline of 30 micrograms of PERC per cubic meter of air (30 mcg/m^3) or 0.03 milligrams of PERC per cubic meter of air (0.03 mg/m^3). The fact sheet focuses on the health risks from air exposures because most of the PERC released into the environment goes into air.

Prepared by

Bureau of Toxic Substance Assessment
New York State Department of Health

1. WHAT IS TETRACHLOROETHENE (PERC)?

Tetrachloroethene is a manufactured chemical that is widely used in the dry-cleaning of fabrics, including clothes. It is also used for degreasing metal parts and in manufacturing other chemicals. Tetrachloroethene is found in consumer products, including some paint and spot removers, water repellents, brake and wood cleaners, glues, and suede protectors. Other names for tetrachloroethene include PERC, tetrachloroethylene, perchloroethylene, and PCE. PERC is a commonly used name and will be used in the rest of the fact sheet.

PERC is a nonflammable, colorless liquid at room temperature. It readily evaporates into air and has an ether-like odor. Because most people stop noticing the odor of PERC in air after a short time, odor is not a reliable warning signal of PERC exposure.

2. HOW CAN I BE EXPOSED TO PERC?

People may be exposed to PERC in air, water, and food. Exposure can also occur when PERC or material containing PERC (for example, soil) gets on the skin. For most people, almost all exposure is from PERC in air.

PERC gets into outdoor and indoor air by evaporation from industrial or dry-cleaning operations and from areas where chemical wastes are stored or disposed. People living in homes located near these operations may be exposed to higher levels of PERC than the general population not living near such operations. Groundwater near these areas may become contaminated if PERC is improperly dumped or leaks into the ground. People may be exposed if they drink the contaminated water. They also may be exposed if PERC evaporates from contaminated drinking water into indoor air during cooking and washing. PERC may evaporate from contaminated groundwater and soil into the indoor air of buildings above the contaminated area. PERC also may evaporate from dry-cleaned clothes into indoor air or may get into indoor air after PERC-containing products, such as spot removers, are used. Indoor air PERC levels may get high if PERC-containing products are used in poorly ventilated areas.

3. HOW DOES PERC ENTER AND LEAVE MY BODY?

When people inhale air containing PERC, the PERC is taken into the body through the lungs and passed into the blood, which carries it to all parts of the body. A large fraction of this PERC is exhaled, unchanged, through the lungs into the air. Some of this PERC is stored in the body (for example, in fat, the liver, and the brain) and some is broken down in the liver to other compounds and eliminated in urine. PERC can also be found in breastmilk. Once exposure stops, most of the PERC and its breakdown products leave the body in several days. However, it may take several weeks for all of the PERC and its breakdown products to leave the body.

4. WHAT KINDS OF HEALTH EFFECTS CAN BE CAUSED BY EXPOSURE TO PERC IN AIR?

In humans, PERC may affect the central nervous system, the liver, kidneys, blood, immune system, and perhaps the reproductive system. The available data are insufficient to draw conclusions regarding effects of PERC exposure on development in infants and children.

For all health effects, the potential for an increased health risk depends on several factors, including the amount of exposure, the frequency of exposures, and the duration of the exposures. It also depends on the characteristics of the exposed person, such as age, sex, diet, family traits, lifestyle, genetic background, the presence of other chemicals in their body (e.g., alcohol, prescription drugs), and general state of health. Although difficult to quantify, these differences can affect how people will respond to a given exposure. This is known as sensitivity. Differences in sensitivity should be kept in mind when reading the following information on the human health effects of PERC.

Short-Term Exposure - Studies with volunteers show that exposure of eight hours or less to 700,000 micrograms per cubic meter of air (mcg/m^3) cause central nervous system symptoms such as dizziness, headache, sleepiness, lightheadedness, and poor balance. Exposure to 350,000 mcg/m^3 for four hours affected the nerves of the visual system and reduced scores on certain behavioral tests (which, for example, measure the speed and accuracy of a person's response to something they see on a computer screen). These effects were mild and disappeared soon after exposure ended.

Long-Term Exposure - Numerous studies of dry-cleaning workers indicate that long-term exposure (7 to 20 years, for example) to workplace air levels (41,000 mcg/m^3 to 120,000 mcg/m^3) caused reduced scores on neurobehavioral or color vision tests, increased levels of biochemical indicators of liver or kidney damage, reduced red blood cells, and blood and immune system effects [increased white blood cells and blood levels of a certain type of antibody (immunoglobulin E)]. The effects were mild and required special tests to be detected. It is not known how long these effects last.

The New York State Department of Health (NYSDOH, 2010) measured visual function [visual contrast sensitivity (VCS); color vision][1] in adults and children living in the apartments located in buildings with or without a dry-cleaner using PERC and also measured PERC indoor air levels. PERC levels were higher in the indoor air of apartments in buildings with dry-cleaners. Elevated indoor air PERC levels were associated with a slightly increased risk for children to have decreased VCS scores. The effect of PERC on VCS scores was most noticeable in a small group of children living in buildings with co-located dry cleaners using PERC. In those apartments, indoor air PERC levels ranged from 127 to 710 mcg/m^3, with a 50th percentile[2] (also known as the median) level of 340 mcg/m^3. For affected children (7 years mean duration of residency), the decrease was very small and occurred for only one eye in one of five tests. Mean VCS test scores were still within a normal range. Therefore, the risk for decreased VCS scores among affected children is considered to be small. Elevated indoor air PERC levels were not associated with effects on adult VCS scores, or with color vision of either children or adults. The observed associations between elevated indoor air PERC levels and children's VCS suggests that indoor air PERC levels in the range detected may have subtle effects on the brain.

A few epidemiological studies showed positive associations between workplace PERC exposure and reproductive effects (increased risk of spontaneous abortion, sperm disorders, and reduced fertility or delayed conception). Data on workplace air levels were not reported or were limited; however, workplace air levels during the times these studies were conducted were considerably higher than those typically found in indoor or outdoor air. These data suggest, but do not prove, that the reproductive effects were caused by PERC and not by some other factor or factors.

Lastly, epidemiological studies provide a pattern of evidence for a positive association between PERC exposure in the workplace and several types of cancer, specifically bladder cancer, non-Hodgkin lymphoma, and multiple myeloma. These associations were observed in studies with high quality assessments of the likelihood of PERC only exposures. However, data on PERC workplace air levels were not reported, but measurements from other studies indicate that workplace air levels during the times the workers were exposed were considerably higher than those typically found in indoor or outdoor air. Moreover, it is unlikely that the associations were dependent, totally or in part, on factors other than PERC exposures, such as common lifestyle factors as smoking or drinking alcohol. Data from more limited studies suggest that other types of cancer (esophageal, kidney, lung, liver, cervical, and breast cancer) are associated with PERC exposure. In laboratory studies, PERC caused cancer in rats and mice when they ingested or inhaled high doses almost daily for a lifetime. Based on human and animal data, the United States Environmental Protection Agency (USEPA) classifies PERC as "likely to be carcinogenic in humans by all routes of exposure."

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[1] VCS is a measure of a person's ability to distinguish the contrast between a viewed object and its background. It is easier to detect images of high contrast (e.g., a black cat on snow) than low contrast (e.g., a white cat on snow).

[2] Half the results are less than or equal to this value and half are above this value.

5. WHAT ARE BACKGROUND LEVELS FOR PERC IN OUTDOOR AND INDOOR AIR IN AREAS THAT ARE NOT NEAR A KNOWN ENVIRONMENTAL SOURCE OF PERC?

Various studies provide data on background levels of PERC in outdoor and indoor air. The New York State Department of Environmental Conservation collects data on outdoor air levels of air toxics under the Toxics Monitoring System (also known as Volatile Organics Network). The monitoring sites were selected to provide air quality data from the state's urban, industrial, residential, and rural areas. Based on 5882 samples collected across the state during 1999 to 2008, the 50th percentile (median) and 95th percentile[3] PERC levels were 0.41 mcg/m^3 and 4.8 mcg/m^3, respectively. NYSDOH (2005) conducted a study between 1997 and 2005 on the occurrence of volatile organic chemicals, including PERC, in the indoor and outdoor air of about 100 homes across the state (excluding New York City). Two outdoor samples were collected just outside each home for a total of 200 samples. The 50th percentile and 95th percentile PERC levels were less than 0.25 mcg/m^3 and 1.6 mcg/m^3, respectively. Finally, the 50th percentile and 95% percentile PERC levels in 587 outdoor air samples collected in 1999 - 2011 during the investigation of NYS remedial sites not known to have nor suspected to have sources of PERC were 0.52 mcg/m^3 and 2.6 mcg/m^3, respectively (NYSDOH, 2013b). Collectively, these three data sets, particularly given the low 95% percentile level in the large dataset from the Toxics Monitoring System, indicate that fewer than 5% of the background PERC levels in outdoor air are above 10 mcg/m^3.

The NYSDOH, the USEPA, and others have collected and analyzed information on PERC levels in indoor air. The table below contains the results from air samples collected inside of buildings that were not near known sources of PERC and other chemicals (for example, a home not known to be near a chemical spill, a hazardous waste site, a dry-cleaner, or a factory). The five studies that reported 90th percentile PERC air levels indicate that fewer than 10% of the background PERC levels in indoor air are above 10 mcg/m^3. In addition, the results for six of the eight studies that reported 95th percentiles and contained most of the samples indicate that fewer than 5% of the background PERC levels in indoor air are above 10 mcg/m^3. The other two studies (NYSDOH, 2009, 2013b; USEPA, 2001, 2013) indicate that fewer than 5% of the background indoor air levels are above 20 mcg/m^3.

[3] 95% of the results are less than or equal to this value.

Background Indoor Air Levels in US Buildings (1990-2013).

Study Description (and Sampling Years)	No. of Samples	Air Level Percentiles (mcg/m^3)			Reference
		50th (median)	90th [A]	95th	
Residential Buildings					
13 studies on residential properties (number NR[B]) in North America (1990-2005)	2312[C]	ND[D] - 2.2 (range)[E]	ND[D] - 7 (range)[E]	4.1 - 9.5 (range)[E]	USEPA (2011); also see Dawson & McAlary (2009)
screening study of households (284) in urban or non-urban areas of MN (1997)	284	1.4	NR[B]	4.9	Adgate et al. (2004)
subset of the screened households (101) in MN (1997)	101	1.3	NR[B]	5.2	
single family homes (about 100) heated with fuel oil from across NYS (excluding NYC) (1997-2003)	400	0.34	2.9	3.9	NYSDOH (2005, 2013a)[F]
households (about 100 each) in Elizabeth, NJ, Houston, TX, and Los Angeles, CA (1999-2001)	554	0.56	NR[B]	6.0	Weisel et al. (2005)
apartments (61) in NYC building **without** a co-located dry-cleaner (2001-2003)	61	2.2	8.5	19.09	NYSDOH (2009, 2013b)
Office Buildings					
public & commercial office buildings (70) in US (1994-1996)	209	1.5	9.3	18	USEPA (2001, 2013)
Mixed-Use Buildings					
buildings (number NR[B]) near NYS remedial sites not known nor suspected to have sources of PERC (1999-2011)	1625	0.72	2.8	6.6	NYSDOH (2013b)

[A] 90% of the results are less than or equal to this value.
[B] NR: not reported.
[C] Total number of samples, but number of samples associated with each percentile range is less than 2312, but was not reported.
[D] ND: not detected.
[E] The range from 13, 8, and 5 studies that reported the 50th, 90th, and 95th percentiles, respectively.
[F] One of the 13 studies included in USEPA (2011) and Dawson & McAlary (2009).

6. WHAT IS THE NEW YORK STATE DEPARTMENT OF HEALTH'S NEW GUIDELINE FOR PERC IN AIR?

After consideration of the potential health effects of PERC, background levels of PERC in air, and analytical techniques (the ability and reliability of methods to measure PERC in air), NYSDOH recommends that the average air level not exceed 30 mcg/m^3. This determination considered continuous, lifetime exposure and sensitive people. Three other ways of expressing the new guideline are 0.03 milligrams per cubic meter of air (0.03 mg/m^3), 4.4 parts per billion (ppb) or 0.0044 parts per million (ppm). This replaces the old guideline of 100 mcg/m^3.

An air guideline of 30 mcg/m^3 is below the PERC air levels known to cause noncancer effects, including developmental and reproductive effects, in humans and animals, and should be protective against those effects. It is lower than the USEPA's (2012) reference concentration (RfC)[4] for PERC of 40 mcg/m^3. The estimated excess cancer risk associated with lifetime, continuous exposure to 30 mcg/m^3 is about one-in-one-hundred thousand.

[4] The reference concentration is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Decisions about whether to take actions to further reduce exposure are generally made on a case-by-case basis at this level of risk.

However, NYSDOH recommends that reasonable and practical actions should be taken to reduce PERC exposure whenever air levels are above background. The purpose of the guideline is to help guide decisions about the urgency of the actions to reduce PERC exposure. The urgency to initiate these actions and to determine, in a timely manner, whether they have reduced exposure, increases with indoor air levels, particularly when air levels are above the guideline.

Indoor air levels substantially above the guideline indicate a significant PERC source and may require more immediate remedial action. NYSDOH has concerns about lengthy exposure (months to years) to air levels higher than 300 mcg/m^3 because the results of a recent NYSDOH study suggested that indoor air PERC levels in apartments (median value of 340 mcg/m^3) may have subtle effects on the nervous system (vision function) of children (NYSDOH, 2010 at http://www.health.ny.gov/environmental/investigations/perc/info_sheet.htm). Thus, NYSDOH recommends taking immediate and effective action to reduce exposure when an air level is equal to or above 300 mcg/m^3. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended actions is to reduce PERC levels in indoor air to as close to background as practical.

7. WHY DID NEW YORK STATE DEPARTMENT OF HEALTH REDUCE THE GUIDELINE FOR PERC IN AIR FROM 100 MCG/M^3 TO 30 MCG/M^3?

The guideline of 100 mcg/m^3 was issued in 1997 and was based on the toxicological data available at the time. Since then, many new toxicity studies have been published and the USEPA has completed a comprehensive, state-of-the-science, peer-reviewed risk assessment of PERC. Based on the risk assessment, the USEPA recommended values for evaluating the potential for noncancer and cancer effects from exposure to PERC in air [a RfC (40 mcg/m^3) and an air level (4 mcg/m^3) associated with an estimated excess cancer risk of one-in-one million, assuming continuous, lifetime exposure]. NYSDOH staff reviewed the USEPA risk assessment and determined that the recommended values are scientifically robust and should replace the values derived in 1997. The USEPA publication of its RfC (40 mcg/m^3) necessitated a re-evaluation of the health-protectiveness of the old NYSDOH guideline (100 mcg/m^3) because it has been the past practice of NYSDOH to set guidelines at air levels that are equal to or less than a RfC. Consequently, the guideline was reduced to 30 mcg/m^3 after consideration of new toxicity data (e.g., NYSDOH, 2010) and the USEPA risk assessment.

8. SHOULD I BE CONCERNED ABOUT HEALTH EFFECTS IF I AM EXPOSED TO AN AIR LEVEL SLIGHTLY ABOVE THE GUIDELINE?

The guideline is not a bright line between PERC levels that cause health effects and those that do not. The differences between exposure at the guideline and exposure levels known to cause effects in humans and animals are large. Thus, exposure to levels above but near the guideline will not cause health effects in most, if not all, people. In addition, the guideline is based on the assumption that people are continuously exposed to PERC in air all day, every day for as long as a lifetime. Continuous exposure is rarely true for most people, who, if exposed, are more likely to be exposed for a part of the day and part of their lifetime.

9. IS THERE A TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO PERC?

PERC levels can be measured in the breath for weeks following a high exposure to PERC because it is stored in body fat and is slowly released into the bloodstream and then exhaled in the breath. PERC can be measured in blood. Also, breakdown products of PERC can be detected in the blood and urine for several days after exposure to PERC. Because exposure to other chemicals can produce the same breakdown products in the urine and blood as PERC, the tests for breakdown products cannot determine if you have been exposed only to PERC. Although the tests can show if PERC levels in the body are elevated compared to background levels, they

cannot conclusively determine when and for how long a person was exposed, what the source of that exposure was, or whether or not the person will develop adverse health effects.

10. WHEN SHOULD MY CHILDREN OR I SEE A PHYSICIAN?

If you believe you or your children have symptoms that you think are caused by PERC exposure, you and your children should see a physician. You should tell the physician about the symptoms and about when, how, and for how long you think you and/or your children were exposed to PERC.

11. WHERE CAN I GET MORE INFORMATION?

If you have any questions about the information in this fact sheet, would like to know more about PERC, or are concerned that you may be exposed to elevated levels of PERC, please call the New York State Department of Health at 518-402-7800 or 1-800-458-1158, send an e-mail to btsa@health.state.ny.us, or write to us at the following address.

New York State Department of Health
Bureau of Toxic Substance Assessment
Corning Tower, Room 1743
Empire State Plaza,
Albany, NY 12237

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TRICHLOROETHENE (TCE) IN INDOOR AND OUTDOOR AIR

AUGUST 2015 FACT SHEET

This fact sheet answers questions about a chemical called trichloroethene (TCE), which is widely used to remove grease from manufactured products. It provides information on health effects seen in humans exposed to TCE in air. It also provides information about the New York State Department of Health's guideline of 2 micrograms of TCE per cubic meter of air (2 mcg/m^3) or 0.002 milligrams of TCE per cubic meter of air (0.002 mg/m^3). The fact sheet focuses on the health risks from air exposures because the primary route of exposure for most people in New York State is via indoor air.

Prepared by

Bureau of Toxic Substance Assessment
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1. WHAT IS TRICHLOROETHENE?[1]

Trichloroethene is a human-made clear, colorless liquid that has a somewhat sweet odor similar to ether or chloroform, but it is volatile, meaning it readily evaporates at room temperature into air. It is used as a solvent to remove grease from metal during the manufacture of variety of products, including building/furniture materials, fixtures, fabricated metal, and electric/electronic equipment. Trichloroethene also is used as a paint stripper, adhesive solvent, as an ingredient in paints and varnishes, and in the manufacture of other chemicals. Other names for trichloroethene include TCE and trichloroethylene. TCE will be used in the rest of this fact sheet.

2. HOW CAN PEOPLE BE EXPOSED TO TCE?

People may be exposed to TCE in air, water, and food. Exposure can also occur when TCE or material containing TCE (for example, soil) gets on the skin. For most people, almost all TCE exposure is from indoor air.

TCE gets into air when it is released from industrial facilities and when it evaporates from areas where chemical wastes are stored or disposed. People living in homes located near TCE sources may be exposed to higher levels of TCE than most other people. Groundwater near these areas may become contaminated if TCE is improperly dumped or leaks into the ground. People may be exposed if they drink the contaminated water or if TCE evaporates from contaminated drinking water into indoor air during cooking, showering, and bathing. They may also be exposed if TCE evaporates from the groundwater, enters soil vapor (air spaces between soil particles), and migrates through the foundation and into the indoor air of an overlying building. This process is called soil vapor intrusion. TCE also may get into indoor air when TCE-containing products (for example, glues, adhesives, paint removers, spot removers, and metal cleaners) are used. Indoor air TCE concentrations may increase if people use TCE-containing products in poorly ventilated areas.

3. HOW CAN TCE ENTER AND LEAVE THE BODY?

If people inhale air containing TCE, some of the TCE is exhaled unchanged from the lungs and back into the air. Much of the TCE is taken into the body through the lungs and is passed into the blood, which carries it to other parts of the body. The liver changes most of the TCE in the blood into other compounds,

[1] For a "plain language" version of this fact sheet, see the fact sheet "Important Information on Trichloroethene (TCE) in Indoor and Outdoor Air" available at http://www.health.ny.gov/environmental/chemicals/trichloroethene/.

called breakdown products, most of which are excreted in the urine within a week or so. However, some of the TCE and its breakdown products can be stored in the fat or the liver, and it may take several weeks after exposure stops before almost all of them leave the body.

4. WHAT ARE THE CONCENTRATIONS OF TCE IN INDOOR AND OUTDOOR AIR?

Background Concentrations in Air

Indoor Air

Background indoor air concentrations of chemicals such as TCE are the concentrations measured in buildings in the absence of a local, external environmental source of the chemical. In the absence of such a source, the presence of the chemical in the air of the building is due to its release from products in the building. We used several sources of information on background concentrations of TCE in indoor air collected across the US and in NY and other states (Adgate et al., 2004; Dawson and McAlary, 2009; NYSDOH, 2005, 2014; USEPA, 2001, 2011b, 2015a; Weisel et al., 2005). Overall, the results indicate background concentrations are almost always 1 micrograms per cubic meter of air (1 mcg/m^3) or less when a local, external TCE source is not present.

Outdoor Air

Background outdoor air concentrations of TCE are the concentrations measured in the absence of a known local point-source of TCE. Various NYS studies provide data on TCE outdoor air background concentrations (NYSDEC, 2000, 2002; NYSDOH, 2005, 2014). Collectively, the results indicate background concentrations are almost always 1 mcg/m^3 or less when a local, point-source of TCE source is not present.

Workplace Air Concentrations

TCE air concentrations in workplaces where TCE is manufactured or used are substantially higher than background concentrations. Bakke et al. (2007) reported that the average TCE workplace air concentration across all U.S. industries and over four decades (1950s to 1980s) was 210,000 mcg/m^3. Hein et al. (2010) reviewed the literature (1940 to 2001) and reported the average workplace air concentrations in various industries and occupations ranged from 1.1 mcg/m^3 to 5.9 million mcg/m), with a median of 38,000 mcg/m^3. ATSDR (1997, 2013) reported that the majority of published data on workplace air concentrations showed average concentrations ranging from less than 270,000 mcg/m^3 to 540,000 mcg/m^3.

5. WHAT KINDS OF HEALTH EFFECTS CAN BE CAUSED BY EXPOSURE TO TCE IN AIR?

Information on the health effects of TCE largely comes from studies where people were exposed to air levels much higher than the background levels commonly found in indoor or outdoor air (for example, 90,000 to 807,000 mcg/m^3). In humans, TCE can cause effects on the central nervous system (CNS), liver, kidneys, reproductive and immune systems, and may affect fetal development during pregnancy. Studies in animals show similar kinds of effects. In this fact sheet, we focus on those health effects of greatest concern, largely because they are considered the most sensitive or most serious human health responses to TCE exposures (i.e., CNS effects, developmental and reproductive effects, and cancer).

For all of the different kinds of health effects, the potential for a person to actually experience a health effect depends on several factors, including the amount of exposure, the frequency of exposure, and the duration of the exposure. It also depends on the characteristics of the exposed person, such as age, sex, diet, family traits, lifestyle, genetic background, the presence of other chemicals in their body (for example, alcohol, prescription drugs), and general state of health. Although difficult to quantify, these differences can affect how people will respond to a given exposure. This is known as sensitivity. Differences in sensitivity should be kept in mind when reading the following information on the human health effects of TCE.

Short-Term Exposure

TCE was once used as an anesthetic during surgery. The primary effects of short-term exposure to TCE in air are on the CNS. Exposure to 590,000 mcg/m^3 for eight hours or less reduced performance on neurobehavioral tests of perception, reaction time, memory, and learning. Symptoms of CNS effects, including headaches, lightheadedness, sleepiness, and fatigue, were common in volunteers exposed to 1,100,000 mcg/m^3 for 7 hours/day for 5 days. Also reported were eye, nose, and throat irritation.

A few studies have reported an increased risk for harmful effects on human development, including fetal heart defects, in the offspring of women who lived in areas with elevated concentrations of TCE in indoor air or drinking water. Due to the limitations of the studies, including poor or no quantitative exposure estimates, we do not know if the observed effects on fetal development in humans were caused by TCE or some other factor. Some, but not all, studies in rats, indicate that TCE exposure can cause heart defects in rat pups exposed *in utero* when the mother was exposed during pregnancy.

Long-Term Exposure

Long-term exposure to high concentrations of TCE in workplace air has caused a variety of effects on the CNS, including effects on nerve function, behavior, vision, hearing, muscle control, memory, ability to think, and other symptoms, such as headache and dizziness.

Some human studies have reported associations between TCE exposure and effects on the reproductive system. For women, reported effects include more difficulty getting pregnant and menstrual cycle disturbances. For men, reported effects have included changes in sperm quality/quantity, hormonal function, and reproductive behavior. These studies suggest, but do not prove, that the reproductive effects were caused by TCE and not by some other factor or factors.

Lastly, epidemiological studies provide convincing evidence of a cause-effect relationship between TCE exposure and cancer. The strongest evidence comes from several well-designed studies that found increased risks of kidney cancer among workers exposed to TCE during the degreasing of metal parts, with more limited evidence for non-Hodgkin's lymphoma (NHL) and liver cancer. In laboratory studies, TCE caused cancer at several sites (kidneys, liver, and lymphoid tissues) in rats and mice when they ingested or inhaled high doses almost daily for a lifetime. Based on human and animal data, the United States Environmental Protection Agency (USEPA) classifies TCE as "carcinogenic to humans by all routes of exposure."

6. WHAT IS THE NEW YORK STATE DEPARTMENT OF HEALTH (NYSDOH) GUIDELINE FOR TCE IN AIR?

After considering the potential health effects of TCE, the background concentrations of TCE in air, and the ability and reliability of the analytical techniques used to measure TCE in air, NYSDOH recommends that the TCE concentration in air not exceed 2 mcg/m^3. This determination also considers continuous exposure for months or as long as a lifetime and sensitive populations (for example, children, pregnant women). Three other ways of expressing this guideline are 0.002 milligrams per cubic meter of air (0.002 mg/m^3), 0.4 parts per billion (ppb) or 0.0004 parts per million (ppm). This replaces the previous guideline of 5 mcg/m^3 (NYSDOH, 2006).

7. WHY WAS THE TCE AIR GUIDELINE REDUCED FROM 5 MCG/M^3 TO 2 MCG/M^3?

NYSDOH reduced its air guideline because of new information on the toxicity of TCE. In 2011, the USEPA (2011a, 2015b) recommended a reference concentration (RfC), of 2 mcg/m^3 and an air unit risk of

4.8×10^{-6} per mcg/m^3. An RfC is the level of a chemical in air that is unlikely to cause harmful noncancer health effects in people, even after a lifetime of continuous exposure. An air unit risk is a measure of the potency of a chemical to cause cancer. The air unit risk for TCE means that 4.8 excess cancers are estimated to develop per 1,000,000 people continuously exposed to TCE in air for a lifetime at a concentration of 1 mcg/m^3. Another way to express this value is to say that an air concentration of 0.21 mcg/m^3 is associated with an estimated excess cancer risk of 1×10^{-6} (also expressed as one-in-one million), assuming continuous, lifetime exposure.

The NYSDOH replaced its old RfC and unit risk with USEPA's RfC and unit risk after determining that the USEPA values were (1) based on toxicity information not available when NYSDOH derived its RfC and unit risk and issued the guideline of 5 mcg/m^3; (2) scientifically strong; and (3) adequately protective of the public health. The new RfC is lower than the old NYSDOH guideline, which raised concerns because it has been the past practice of NYSDOH to set a guideline for a chemical at an air concentration that is equal to or less than its RfC. Lowering the guideline also would lower the estimated excess cancer risk associated with lifetime, continuous exposure to the guideline. Consequently, the guideline was reduced to 2 mcg/m^3.

8. HOW IS THE GUIDELINE USED?

The guideline is used to help guide decisions regarding the urgency of efforts to reduce TCE exposure. At TCE air levels above the guideline, the higher the level, the greater the urgency to take action to reduce exposure. But as with any chemical in indoor air, the NYSDOH always recommends taking action to reduce exposure when the air concentration of a chemical is above background, even if it is below the guideline.

Indoor air concentrations substantially above the guideline clearly indicate a significant TCE source and the need for action to reduce exposure. In particular, NYSDOH has concerns about exposure during pregnancy, particularly during the first trimester, to air concentrations higher than 20 mcg/m^3 because the major steps of heart development occur during this period and TCE may be a risk factor for fetal heart defects in humans. Thus, NYSDOH recommends taking immediate and effective action to reduce exposure when an air concentration is equal to, or above 20 mcg/m^3. In all cases, the specific recommended action depends on a case-by-case evaluation of the situation.

9. SHOULD I BE CONCERNED ABOUT HEALTH EFFECTS IF I AM EXPOSED TO TCE LEVELS SLIGHTLY ABOVE THE GUIDELINE?

The guideline is not a bright line between TCE concentrations that cause health effects and those that do not. The guideline was set at an air concentration that is lower than air concentrations known to cause, or suspected of causing, effects in humans and animals. Thus, exposure to concentrations above, but near the guideline, is not expected to cause health effects in people. In addition, the guideline is based on the assumption that people are continuously exposed to TCE in air all day, every day for months or as long as a lifetime. Continuous exposure is rarely true for most people, who, if exposed, are more likely to be exposed for a part of the day, part of a week, or part of their lifetime.

10. WHEN SHOULD I OR MY CHILDREN SEE A PHYSICIAN?

If you believe you, your children, or others you know have signs or symptoms that you think are caused by TCE exposure, see a physician. Tell the physician about the signs/symptoms and about when, how and for how long you think you and/or your children were exposed to TCE.

11. IS THERE A MEDICAL TEST THAT CAN TELL ME IF I HAVE BEEN EXPOSED TO TCE?

TCE can be measured in people's breath and blood soon after they are exposed, and levels generally reflect recent exposures (for example, within the past week or so). TCE breakdown products can be measured in the urine and blood for up to several weeks after exposure to TCE stops. However, the tests for breakdown products cannot determine if you have been exposed only to TCE because exposure to other chemicals can produce the same breakdown products in the urine and blood as TCE. These tests are not routinely done by most clinical laboratories.

Finding a measurable amount of any of these chemicals in breath, blood, or urine does not mean that the levels have or will cause adverse health effects. The results can be used to compare to levels in people without a known source of TCE exposure (i.e., the general population) or to levels found in workers exposed to much greater amounts of TCE. Your physician should discuss these test results with you.

12. WHERE CAN I GET MORE INFORMATION?

If you have any questions about the information in this fact sheet, would like to know more about TCE, or are concerned that you may be exposed to elevated levels of TCE, please call the New York State Department of Health at 1-518-402-7800 or 1-800-458-1158, send an e-mail to btsa@health.ny.gov, or write to us at the following address.

New York State Department of Health
Bureau of Toxic Substance Assessment
Corning Tower, Room 1743
Empire State Plaza,
Albany, NY 12237

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Appendix C – Quality Assurance Project Plan (QAPP)

AECOM

Quality Assurance Project Plan (QAPP)

Site Characterization
Off-Site 91 Leighton Avenue (Site No. C828231A)
Work Assignment D009803.64

August 2026

Prepared for:

New York State Department of Environmental Conservation
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Acronyms and Abbreviations

ASP	Analytical Services Protocol
°C	degrees Celsius
CLP	Contract Laboratory Program
COC	chain-of-custody
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
FAP	Field Activities Plan
FB	field equipment (rinsate) blank
FD	field duplicate
IDL	instrument detection limit
ITR	independent technical review
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MD	matrix duplicate
MDL	method detection limit
mg/L	milligrams per liter
mg/kg	milligrams per kilograms
MS	matrix spike
MSB	matrix spike blank
MSD	matrix spike duplicate
NEIC	National Enforcement Investigations Center
ng/L	nanograms per liter
ng/g	nanograms per gram
NIST	National Institute of Standards and Technology
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCB	polychlorinated biphenyl
PMWP	Project Management Work Plan
ppbv	parts per billion by volume
PQO	Project Quality Objective
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	relative percent difference
SCWP	Site Characterization Work Plan
TCLP	toxicity characteristic leaching procedure
µg/kg	micrograms per kilograms
µg/L	micrograms per liter
µg/m^3	micrograms per cubic meter
USEPA	United States Environmental Protection Agency
VTSR	validated time of sample receipt

1.0 INTRODUCTION

1.1 PURPOSE AND OBJECTIVE

The purpose of this Quality Assurance Project Plan (QAPP) is to document planned investigative activities and establish the criteria for performing these activities at a predetermined quality for the work conducted by AECOM USA, Inc. (AECOM) under NYSDEC Standby Engineering Contract D009803.

Project work will be conducted in general accordance with the NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation (NYSDEC, 2010a), DER's Spill Response Guidance Manual, as applicable, technical requirements in Contract D009803 between NYSDEC and AECOM (NYSDEC and AECOM, 2019), and United States Environmental Protection Agency (USEPA) Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988).

The QAPP is intended to be a companion document to the site-specific Work Plan prepared for each work assignment. This QAPP was prepared as an Appendix to the site-specific Work Plan for Work Assignment #64 to address site-specific conditions and project-specific requirements.

1.2 PROJECT MANAGEMENT AND ORGANIZATION

1.2.1 Personnel

The general responsibilities of key project personnel are listed below.

Program Manager – Michael L. Spera, PE will have responsibility for overall program management and coordination of AECOM personnel and subcontractors to complete the work.

Project Manager – Michael Gutmann will have responsibility for overall project management and coordination with NYSDEC, and will coordinate the initiation and implementation of the work assignment activities. The AECOM Project Manager will serve as the initial and primary contact with NYSDEC throughout the project and will be responsible for successful implementation of the project's QA/QC activities. The AECOM Project Manager may delegate a portion of the tasks required for successful implementation of the project to a qualified individual, the Site Manager, who will be on site during field activities (i.e., investigations, remedial action, operation and maintenance activities, etc.). The Site Manager will work under the direction of the AECOM Project Manager and will be responsible for implementing applicable QC procedures in the field and verifying that all other AECOM field personnel adhere to these procedures and perform all activities as described in the project work plans.

Task Leaders/Field Team Leaders – Edyta Chorostkowska will share the responsibility of implementing and coordinating the field and office project activities.

Program QA Officer – Robert Montione will serve as the Program Quality Assurance Officer (QAO) for work assignments issued under this contract. The QAO will be responsible for oversight of the data validation and laboratory subcontractors, as well as data usability reports. The QAO will work with the AECOM database manager to assure that electronic deliverables provided by the laboratory are accurate and are formatted and consistent with AECOM and NYSDEC requirements. The Program QAO may designate another qualified individual to serve as project QA officer to oversee the data-to-day quality assurance aspects of specific work assignments.

Project Chemist – Peter Fairbanks will be responsible for verifying that the analytical laboratories adhere to the QA/QC requirements specified in this QAPP. The AECOM Project Chemist will be the point-of-contact for the Laboratory's Project Manager and will personally communicate with the Laboratory's Project Manager to verify that all sample analyses are being performed such that the resulting data will be of sufficient quality for its intended purpose.

H & S Officer – Caroline Lee is responsible for oversight and preparation of the project health and safety plan, approving it, and tracking its implementation.

Database Manager – Maxwell Reis, or an assigned qualified individual, will serve as database manager. The database manager is responsible for verifying that laboratory deliverables meet AECOM and NYSDEC electronic data deliverable specifications, and for preparing the final EQuIS deliverable for submission to NYSDEC.

Resumes for AECOM personnel have previously been submitted to the Bureau of Program Management.

1.2.2 Specific Tasks and Services

AECOM has obtained the following subcontractor specialists for services relating to laboratory/ analytical services and data validation services.

Laboratory Analysis – The laboratory assigned for the project, selected from laboratories subcontracted by NYSDEC based on the Call-out Subcontract, is Pace Analytical Services, LLC, which is certified for aqueous and non-aqueous matrices. The laboratory is also certified for air sample analysis.

All laboratories to be used for the work assignment shall hold applicable New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certifications for the analyses to be performed. Copies of the applicable ELAP certifications for each laboratory to be used during the work assignment are held at the NYSDEC. Each laboratory maintains its own QA/QC program and employs the required staff to implement this program. The QA Officer for each laboratory is responsible for verifying that all sample analyses are performed in accordance with the analytical methods, laboratory QA/QC procedures, and this QAPP.

Data Validation – An AECOM data validator will be assigned for data quality review and Data Usability Summary Report (DUSR) preparation as needed for this project. Data validation is performed to establish the data quality for all data which are to be considered when making project decisions.

Field surveying and mapping – Mike Rozeski, L.S., a certified New York State land surveyor, will complete the field surveying.

Geophysical/utility locating will be provided by Matrix Environmental Technologies, Inc.

Drilling and monitoring well installation will be provided by Atlantic Testing Laboratories Limited.

Investigation derived waste (IDW) disposal will be provided by Momentum Environmental Services.

1.3 SITE DESCRIPTION AND LOCATION

Background data on the site, including the site description and location, site history, previous investigations, and current conditions, are summarized in the site-specific Site Characterization Work Plan (SCWP) or Field Activities Plan (FAP). A site map showing proposed sampling locations is included in the site-specific SCWP.

2.0 SITE INVESTIGATION

Site investigation procedures are provided below.

2.1 FIELD SAMPLING PROCEDURES

Field activities are detailed in the SCWP or FAP and are not repeated in this QAPP. Proposed sampling procedures to be utilized will be identified in the site-specific FAP.

2.2 EQUIPMENT DECONTAMINATION

To avoid cross contamination, sampling equipment (defined as any piece of equipment which may contact a sample) will be decontaminated according to the procedures specified in the SCWP or FAP.

The procedures discussed here are general and will be superseded by project-specific requirements (as documented in the SCWP or FAP). However, these procedures are provided for guidance in developing those plans.

Field equipment rinsate blanks (see Section 4.3.1) are generated and analyzed to monitor the effectiveness of field decontamination procedures.

Cross contamination is minimized by the use of vendor-decontaminated, dedicated, or disposable equipment to the extent practicable.

2.2.1 Decontamination Procedures

As indicated in the SCWP or FAP, a decontamination pad may be constructed on the site. The pad will be appropriately sized and large enough to handle the equipment used on site (e.g., drill rig). The pad will also be used for small equipment decontamination as well as personnel decontamination.

2.2.2 Small Equipment Decontamination

Small equipment decontamination for non-disposable equipment such as Geoprobe Hydropunch samplers, transducer probes and cables, etc., will be accomplished using the following procedures:

- Alconox (or equivalent) and potable water wash;
- Potable water rinse; and
- Distilled/deionized water rinse.

Solvents will not be used in the field decontamination of such equipment. Decontamination will include scrubbing/washing with a laboratory grade detergent (e.g., Alconox) to remove visible contamination, followed by potable (tap) water and analyte-free water rinses. Tap water may be used from any treated municipal water system; the use of an untreated potable water supply is not an acceptable substitute.

Equipment should be allowed to dry prior to use. Steam cleaning or high-pressure hot water cleaning may be used in the initial removal of gross, visible contamination.

Electric submersible pumps (such as a Grundfos Redi-Flow II) will be decontaminated using the above steps followed by running a large volume (several gallons) of potable water through the pump, followed by an analyte-free water rinse. Tubing will not be re-used (new tubing will be used for each well). Submersible pumps and supporting lines and cables will be placed in a large clean plastic garbage can filled with potable water and then run for several minutes (to decontaminate both exterior and interior parts); submersible pumps will also be given a final analyte-free water rinse of both interior and exterior parts.

If bladder pumps are used, the pump will be disassembled and cleaned after each used. A new bladder will be used for each sample. Small parts, such as screens and gaskets will be replaced after each use. Dedicated air line tubing and sample tubing will be used at each monitoring well. The pump will be cleaned using the following steps:

- Alconox (or equivalent) and potable water wash;
- Potable water rinse;
- Distilled/deionized water rinse;
- Solvent (reagent or pesticide grade) rinse if samples are collected for organic analysis;
- Dilute (10%) nitric acid rinse if samples are collected for metals analysis; and
- Distilled/deionized rinse, air dry.

2.2.3 Heavy Equipment Decontamination

Drilling equipment will be decontaminated before the first use during this project, between boreholes and prior to demobilization using high-pressure steam. Decontamination will be conducted at a dedicated decontamination pad constructed for the project or at an alternate location as indicated in the SCWP or FAP. Decontamination fluids will be containerized (drummed) for subsequent characterization or disposal, unless other arrangements are made on a project-specific basis and as indicated in the SCWP.

2.2.4 Personnel Decontamination

Wash buckets and potable water will be set up at the decontamination pad or alternate location as indicated in the work plan, FAP, or Health and Safety Plan (HASP). This includes washing hands and a boot wash. Details of the personnel decontamination procedures will be provided in the HASP.

3.0 SAMPLE HANDLING

3.1 SAMPLE IDENTIFICATION AND LABELING

Samples will be assigned a unique identification using the sample location or other sample-specific identifier. Sample identification and labeling requirements are presented in FAP Section 10 and are not repeated here.

The procedures discussed here are general and will be superseded by project-specific requirements (as documented in the SCWP or FAP). However, these procedures are provided for guidance in developing those plans. Sample identification may be limited to a specific number of alphanumeric characters to be consistent with the limitations of the laboratory tracking/reporting software. The general sample identification format follows (other designations may be used to accommodate the requirements of specific projects). It should be noted that the field sample IDs shown below are not those required for the EQuIS deliverable; AECOM will coordinate with the analytical laboratory so that the sample types and codes are entered properly for each field and QC sample, and that the codes are consistent with the most recent NYSDEC Valid Values.

MW = Monitoring Well

IA = Indoor Air

OA (or AA) = Outdoor (or ambient) air

SV = Soil Vapor

FB = Field Equipment (Rinsate) Blank

TB = Trip Blank

XX = Numerical sample identifier (up to five characters). This will ordinarily be the number of the monitoring well or soil boring location from which the sample was obtained.

As part of the unique identifier, the sample date will be included following any location that may have more than one sample collected. The format will be MMDDYY. For example, MW-01S that is sampled on May 24, 2026, will be MW-01S-052426.

QC field duplicate samples will be submitted blind to the laboratory; a fictitious sample ID will be created using the same system as the original by adding 50 to the original well ID (e.g., MW-51S-052426 would be a field duplicate of MW-01S-052426). The sample identifications (of the original sample and its field duplicate) will be marked in the field book and on the copy of the chain-of-custody kept by the sampler and copied to the project manager. As the field duplicates are blind to the laboratory, the NYSDEC Valid Value for a field duplicate (FD) along with the identification of the parent sample will be done by AECOM after the EQuIS deliverable is received from the laboratory.

Affixed to each sampling container will be a non-removable label on which the following information will be recorded with permanent water-proof ink:

- Site name, location, and job number;
- Sample name;
- Date and time;
- Sampler's name;
- Preservative;
- Type of sample (e.g., water, soil, sludge, sediment, air); and
- Requested analyses.

3.2 SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIME

Table 1 identifies the sample preparation and analytical method, matrix, holding time, containers, and preservatives for the typical analyses to be performed under this contract. Sample bottle requirements, preservation, and holding times are discussed further below.

3.2.1 Sample Containers

The selection of sample containers used to collect samples is based on the criteria of sample matrix, analytical method, potential contaminants of concern, reactivity of container material with the sample, QA/QC requirements and any regulatory protocol requirements.

Sample containers will be provided by the analytical laboratory and will conform to the requirements of the USEPA Specifications and Guidance for Contaminant-Free Sample Containers. Aqueous samples for volatile organic compound (VOC) analysis will be collected in 40-mL vials with Teflon septa. Summa canisters for air samples will be individually certified by the laboratory.

3.2.2 Sample Preservation

Samples will be preserved as indicated below and summarized on **Table 1**.

Aqueous Samples:

Volatile organics – cooled to 4º C; HCl added to pH ≤ 2.

Chemical preservatives will be added to the sample bottles (prior to sample collection) by the analytical laboratory. The pH of samples will be spot-checked in the field and additional preservative will be added as needed. Sample preservation is checked upon sample receipt by the laboratory; this information is reported to the AECOM Quality Assurance Officer (QAO). If it appears that the level of chemical preservation added is not adequate, laboratory preservative preparation and addition will be modified, or additional preservative will be added in the field by the sampling team.

Air Samples (Summa Canisters):

No chemical preservatives are used for air samples.

Investigative Derived Waste (IDW) (Non-Aqueous and Aqueous) Samples:

No chemical preservatives are added to IDW samples.

3.2.3 Holding Times

Holding times (see **Table 1**) are calculated from the time of sample collection; samples will be shipped from the field to arrive at the lab no later than 48 hours from the time of sample collection except for instances with shorter holding time parameters. Holding time requirements will be those specified in the analytical methods.

Although trip blanks are prepared in the analytical laboratory and shipped to the site prior to the collection of environmental samples, for the purposes of determining holding time conformance, trip blanks will be considered to have been generated on the same day as the environmental samples with which they are shipped and delivered. Procurement of sample containers and blanks will be scheduled to prevent trip blanks from being stored for excessive periods prior to their return to the laboratory; the goal is that trip blanks should be held for no longer than one week prior to use.

3.2.4 Sample Custody

Proper documentation of sample collection and the methods used to control these documents are referred to as chain-of-custody (COC) procedures. Chain-of-custody procedures are essential for presenting sample analytical results as evidence in litigation or at administrative hearings held by regulatory agencies. Chain-of-custody procedures also serve to minimize loss or misidentification of samples and to ensure that unauthorized persons do not tamper with collected samples.

The procedures used in this work assignment will follow the COC guidelines of National Enforcement Investigations Center (NEIC) Policies and Procedures, prepared by the NEIC of the USEPA Office of Enforcement.

3.2.4.1 Custody Definitions

Chain-of-Custody Officer - The employee responsible for oversight of all COC activities is the Project Manager (or his/her designee).

Under Custody - A sample is “Under Custody” if:

- It is in one's possession, or
- It is in one's view, after being in one's possession, or
- It was in one's possession, and one placed it under lock, or
- It is in a designated secure area.

3.2.4.2 Responsibilities

The Project Manager will be responsible for monitoring all COC activities and for collecting legally admissible COC documentation for the permanent project file, and will perform the following tasks:

- Review sample labels or tags, closure tapes, and COC records.
- Train all field sampling personnel in the methodologies for carrying out COC activities and the proper use of all COC and record documents.
- Monitor the implementation of COC procedures.
- Submit copies of the completed COC records to the Project Chemist.

A COC form will trace the path of sample containers from the project site to the laboratory. Chain-of-custody forms are typically provided by the analytical laboratory.

Sample container tracking sheets or the chain-of-custody will be used to track the containers from the laboratory to the containers’ destination. The Project Manager will notify the laboratory of upcoming field sampling events and the subsequent transfer of samples. This notification will include information concerning the number and type of samples, and the anticipated date of arrival. Insulated sample shipping containers (typically coolers) will be provided by the laboratory for shipping aqueous samples. Air canisters will be shipped back to the laboratory in their original shipping containers. Sample bottles/canisters within each shipping container will be individually labeled with an adhesive identification label provided by the laboratory. Project personnel receiving the sample containers from the laboratory will check each cooler/shipping container for the condition and integrity of the bottles/canisters prior to field work.

Once the sample containers are filled, they will be immediately placed in the cooler with ice (in Ziploc plastic bags to prevent leaking) or synthetic ice packs to maintain the samples at 4º C (where applicable). The field sampler will indicate the sample designation/location number in the space provided on the COC form for each sample. The COC forms will be signed and placed in a sealed plastic Ziploc bag in the cooler/shipping container. The completed shipping container will be closed for transport with nylon strapping, or a similar shipping tape, and two paper seals will be affixed to the lid. The seals must be broken to open the cooler and will indicate tampering if the seals are broken before receipt at the laboratory. A label may be affixed identifying the cooler as containing “Environmental Samples” and the cooler will be shipped by an overnight delivery service to the laboratory. When the laboratory receives the coolers, the custody seals will be checked and lab personnel will sign the COC form.

3.3 LABORATORY SAMPLE RECEIPT

Upon receipt at the laboratory, a laboratory representative inspects the samples for integrity and checks the shipment against the COC/analytical task order form. Discrepancies are addressed at this

point and documented on the COC form and the cooler checklist (an example will be provided in each of the project-specific Field Sampling and Analysis Plans). Discrepancies are reported to the Laboratory Project Manager who contacts the AECOM Project Manager or QAO for resolution.

When the shipment and the COC are in agreement, the custodian enters the samples into the Laboratory Information Management System and assigns each sample a unique laboratory number. This number is affixed to each sample bottle/container. The custodian then enters the sample and analysis information into the laboratory computer system.

3.3.1 Laboratory Sample Custody

The laboratory must satisfy the sample chain-of-custody requirements by implementing the following procedures for laboratory/sample security:

- Samples are stored in a secure area
- Access to the laboratory is through a monitored area
- Visitors sign a visitor's log and are escorted while in the laboratory
- Only the designated sample custodians have keys to sample storage area(s)
- Transfers of samples in and out of storage are documented.

3.3.2 Sample Storage, Security, and Disposal

While in the laboratory, the samples and aliquots that require storage at 4°C ± 2°C are maintained in a locked refrigerator unless they are being used for analysis. The laboratory is responsible for sample storage and security so that:

- Samples and extracts are stored for 60 days after the final analytical data report has been submitted to AECOM. The samples, extracts, and digestates are then disposed of by the laboratory in accordance with laboratory SOPs and applicable regulations.
- Samples are not stored with standards or sample extracts.

4.0 DATA QUALITY REQUIREMENTS

4.1 ANALYTICAL METHODS

Water sample analyses for this contract will typically utilize USEPA SW-846 methods as listed below.

Analytical and extraction/sample preparation methods typically used are shown on **Table 1** and summarized below.

- Volatile Organics - SW-846 Method 8260D

Air samples (sub-slab vapor samples, indoor air samples, ambient air samples) will typically be collected in 6-L Summa® canisters and analyzed by USEPA method TO-15-SIM.

Solid and aqueous waste characteristic samples will be extracted/prepared and analyzed by the methods shown on **Table 1** (i.e., Full TCLP, RCRA Characteristics, and PCBs).

NYSDEC Analytical Services Protocol (ASP) full Category B deliverables will be required unless specified otherwise in specific work assignments or work plans. Typically, Category A deliverables are required for waste characterization samples.

NYSDEC assigned Pace laboratory to this project under their call-out subcontract. Pace is certified by the NYSDOH Environmental Laboratory Approved Program (see Section 1.2). The laboratory, Pace Analytical Services, is in good standing for the applicable parameter groups.

4.2 QUALITY ASSURANCE OBJECTIVES

Data quality objectives (DQOs) for measurement data in terms of sensitivity and the PARCC parameters (precision, accuracy, representativeness, comparability, and completeness) are established so that the data collected are sufficient and of adequate quality for their intended uses. Data collected and analyzed in conformance with the DQO process described in this QAPP will be used in assessing the uncertainty associated with decisions related to this site.

Project quality objectives (PQOs), such as those described in the *Uniform Federal Policy for Quality Assurance Project Plans* (USEPA, 2005), define the type, quantity, and quality of data that are needed to answer specific environmental questions and support proper environmental decisions.

More specifically, the PQOs:

- Define the environmental problem;
- Identify target analytes/contaminants of concern and concentration levels;
- Establish the analytical techniques to be used (field-screening, on-site, and/or off-site);
- Establish the appropriate sampling techniques to be used;
- Establish project sampling/analytical measurement performance criteria (where applicable) for precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity; and
- Determine the number of samples needed for each analytical group/matrix/concentration level.

PQOs are provided in the site-specific SCWP and in the project FAP.

4.2.1 Sensitivity

The sensitivity or detection limit desired for each analysis or compound is based on the DQOs established for the project. The method detection limit is determined in accordance with the procedure in ASP Exhibit A, Section 4.9.2.12, which is consistent with the procedure in 40 CFR Part 136 Appendix B.

The reporting limit (RL) for non-detected analytes will be the lowest calibration standard associated with the analysis. Reporting limits will be equal to or lower than those presented in the applicable

methods. Analytes detected at concentrations below the RL but above the MDL will be flagged "J" (estimated) by the laboratory. Typical RLs are summarized on **Table 2**.

The RLs and MDLs of the assigned laboratory will be reviewed by AECOM's QAO for each project to verify that the laboratory sensitivity is sufficient to meet the project objectives. These will typically include meeting the applicable standards, criteria, and guidance (SCGs) including groundwater and surface water criteria (compiled in TOGS 1.1.1), and guidance for evaluating soil vapor intrusion (SVI) decision matrices (NYSDOH 2024).

For VOCs in groundwater, a RL goal range of 0.5 to 1.0 µg/L has been established for the contaminants of concern, identified as those VOCs which were reported to have exceeded criteria in the scope of work; specifically, trichloroethene (TCE), tetrachloroethene (PCE), cis-1,2-dichloroethene, and vinyl chloride.

Reporting limit goals for SVI samples range from 0.2 to 10 ug/m^3. The minimum RLs for those VOCs specified by the NYSDOH in their decision matrices (A to F) must be met at the non-detect level.

4.2.2 Precision

The laboratory objective for precision is to equal or exceed the precision demonstrated for the applied analytical methods on similar samples. Precision is evaluated by the analyses of laboratory and field duplicates. Matrix spike duplicate analyses will be performed once for every 20 samples for VOCs.

Relative Percent Difference (RPD) criteria determined from laboratory performance data are used to evaluate precision between duplicates. A matrix spike duplicate will be performed once for every 20 samples for volatile organics.

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. Precision is usually stated in terms of standard deviation but other estimates such as the coefficient of variation, relative standard deviation, range (maximum value minus minimum value), and relative range are common, and may be used pending review of the data.

The overall precision of measurement data is a mixture of sampling and analytical factors. Analytical precision is easier to control and quantify than sampling precision; there are more historical data related to individual method performance and the "universe" is not limited to the samples received in the laboratory. In contrast, sampling precision is unique to each site or project.

Overall system (sampling plus analytical) precision will be determined by analysis of field duplicate samples. Analytical results from laboratory duplicate samples will provide data on measurement (analytical) precision.

Precision will be determined from field duplicates, as well as laboratory matrix spikes and matrix spike duplicates for organic analyses; it will be expressed as the RPD:

$$RPD = 100 \times 2(|X_1 - X_2|) / (X_1 + X_2)$$

where:

X_1 and X_2 are reported concentrations for each duplicate sample and subtracted differences represent absolute values.

Criteria for evaluation of laboratory duplicates are specified in the applicable methods. The objective for field duplicate precision for groundwater is ≤ 30% RPD (≤ 50% for air samples) for analytes detected at concentrations at least 2 times the RL. Where one or both analytes are detected at less than 2 times the RL, the criterion is the absolute difference "D" ($X_1 - X_2$), and D should be less than the RL for the analyte.

4.2.3 Accuracy

The laboratory objective for accuracy is to equal or exceed the accuracy demonstrated for the applied analytical method on similar samples. Percent method recovery criteria and those determined from laboratory performance data, are used to evaluate accuracy in matrix (sample) spike and blank spike

quality control samples. A matrix spike and blank spike or laboratory control will be performed once for every analytical batch or as specified in the methods. Other method-specific laboratory QC samples (such as continuing calibration standards) may also be used in the assessment of analytical accuracy. Sample (matrix) spike recovery is calculated as:

% Recovery = 100 × (SSR-SR)/SA

Where:

SSR = Spiked sample Result

SR = Sample Result, and

SA = Spike Added

Accuracy measures the bias in a measurement system. It is difficult to measure accuracy for the entire data collection activity. Accuracy will be assessed through use of known QC samples. Accuracy values can be presented in a variety of ways. For projects under this NYSDEC contract, accuracy will be normally presented as percent recovery.

Routine organic analytical protocol requires a surrogate spike in each sample. Surrogate recovery will be defined as:

% Recovery = (R/S) x 100

Where:

S = surrogate spike concentration

R = reported surrogate compound concentration

Recovery criteria for laboratory spikes and other laboratory QC samples through which accuracy may be evaluated are established in the applicable analytical method.

4.2.4 Representativeness

The representativeness of data is only as good as the representativeness of the samples collected. Sampling and handling procedures, and laboratory practices are designed to provide a standard set of performance-driven criteria to provide data of the same quality as other analyses of similar matrices using the same methods under similar conditions. Representativeness will be determined by a comparison of the quality controls for these samples against data from similar samples analyzed at the same time.

4.2.5 Comparability

Comparability of analytical data among laboratories becomes more accurate and reliable when all labs follow the same procedure and share information for program enhancement. Some of these procedures include:

- Instrument standards traceable to National Institute of Standards and Technology (NIST), the US Environmental Protection Agency (USEPA), or the New York State Departments of Health or Environmental Conservation;
- Using standard methodologies;
- Reporting results for similar matrices in consistent units;
- Applying appropriate levels of quality control within the context of the laboratory quality assurance program; and,
- Participation in inter-laboratory studies to document laboratory performance.

By using traceable standards and standard methods, the analytical results can be compared to other labs operating similarly. The QA Program documents internal performance. Periodic laboratory proficiency studies are instituted as a means of monitoring intra-laboratory performance.

Comparability within any specific project is also assessed by comparison of the project data to data generated previously; and, if available, comparison of the data for multiple sampling events conducted for the project. Comparability (consistency) of sampling techniques is also assessed, to some extent, by analysis of field duplicates; although it should be noted that large differences between field duplicates may result from a wide variety of causes, not just inconsistent sampling.

4.2.6 Completeness

The goal of completeness is to generate the maximum amount possible of valid data for all planned samples. Completeness of 100 percent indicates that all planned samples were collected; and the resultant data were fully valid and acceptable. As completeness is a function of both field activities and laboratory activities, separate completeness goals are established for each.

The default goal for sampling completeness is 95 percent, as is calculated as

Sampling Completeness (%) = (Sc/Sp) × 100

Where:

Sc = Samples collected (submitted) for analysis (documented from field records or COC)

Sp = Samples planned (as documented in the FAP or QAPP)

The default goal for analytical completeness is also set at 95 percent. Analytical completeness may be less than 100 percent either due to systemic failures that result in the rejection or loss of data for an entire sample; or compound-specific rejection (e.g., 2-hexanone) within an otherwise valid analysis.

For typical work assignments, the default overall completeness goal is 90 percent usable data. The impact of rejected or unusable data will be made on a case-by-case basis. If the goals of the project can be achieved without the missing datum or data, or if data from a different sampling event can be used to fill the data gap, no further action would be necessary. However, loss of critical data may require resampling or reanalysis.

4.3 FIELD QUALITY ASSURANCE

Blank water generated for use during this project must be “demonstrated analyte-free.” The criteria for analyte-free water are based on the USEPA-assigned values for the Contract Required Quantitation Limits (CRQLs) for CLP analyses, or the RL for SW-846 or other EPA methods.

However, specifically for the common laboratory contaminants (acetone and 2-butanone), the allowable limits are five times the CRQL (or RL). For methylene chloride, the limit is 2.5 times the CRQL. For common SVOC contaminants (phthalate esters such as bis(2-ethylhexyl) phthalate), the limit is 5 times the CRQL.

The analytical testing required for the water to be demonstrated as analyte-free must be performed prior to the start of sample collection; thus, blank water will be supplied by the laboratory.

Table 2 of this QAPP shows typical QA/QC samples and RLs. QA/QC samples are discussed below.

4.3.1 Field Equipment (Rinsate) Blanks

Equipment blanks consist of demonstrated, analyte-free water that show if sampling equipment has the potential for contaminant carryover to give a false impression of contamination in an environmental sample. When blank water is used to rinse a piece of sampling equipment (before it is used to sample), the rinsate is collected and analyzed to see if sampling could be biased by contamination from the equipment.

Rinsate blanks are not required when samples are collected directly into laboratory-provided sample containers (e.g., if specified as such in the FAP for matrices such as surface water or leachate seeps).

Field Equipment (Rinsate) blanks for bailers: For initial sampling, as well as at subsequent rounds of sampling when bailers are reused, at least one of the bailers used per decontamination batch, will be used to generate equipment (rinsate) blanks during groundwater sampling. Disposable bailers will be obtained from a single vendor for this project. One rinsate blank will be collected for each groundwater

sampling event to verify that the vendor decontamination was adequate, and that contamination has not occurred during shipment and storage.

Typically, one rinsate blank will be collected for every 20 field samples collected or one per week, whichever is more frequent, for each type of sampling equipment. The rinsate blanks will be collected from the groundwater sampling equipment.

Equipment blanks are not collected or submitted in association with SVI (Summa® canister) samples.

4.3.2 Field Duplicate Samples

Field duplicate samples are used to assess the variability of a matrix at a specific sampling point and to assess the reproducibility of the sampling method.

Aqueous field duplicate samples are second samples collected from the same location, at the same time, in the same manner as the first, and placed into a separate container (technically, these are co-located samples). Each duplicate sample will be analyzed for the same parameters as the original sample collected that day.

SVI field duplicates are typically collected by utilizing a “T” fitting on the sample line and splitting the air between two Summa® canisters of the same size and set to the same flow rate.

The default field duplicate precision (RPD) objective for groundwater is ≤30% percent RPD (≤50% percent RPD for SVI samples) where the sample concentration is at least two times the RL. Where the analyte is detected in both samples, but the concentration is less than 2 times the RL, precision is assessed by the absolute difference, which should be less than the RL. The RPD is not calculable when the analyte is not detected in one or both analyses. A more detailed discussion of the calculation is provided in Section 4.2.2 (Precision), above.

Field duplicates will be collected at a frequency of one per 20 groundwater samples. The default field duplicate frequency for SVI samples is 10 percent (one per 10 environmental samples).

4.3.3 Split Samples

Split samples are used for performance audits or inter-laboratory comparability of data. Split samples may also be generated if a site owner or PRP requests them. A split sample will be defined as at least two separate sub-samples taken from a single original sample which has been thoroughly mixed or homogenized prior to the formation of the split samples. The exception to this is samples for volatile organics analysis which will not be homogenized. Collection of split samples may be conducted only when specifically requested by NYSDEC.

4.3.4 Trip Blanks

The purpose of a VOC trip blank (using demonstrated analyte-free water) is to place a mechanism of control on sample bottle preparation and blank water quality, and sample handling. The trip blank travels from the lab to the site with the empty sample bottles and back from the site with the collected samples. There will be a minimum of one trip blank per shipment containing aqueous samples for VOC analysis.

Trip blanks will be collected only when aqueous volatile organics are being sampled and shipped; except that a trip blank is not required when the only aqueous samples in a shipment are QC samples (rinsate blanks).

4.3.5 Temperature Blanks

The laboratory will use either an infrared instrument to measure the temperature of liquid samples, or a temperature blank will be used to measure the temperature of liquid samples. If used, temperature blanks will be supplied by the analytical laboratory. If multiple coolers are necessary to store and transport aqueous samples, then each cooler will contain an individual temperature blank (if used).

4.4 FIELD TESTING QC

Field testing of groundwater will be performed during purging of wells prior to sampling for laboratory samples. Field QC checks of control limits for pH, specific conductance (conductivity), dissolved oxygen, reduction/oxidation potential, and turbidity are detailed below. The calibration frequencies discussed below are the minimum. Field personnel can and should check calibration more frequently in adverse conditions, if anomalous readings are obtained, or subjective observations of instrument performance suggest the possibility of erroneous readings. Calibration logs for the instruments discussed below will be provided in the work plan or FAP.

4.4.1 pH Meter

The pH meter is calibrated daily, using two standards bracketing the range of interest (generally 4.0 and 7.0). If the pH QC control sample (a pH buffer, which may be the same or different than those used to initially calibrate the instrument) exceeds 0.1 pH units from the true value, the source of the error will be determined and the instrument recalibrated. If a continuing calibration check with pH 7.0 buffer is off by more than 0.1 pH units, the instrument will be recalibrated. Expired buffer solutions will not be used.

Note that gel-type probes take longer to equilibrate (up to 15 minutes at near-freezing temperatures); this must be taken into account in calibrating the instrument and reading samples and standards.

4.4.2 Specific Conductivity

A vendor-provided conductivity standard will be used to check the calibration of the conductivity meter daily. Specific conductance QC samples will be on the order of 0.01 or 0.1 molar potassium chloride (KCl) solutions in accordance with manufacturer's recommendations.

4.4.3 Dissolved Oxygen

A vendor-provided dissolved oxygen standard will be used to check the calibration of the dissolved oxygen meter in accordance with manufacturer's recommendations. Dissolved oxygen will be measured in milligram per liter (mg/L).

4.4.4 Reduction/Oxidation Potential

A vendor-provided reduction/oxidation potential standard will be used to check the calibration of the reduction/oxidation potential meter in accordance with manufacturer's recommendations. Reduction/ oxidation potential will be measured in millivolts (mV).

4.4.5 Turbidity

The turbidity meter should be calibrated using a standard as close as possible to 50 NTU (the critical value for determining effectiveness of well development and evacuation). The turbidimeter will be checked daily. The turbidity QC sample will be a commercially prepared polymer standard (Advanced Polymer System, Inc., or similar).

4.4.6 Temperature

Temperature probes associated with instruments (such as the YSI SCT-33 conductivity and temperature meter) are not subject to field calibration, but the calibration should be checked to monitor instrument performance. It is recommended that the instrument temperature reading be checked against a NIST-traceable thermometer concurrently with checking the conductivity calibration. The instrument manual will be referenced for corrective actions if accurate readings cannot be obtained.

4.5 LABORATORY QUALITY ASSURANCE

4.5.1 Method Blanks

A method blank is laboratory water on which every step of the method is performed and analyzed along with the samples. Method blanks are used to assess the background variability of the method and to assess the introduction of contamination to the samples by the method, technique, or

instruments as the sample is prepared and analyzed in the laboratory. Method blanks will be analyzed at a frequency of one for every twenty samples analyzed or as otherwise specified in the analytical protocol.

4.5.2 Laboratory Duplicates

Laboratory duplicates are sub-samples taken from a single aliquot of sample after the sample has been thoroughly mixed or homogenized (except for volatile organics), to assess the precision or reproducibility of the analytical method on a sample of a particular matrix. Laboratory duplicates will be performed on spiked samples as a matrix spike and a matrix spike duplicate (MS/MSD) for volatile organics.

4.5.3 Spiked Samples

Two types of spiked samples will be prepared and analyzed as quality controls: matrix spikes and matrix spike duplicates (MS/MSD), which are analyzed to evaluate instrument and method performance and performance on samples of similar matrix. MS/MSD samples will be analyzed at a frequency of one (pair) for every 20 samples. In addition, matrix spike blanks (MSBs) may also be prepared and analyzed by the laboratory as required by NYSDEC ASP.

4.5.4 Laboratory Control Sample

A fortified clean matrix (laboratory control sample, or LCS) is analyzed with each analysis. In some cases, a “Laboratory-Fortified Blank” (LFB) may serve as the LCS. These samples generally consist of a standard aqueous or solid matrix fortified with the analytes of interest for single-analyte methods and selected analytes for multi-analyte methods according to the appropriate analytical method. The LCS may be analyzed in duplicate for some methods (LCSD). The analyte recovery from each analysis (LCS and LCSD) is used to monitor analytical accuracy; analytical precision can be assessed from evaluation of the LCS/LCSD in the same manner as the MS/MSD.

5.0 FIELD DATA DOCUMENTATION

Field reporting documentation, including field logbooks and field data reporting forms, is discussed in FAP Section 10; therefore, it is not repeated here.

6.0 EQUIPMENT CALIBRATION AND MAINTENANCE

Quality assurance for instrumentation and equipment used for a project is controlled by a formal calibration program, which verifies that equipment is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. Instruments and equipment that measure a quantity, or whose performance is expected at a stated level, are subject to calibration. Calibration is performed using reference standards or externally by calibration agencies or equipment manufacturers.

6.1 STANDARD WATER AND AIR QUALITY FIELD EQUIPMENT

Field equipment used during the collection of environmental samples typically includes a turbidimeter (turbidity per EPA Method 180.1), pH meter (pH per EPA Method 150.1), conductivity meter (specific conductance per EPA Method 120.1), dissolved oxygen meter, reduction/oxidation potential meter, thermometer, and photoionization detector. See Section 4.4 of this QAPP for additional discussion.

The organic vapor analyzer (MultiRAE, or equivalent organic vapor analyzer) used for soil screening and health and safety air monitoring will be calibrated following the manufacturer's instructions, at the beginning of the day, whenever the instrument is shut off for more than two hours, and at the field technician's discretion.

6.2 LABORATORY EQUIPMENT CALIBRATION

Laboratory equipment will be calibrated according to the method-specific requirements, and maintained following professional judgment and the manufacturer's specifications, and additional requirements as specified in the ELAP certification manual.

6.2.1 Analytical Support Areas

Prior to generating quality data, several analytical support areas must be considered:

Standard/Reagent Preparation - Primary reference standards and secondary standard solutions shall be obtained from sources traceable to National Institute of Standards and Technology, or other reliable commercial sources to ensure the highest purity possible. The preparation and maintenance of standards and reagents will be accomplished as per the referenced methods. All standards and standard solutions are to be formally documented (i.e., in a bound logbook) and should identify the supplier, lot number, purity/concentration, receipt/preparation date, preparer's name, method of preparation, expiration date, and any other pertinent information. All standard solutions shall be validated prior to use. Care shall be exercised in the proper storage and handling of standard solutions (e.g., separating volatile standards from nonvolatile standards). The laboratory shall continually monitor the quality of the standards and reagents through well-documented procedures.

Balances - The analytical balances shall be calibrated and maintained in accordance with manufacture specifications. Calibration is conducted with two American Society of Testing Materials Class 1 weights that bracket the expected balance use range. The laboratory shall check the accuracy of the balances daily and properly document results in permanently bound logbooks.

Refrigerators/Freezers - The temperature of the refrigerators and freezers within the laboratory shall be monitored and recorded daily. This will verify that the quality of the standards and reagents is not compromised and the integrity of the analytical samples is upheld. Appropriate acceptance ranges (e.g., 4°C ± 2°C for refrigerators) shall be clearly posted on each unit in service.

Water Supply System – Laboratories performing water/solid/waste sample analyses must maintain a sufficient supply of analyte-free water for all project needs. The grade of the water must be of the highest quality in order to eliminate false-positives from the analytical results. Ultraviolet cartridges or carbon absorption treatments are recommended for organic analyses, and ion-exchange treatment is recommended for inorganic tests. Appropriate documentation of the quality of the water supply system(s) will be performed on a regular basis by the laboratory.

Air Supply System – Laboratories performing air/soil vapor sample analyses must maintain a sufficient supply of analyte-free air for all project needs. The grade of air must be of the highest quality in order

to eliminate false-positives from the analytical results. Appropriate documentation of the quality of the air supply system(s) will be performed on a regular basis by the laboratory.

6.2.2 Calibration Procedure

Written procedures are used for all instruments and equipment subject to calibration. For chemical analyses typically performed for these contracts, the calibration procedures are specified in the methods. If established procedures are not available, a procedure is developed considering the type of equipment, stability characteristics of the equipment, required accuracy, and the effect of operational error on the quantities measured.

6.2.3 Calibration Frequency

Calibration frequency is based on the type of equipment, inherent stability, manufacturer's recommendations, values provided in recognized standards, intended data use, specified analytical methods, effect of error upon the measurement process, and prior experience.

6.2.4 Calibration Reference Standards

Two types of reference standards will be used by the standby laboratories for calibration:

Physical standards, such as weights for calibrating balances and certified thermometers for calibrating working thermometers, refrigerators and ovens, are generally used for periodic calibration.

Chemical standards, such as Standard Reference Materials (SRMs) provided by the National Institute of Standards and Technology (NIST) or USEPA, may also include vendor-certified materials traceable to NIST or USEPA SRMs. These are primarily used for operational calibration.

6.2.5 Calibration Failure

Equipment that cannot be calibrated or becomes inoperable is removed from service. Such equipment must be repaired and satisfactorily recalibrated before re-use. For laboratory equipment that fails calibration, analysis cannot proceed until appropriate corrective action is taken and the analyst achieves an acceptable calibration.

Laboratory managers are responsible for development and implementation of a contingency plan for major equipment failure. The plan includes guidelines on waiting for repairs, use of other instrumentation, subcontracting analyses, and evaluating scheduled priorities.

6.2.6 Calibration Records

Records are prepared and maintained for each piece of equipment subject to calibration. Records demonstrating accuracy of preparation, stability, and proof of continuity of reference standards are also maintained. Copies of the raw calibration data are kept with the analytical sample data.

6.3 OPERATIONAL CALIBRATION

Operational calibration is generally performed as part of the analytical procedure and refers to those operations in which instrument response (in its broadest interpretation) is related to analyte concentration. Included are the preparation of a standard response (calibration) curve and often the analysis of blanks.

Preparation of a standard calibration curve is accomplished by the analysis of calibration standards, which are prepared by adding the analyte(s) of interest to the solvent that is introduced into the instrument. The concentrations of the calibration standards are chosen to cover the working range of the instrument or method. For most methods, five calibration standards are used, with the concentration of the lowest calibration standard being the reporting or quantitation limit for that analysis. Sample measurements are made and reported within this working range; apparent concentrations which exceed the high end of the calibrated range ("E"-flagged data for organic analyses) are diluted (or a smaller sample is used) and re-analyzed. The calibration curve is prepared by plotting or performing a linear regression of the instrument responses against the analyte concentration.

7.0 DATA REDUCTION, VALIDATION, AND REPORTING

The guidance followed to perform quality data validation, and the methods and procedures outlined herein and elsewhere in the SCWP, pertain to initiating and performing data validation, as well as reviewing data validation performed by others (if applicable). An outline of the data validation process is presented here, followed by a description of data validation review summaries.

7.1 LABORATORY DATA REPORTING AND REDUCTION

Data reduction is the process by which raw analytical data generated from laboratory instrument systems is converted into usable concentrations. The raw data, which may take the form of area counts, instrument responses, or observations, are processed by the laboratory and converted into concentrations expressed in the parts per million (milligrams per kilogram [mg/kg] or milligrams per liter [mg/L]), parts per billion (micrograms per kilogram [µg/kg], micrograms per liter [µg/L], or nanograms per gram [ng/g]), or parts per trillion (ng/L) range. Raw data from these systems include compound identifications, concentrations, retention times, and data system print-outs. Raw data are usually reported in graphic form, bar graph form, or tabular form. The laboratory will follow standard operating procedures consistent with the data handling requirements of the applicable methods.

The laboratory will meet the applicable documentation, data reduction, and reporting protocols as specified in the 2005 revision of the NYSDEC ASP. ASP Deliverables are either Category B (full deliverables; similar to USEPA CLP requirements) or Category A (a reduced deliverable level). For this contract, Category B deliverables are the default and will be provided for all deliverables generated under the contract unless explicitly indicated otherwise on a site-specific basis. Laboratory data reports will conform to NYSDEC Category B deliverable requirements, as specified in Exhibit B, Part II.E, Sections 2 and 3, respectively. Laboratory data reports for waste characterization samples will conform to Category A requirements.

Copies of the laboratory's generic Quality Assurance Management Plan (QAMP, as defined in ASP 2005 Exhibit E, Part I) will be maintained at NYSDEC's principal contact office (Albany, NY). The laboratory's QAMP will indicate the standard methods and practices for obtaining and assessing data, and how data are reduced from the analytical instruments to a finished report, indicating levels of review along the way.

To meet NYSDEC electronic data deliverable (EDD) requirements, laboratories subcontracted by NYSDEC for this work will be required to submit electronic deliverables in an EQuIS 4-file format consistent with NYSDEC standards. AECOM's database manager will be responsible verifying that the file submitted meets these specifications including verifying that current NYSDEC Valid Values were used for sample coding; providing an Excel (or Access) file to the data validator; uploading the validated data into the database; overseeing the uploading of any other data (field data, boring log information, etc.) and submitting a final EQuIS deliverable to NYSDEC that meets NYSDEC EDD requirements.

In addition to the hard copy of the data report, the laboratory will be asked to provide the sample data in spreadsheet form (submitted electronically). The data spreadsheet will be generated to the extent possible directly from the laboratory's electronic files or information management system to minimize possible transcription errors resulting from the manual transcription of data.

7.2 DATA VALIDATION

Data generated for this work assignment will be validated (i.e., USEPA Level 3 or Stage 3) by AECOM. The AECOM validator will follow guidelines established in the USEPA Region 2 SOPs applicable to the analytical method(s) being reviewed. These SOPs are checklists which are designed to formally and rigorously assess the quality and completeness of SW-846 and SVI sample TO-15-SIM analysis data packages. The use of these USEPA SOPs will be adapted to conform to the specific requirements of the analytical methods (e.g., holding times; matrix spike blank requirements). Where necessary and appropriate, supplemental validation criteria may be derived from the EPA

Functional Guidelines (USEPA National Functional Guidelines for Organic Superfund Methods Data Review, EPA-540-R-20-005, November 2020).

As discussed in the Standby Contract (D009803 – Attachment 1, Work Element V), a DUSR provides a thorough evaluation (i.e., USEPA Level 3 or Stage 3) of analytical data without the costly and time-consuming process of third-party validation. The primary objective of a DUSR is to determine whether the data, as presented, meets the site-specific criteria for data quality and data use. Appendix 2B of NYSDEC's DER-10 provides guidance on data deliverables and development of a DUSR.

Validation reports and DUSRs will consist of text results of the review and marked up copies of Form I (results with qualifiers applied by the validator). Validation will consist of target and non-target compounds with corresponding method blank data, spike and surrogate recoveries, sample data, and a final note of validation decision or qualification, along with any pertinent footnote references. Qualifiers applied to the data will be documented in the report text. Where QC failures caused the laboratory to perform a re-analysis, the data validator will make a recommendation as to which of the two analyses should be used. Data review will also include an assessment of sensitivity (i.e., are RLs appropriate to determine if contaminants are present at or above action levels or other applicable threshold values).

There may be some analyses for which there are no established USEPA or NYSDEC data validation protocol. In such cases, validation will be based on the Region 2 SOPs and EPA Functional Guidelines as much as possible, as well as the laboratory's adherence to the technical requirements of the method, and the professional judgment of the validator. The degree of rigor in such validation will correspond to the nature of the data and the significance of the data and its intended use.

7.3 DATA USABILITY

Subsequent to review of the items evaluated in the AECOM data validator reports (DUSRs) and accompanying tables, AECOM's QA staff then prepares a brief data usability summary. The data usability summary, which will be provided as part of the project report, encompasses both quantitative and qualitative aspects, although the qualitative element is the most significant.

The quantitative aspect is a summary of the data quality as expressed by qualifiers applied to the data; the percent rejected, qualified (i.e., estimated), missing, and fully acceptable data are reported. As appropriate, this quantitative summary is broken down by matrix, laboratory, or analytical fraction or method.

The qualitative element of the data usability summary is the QA Chemists translation and summary of the validation reports into a discussion useful to data users. The qualitative aspect will discuss the significance of the qualifications applied to the data, especially in terms of those most relevant to the intended use of the data. The usability report will also indicate whether there is a suspected bias (high or low) in qualified data and will also provide a subjective overall assessment of the data quality.

If similar analyses are performed by more than one method, a discussion of the extent of agreement among the various methods will be included, as well as discussion of any discrepancies among the data sets.

The QA Chemist will also indicate if there is a technical basis for selecting one data type over another for multiple measurements which are not in agreement.

Data which has not been validated (i.e., solid/aqueous waste characterization) and field data used for the project will be discussed in the data usability summary, including any limitations on the use of such data.

7.4 FIELD DATA VERIFICATION

Field personnel will record all field data in bound field logbooks and on standard forms. After checking the validity of the data in the field notes, the Project Manager or his/her designee will reduce the data to tabular form, when possible, by entering the data into data files. Where appropriate, the data files will be set up for direct input into the project database. Subjective data will be filed as hard copies for later review by the Project Manager and incorporation into technical reports, as appropriate.

Verification of field data will be performed at two different levels. The first level of data verification will be performed at the time of collection by following standard procedures and QC checks. The second level of review consists of the Project Manager, Task Manager, or other competent personnel, reviewing the data to confirm that the correct codes and units have been included. After data reduction into tables and arrays is complete, the Site Manager will review data sets for anomalous values. The Project Manager, who will review field reports for reasonableness and completeness, will validate subjective field and technical data.

8.0 PERFORMANCE AND SYSTEM AUDITS

Audits are systematic checks to determine the quality of operation of some activity or function in the field or laboratory. Field audits are conducted to verify adherence to proper field and sampling procedures. Audits are of two types, as described below.

- Performance audits are independent safety and health, procedure, and/or sample checks made by a supervisor or auditor to arrive at a quantitative measure of the quality of the data produced by one section or the entire measurement process.
- System audits are onsite qualitative inspections and reviews of the QA system used by some part of or the entire measurement system. The audits are performed against the QAPP. A checklist is typically generated from the requirements and becomes the basis for the audit. The results of any deficiencies noted during the audit are summarized in an audit report.

Laboratory performance and system audits are performed by the laboratory's QA staff to assess the effectiveness of the quality system. These internal audits are performed on a routine basis. Audits are also performed by certifying agencies. Audit reports and corrective actions are available to NYSDEC for review.

8.1 RESPONSIBILITY, AUTHORITY, AND TIMING

QA audits to be conducted for the project may include system, performance, and data audits. The Project QA Officer will keep a tentative schedule on record that details the number and types of audits.

8.2 FIELD AUDITS

The need for field audits will be determined on a project-specific basis as required by the WA or in the approved work plans for the project. Not all the aspects listed below will be necessary or appropriate for projects for which field audits are specified.

Field performance audits, if specified, will be conducted during the project as field data are generated, reduced, and analyzed. Numerical manipulations, including manual calculations, will be documented. Records of numerical analyses will be legible, of reproduction quality, and sufficiently complete to permit logical reconstruction by a qualified individual other than the originator.

Indicators of the level of field performance include the analytical results of the blank and replicate samples. Each blank analysis will be considered an indirect audit of the effectiveness of measures taken in the field to maintain sample integrity (e.g., field decontamination procedures).

The results of the field replicate analyses are an indirect audit of the ability of each field team to collect representative sample portions of each matrix type.

System audits of site activities will be accomplished by an inspection of all field site activities. During this audit, the auditor(s) will compare current field practices with standard procedures. The following elements will be evaluated during a field system audit:

- Field activities conducted in substantial compliance with the SCWP and FAP;
- Procedures and analyses conducted according to procedures outlined in the QAPP;
- Sample documentation;
- Working order of instruments and equipment;
- Level of QA conducted by field personnel;
- Contingency plans in case of equipment failure or other event preventing the planned activity from proceeding;
- Decontamination procedures;

- Level of efficiency with which each team conducts planned activities at one site and proceeds to the next; and,
- Sample packaging and shipment.

After completion of the audit, any deficiencies will be discussed with the field staff and corrections identified. If any of these deficiencies could affect the integrity of the samples being collected, the auditor(s) will inform the field staff and corrections will be implemented immediately. The audit will be performed by the Project QA/QC Coordinator or the Site Manager.

8.3 LABORATORY PERFORMANCE AND SYSTEM AUDITS

As part of the laboratory subcontractor procurement process under the AECOM/NYSDEC Standby Engineering Contract, the laboratory assigned to this project, Pace Analytical Services, is certified by the NYSDOH Environmental Laboratory Approval Program for the matrices and analytical protocols to be used. Therefore, no project-specific audit of the laboratory(s) will be performed unless warranted by a problem(s) that cannot be resolved by any other means, or at the discretion of AECOM and NYSDEC.

8.4 AUDIT PROCEDURES

Prior to an audit, the designated lead auditor prepares an audit checklist. During an audit and upon its completion, the auditor(s) will discuss the findings with the individuals audited and discuss and agree on corrective actions to be initiated. The auditor will then prepare and submit an audit report to the manager of the audited group and the project manager.

The manager of the audited group will then prepare and submit, to the Project QA Officer and the Project Manager, a plan for implementing the corrective action to be taken on non-conformances indicated in the audit report, the date by which such corrective action will be completed, and actions taken to prevent reoccurrence. If the corrective action has been completed, supporting documentation should be attached to the reply. The auditor will ascertain (by re-audit or other means) if appropriate and timely corrective action has been implemented.

Records of audits will be maintained in the project files.

8.5 AUDIT DOCUMENTATION

A checklist will be completed during each audit so that the previously defined scope of the individual audits is accomplished and that the audits follow established procedures. The checklist will detail the activities to be executed as part of the auditing plan. Audit checklists will be prepared in advance and will be available for review. Following each system, performance, and data audit, the auditor or QAO will prepare a report to document the findings of the specific audit.

9.0 CORRECTIVE ACTIONS

If instrument performance or data fall outside acceptable limits, then corrective actions will be taken. These actions may include recalibration or standardization of instruments, acquiring new standards, replacing equipment, repairing equipment, and reanalyzing samples or redoing sections of work.

Subcontractors providing analytical services should perform their own internal laboratory audits and calibration procedures with data review conducted at a frequency so that errors and problems are detected early, thus avoiding the prospect of redoing large segments of work.

Situations related to this project requiring corrective action will be documented and made part of the project file. For each measurement system identified requiring corrective action, the responsible individual for initiating the corrective action and the individual responsible for approving the corrective action, if necessary, will be identified.

As part of its quality management system (QMS) program, AECOM provides relevant excerpts and conclusions from data validation reports to the analytical laboratories. The laboratories are therefore made aware of non-critical items and areas where improvement may be made in subsequent NYSDEC ASP work.

The objectives of the corrective action procedures presented below are to ensure that recognized errors in performance of sample and data acquisition lead to effective remedial measures and that those steps are documented to provide assurance that any data quality deficiencies are recognized in later interpretation and are not recurrent.

9.1 RATIONALE

Many times, corrective measures are undertaken in a timely and effective fashion but go undocumented. In other cases, corrective actions are of a complex nature and may require scheduled interactions between departmental groups. In either case, documentation in a formal or informal sense can reinforce the effectiveness and duration of the corrective measures taken.

9.2 CORRECTIVE ACTION METHODS

9.2.1 Immediate Corrective Actions

Immediate corrective actions are of a minor or routine nature such as correcting malfunctioning equipment, correction of data transcription errors, and other such activities routinely made in the field, laboratory, or office by technicians, analysts, and other project staff.

9.2.2 Long-Term Corrective Actions

Long-term corrective action will be used to identify and eliminate causes of non-conformance which are of a complex nature and that are formally reported between management groups.

9.2.3 Corrective Action Steps

For long-term corrective actions, steps comprising closed-loop corrective action system are as follows:

- Define the problem
- Assign responsibility for investigating the problem
- Investigate and determine the cause of the problem
- Determine a corrective action to eliminate the problem
- Assign and accept responsibility for implementing corrective action

Verify that the corrective action has eliminated the problem.

Non-conformance events associated with analytical work are documented by the laboratories' Non-Conformance Records, which are reviewed and approved by the laboratory's Quality Assurance Manager.

9.2.4 Audit-Based Non-Conformances

Following audits, corrective action is initiated by documenting the audit finding and recommended corrective action on an Audit Finding Report.

9.3 CORRECTIVE ACTION REPORT REVIEW AND FILING

Immediate and long-term corrective actions require review to ensure that, during the time of non-conformance, erroneous data were not generated or that, if possible, correct data were acquired instead. Such confirmation and review are the responsibility of the supervisor of the staff implementing the corrective action. Confirmation will be acknowledged by notation and dated signature on the affected data record or appropriate form or by memorandum to the AECOM QAO and Project Manager.

10.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Fundamental to the success of this QA/QC is the active participation of the Project Manager and the Project QA Officer. The Program QA Officer will be advised of project activities and will participate in development, review, and operation of the project. Project management will be informed of QA activities through the receipt, review, and/or approval of:

- Project-specific QA project plans
- Corporate and project-specific QA/QC plans and procedures
- Corrective action notices
- Non-conformance records.

Periodic assessment of field and laboratory QA/QC activities and data accuracy, precision, and completeness will be conducted and reported by the laboratory. Items to be included in the QA reports are the summary of results for the performance or the system audit and where applicable:

- Assessment of adherence to work scope and schedule for the audited task
- Assessment of the precision, accuracy, and completeness of sample batches and subsequent status of data processing and analyses
- Significant QC problems and the status of any ongoing corrective actions
- Changes to the site-specific Work Plan
- Status of implementation of the site-specific Work Plan.

Monthly project status reporting to NYSDEC will include aspects of quality control that were pertinent during the month’s activities. Problems revealed during review of the month’s activities will be documented and addressed. These reports will include a description of completed and on-going activities, and an indication how each task is progressing relative to the project schedule.

The Project Manager will be responsible for verifying that records and files related to the work assignment are stored appropriately and are retrievable.

The laboratory will submit any memoranda or correspondence related to quality control of this project's samples as part of its deliverables package.

11.0 REFERENCES

New York State Department of Environmental Conservation (NYSDEC), 2005. *Analytical Services Protocol (ASP) Manual*. July.

NYSDEC, 2008. *NYSDEC Modifications to EPA Region 9 TO-15 QA/QC Criteria provided in July 2005 ASP*. February 2008.

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NYSDOH, 2007. Letter from Gary Litwin (Director) to Dale Desnoyers (NYSDEC DER) re: Soil Vapor/Indoor Air Matrices. (Adds additional chlorinated VOCs to the original matrices in the 2006 SVI guidance). June 25.

USEPA Region 2, Standard Operating Procedures for Data Review. Available at http://www.epa.gov/region02/qa/documents.htm#sop. Accessed April 2026.

USEPA Region 2, 1998. *Ground Water Sampling Procedure – Low Stress (Low Flow) Purging and Sampling*. Final. March 16.

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USEPA, 1999. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air – Second Edition*. USEPA Center for Environmental Research Information. EPA/625/R-96/010b. January.

USEPA, 1986. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, Third edition. EPA SW-846. With revisions and updates through May 2026. Accessed online (at "SW-846 On-Line") May 2011 at http://www.epa.gov/epaoswer/hazwaste/test/main.htm

USEPA, 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. USEPA Office of Emergency and Remedial Response. OSWER Directive No. 355.3-01. October.

Tables

Table 1
Sample Container, Volume, Preservation, and Holding Time Summary
Quality Assurance Project Plan
Off-Site 91 Leighton Avenue (Site No. C828231A)

AECOM

Matrix / Analysis	Sample Prep Method [1]	Analytical Method [2]	Sample Containers [3]				Minimum Vol Rqd	Preservation [4]	Holding Time [4, 5]		Comment
			Mat'l	Size	Qty	Source			Extraction	Analysis	
Aqueous Samples											
Volatile Organic Compounds (VOCs)	SW-846 5030B	SW-846 8260D	G	40 mL	2 or 3	Lab	40 mL	HCl to pH ≤ 2	NA	14 days	7 days if not preserved to pH <2.
Soil Vapor Intrusion Samples											
Volatile Organics	NA	EPA TO-15-SIM	SS	6 L [6]	1	Lab	400 mL	None	NA	14 days	Summa® canister; certified clean by laboratory.
Solid Waste Charaterization Samples											
TCLP Volatile Organics	SW-846 1311/5030B	SW-846 8260D	G	8 oz	1	Lab	100 g	None	14 days (TCLP)	14 days	
TCLP Semivolatile Organics (SVOCs, Pesticides, Herbicides)	SW-846 1311/3510C/3511/3520C/3535A	SW-846 8270E/8081B/8151A	AG	8 oz [7]	1	Lab	100 g	None	14 days (TCLP), 7 days (Method)	40 days	
TCLP Metals (except mercury)	SW-846 1311/3005A/3010A/3015A	SW-846 6010D	G	"	"	Lab	100 g	None	180 days (TCLP)	180 days	
TCLP Mercury	SW-846 1311/per Analytical Method	SW-846 7470A	"	"	"	Lab	100 g	None	28 days (TCLP)	28 days	
PCBs	SW-846 3510C/3511/3520C/3535A	SW-846 8082A	AG	8 oz [7]	1	Lab	30 g	None	14 days	40 days	
Corrosivity (as pH)	per Analytical Method	SW-846 9045D	G	4 oz	1	Lab	10 g	None	NA	ASAP	
Reactive Cyanide	SW-846 Chp. 7.3	SW-846 9014	G	4 oz	1	Lab	50 g	None	NA	ASAP	
Reactive Sulfide	SW-846 Chp. 7.3	SW-846 9034	G	4 oz	1	Lab	50 g	None	NA	ASAP	
Ignitability	per Analytical Method	SW-846 1030	G	4 oz	1	Lab	50 g	None	NA	ASAP	
Aqueous Waste Charaterization Samples											
TCLP Volatile Organics	SW-846 1311/5030B	SW-846 8260D	G	100 mL	1	Lab	100 mL	None	14 days (TCLP)	14 days	
TCLP Semivolatile Organics (SVOCs, Pesticides, Herbicides)	SW-846 1311/3510C/3511/3520C/3535A	SW-846 8270E/8081B/8151A	AG	1 L [7]	1	Lab	2 L	None	14 days (TCLP), 7 days (Method)	40 days	
TCLP Metals (except mercury)	SW-846 1311/3005A/3010A/3015A	SW-846 6010D	P	"	"	Lab	"	None	180 days (TCLP)	180 days	
TCLP Mercury	SW-846 1311/per Analytical Method	SW-846 7470A	P	"	"	Lab	"	None	28 days (TCLP)	28 days	
PCBs	SW-846 3510C/3511/3520C/3535A	SW-846 8082A	AG	1 L [7]	1	Lab	1 L	None	7 days	40 days	
Corrosivity (as pH)	per Analytical Method	SW-846 9045D	G	100 mL	1	Lab	50 mL	None	NA	ASAP	
Reactive Cyanide	SW-846 Chp. 7.3	SW-846 9014	G	500 mL	1	Lab	500 mL	None	NA	ASAP	
Reactive Sulfide	SW-846 Chp. 7.3	SW-846 9034	G	250 mL	1	Lab	250 mL	None	NA	ASAP	
Ignitability	per Analytical Method	SW-846 1030	G	100 mL	1	Lab	100 mL	None	NA	ASAP	

Notes:
(1) Laboratory may propose alternate extraction/preparation methods, subject to NYSDOH ELAP certification and AECOM approval.
(2) More recent versions of analytical methods may be used subject to NYSDEC ELAP certification and AECOM approval.
(3) Certified clean sample containers shall be provided by the laboratory.
(4) All samples for chemical analysis should be held at 4 ± 2 degrees C in addition to any chemical preservation required.
(5) Holding time calculated from day of collection, unless noted as being from time of extraction.
(6) Smaller canisters (e.g., 1 L "mini-cans") may be substituted provided laboratory can meet reporting limits.
(7) Solid IDW: A single 8-oz sample (100 g) may be sufficient for TCLP SVOCs, pesticides, herbicides, and metals (including mercury) and PCBs; Aqueous IDW: 3 x 1 L for TCLP SVOCs, pesticides, herbicides, and metals (including mercury) and PCBs.
AG = Amber Glass
G = Glass
P = Plastic
SS = Stainless Steel
SW-846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. USEPA SW-846. Complete through Update VII, May 2026.

Table 2
Reporting Limits and QA/QC Sample Quantity Summary
Quality Assurance Project Plan
Off-Site 91 Leighton Avenue (Site No. C828231A)

AECOM

Matrix / Analysis	Analytical Method	Laboratory	Reporting Limit - Typical (units as specified)	Field Sample Quantity (1)	Matrix Spike (MS)	MS Duplicate or Matrix Duplicate	Field Duplicate	Equipment Blank (3)	Trip Blank	Total Billable Analyses
Aqueous Samples - Round 1										
Volatile Organic Compounds	SW-846 8260D	PACE	0.5 - 1.0 µg/L (typical)	4	1	1	1	1	1	9
Aqueous Samples - Round 2										
Volatile Organic Compounds	SW-846 8260D	PACE	0.5 - 1.0 µg/L (typical)	4	1	1	1	1	1	9
Soil Vapor Intrusion (SVI) Samples - November 15, 2026 to March 31, 2027										
Volatile Organic Compounds	TO-15-SIM	PACE	0.2 - 10 µg/m^3	13	NA (4)	NA (4)	2	NA	NA	15
Solid Waste Characterization Samples										
Full TCLP/RCRA Characterisics	SW-846 1311/8260D/8270E/ 8081B/8151A/6010D/7470A/ 9014/9034/9045D/1030	PACE	Analyte-specific	1	0	0	0	0	0	1
PCBs	SW-846 8082A	PACE	33 - 67 µg/kg (2)	1	0	0	0	0	0	1
Aqueous Waste Characterization Samples										
Full TCLP/RCRA Characterisics	SW-846 1311/8260D/8270E/ 8081B/8151A/6010D/7470A/ 9014/9034/9040B/1010	PACE	Analyte-specific	1	0	0	0	0	0	1
PCBs	SW-846 8082A	PACE	1.0 µg/L	1	0	0	0	0	0	1

Notes:
TAL = Target Analyte List (23 Metals)
TBD = To be determined. Laboratory services to be determined by NYSDEC Call-out subcontract.
(1) Estimated number of samples. QC quantities shown are typical requirements for each group of 20 or fewer field samples.
(2) Reporting limits for solid waste samples, when adjusted for dry weight, will be higher. Detections above the MDL but less than reporting limits will be reported and flagged estimated (J).
(3) Field equipment rinsate blank quantity will vary depending on sample collection rate and types of sampling equipment used; quantity may be greater or less than that shown. See RIWP or FAP.
(4) Matrix spikes and duplicates are not explicitly required by method TO-15-SIM, but may be included as part the laboratory's analytical QA program.

Appendix D – Green Remediation Best Management Practices: Site Investigation

Exported On: Aug 18, 2026

Project Name: **WA64: Leighton Ave SC** **Remediation Stage:** Investigation

Technologies: GW Monitoring

Note: *Browser pop-up blocker needs to be turned off to permit export & download.*

Sustainable Remediation BMP	Core Elements	Is Implemented?	Comments
Investigation and Sampling Analysis			
Contract with a laboratory that uses green practices **(EPA, 2022a)**.	Air; Energy; Land & Ecosystems; Materials & Waste; Water	Yes	Using NYSDEC call out lab Pace, who uses green practices.
Use drilling methods which minimized the generation and disposal of cuttings; specifically, direct-push technology – rather than a rotary auger or Rotasonic drill rig – was used to significantly reduce drilling time, avoid generating drilling fluids, and eliminate/reduce drill-cutting that would require characterization and disposal **(EPA, 2022a)**.	Air; Energy; Materials & Waste	Yes	DPT methods will be applied to overburden well installation. Bedrock wells will require rotary augers.
Procurement			
Use phosphate-free detergents instead of organic solvents or acids to decontaminate equipment not used directly for sample collection **(EPA, 2016a; EPA, 2019a)**.	Materials & Waste	Yes	Phosphate-free detergents will be utilized during decontamination.
Choose product manufacturers that use renewable energy-sourced electricity or maintain zero-carbon emission policies **(EPA, 2021b)**.	Materials & Waste; Water	Yes	Equipment suppliers use green practices.
Purchase materials in bulk to reduce packaging waste and minimize the fuel and air emissions associated with onsite deliveries and offsite purchases **(EPA, 2021b)**.	Materials & Waste; Water	Yes	Bulk materials will be ordered at the onset of the projects, where possible.
Choose service providers with local offices, to minimize the distance of worker commutes and machinery transport **(EPA, 2019a)**.	Land & Ecosystems; Materials & Waste; Water	Yes	Local services depots and subcontractors will be utilized.

References

U.S. Environmental Protection Agency (EPA), 2016a. Green Remediation Best Management Practices: Site Investigation and Environmental Monitoring. Office of Land and Emergency Management, EPA 542-F-16-002. [Online]. Available: https://www.clu-in.org/greenremediation/docs/GR_Fact_Sheet_SI&EM.pdf (Date accessed: 2025).

U.S. Environmental Protection Agency (EPA), 2019a. Green Remediation Best Management Practices: Excavation and Surface Restoration. Office of Land and Emergency Management, EPA 542-F-19-002. [Online]. Available: https://clu-

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U.S. Environmental Protection Agency (EPA), 2022a. Greener Cleanups Best Management Practices: PCB Cleanups. EPA 530-F-22-005. [Online]. Available: https://www.epa.gov/system/files/documents/2023-01/pcb-greener-cleanups-factsheet.pdf (Date accessed: 2025).

Form A
Summary of Green Remediation Metrics

Site Name: _____ Site Code: _____ Operable Unit: _____
Address: _____ City: _____
State: _____ Zip: _____ County: _____

Reporting Period
Contract Period From: _____To: _____
Reporting Period From: _____To: _____ Is this a Final Report? Yes ☐ No ☐

Contact Information
Preparer's Name: _____ Phone No.: _____
Preparer's Affiliation: _____ Company Code: _____
Contract No. _____

Materials & Waste Generation: Quantify the materials used or consumed and the management of waste generated on-site.

	Current Reporting Period (Include Units)	Total to Date (Include Units)
Materials Brought to the Site		
• Topsoil		
• Fill		
• Silt Fence		
• Silt Logs		
• Aggregate Base Course		
• Geotextile		
• Solidification Additives		
• Activated carbon		
• Other:		
• Other:		
• Other:		
• Other:		
• Other:		
• Other:		
• Other:		
Total Wastes Generated On-Site		
• Remedy Generated Waste		
• Contractor Generated Waste		
• Other:		
• Other:		
• Other:		
• Other:		
• Other:		
• Other:		
• Other:		

Provide a description of any implemented waste reduction programs appropriate for this project in the space provided on the certification page.

Recycled and Bio-Based Content in Imported Products and Materials: Quantify all materials and products imported to the site, including cost of materials/dollar values. Provide total percentages of recycled and bio-based of products and materials.

List Products and Materials Below	Total $ Value Provided	Total Percent of Recycled Content	Total Percent of Bio-based Content

Provide additional descriptions, as necessary, in the space provided on certification page.

Solid Waste Disposal and Diversion: Quantify all solid wastes generated, and indicate whether material was disposed or diverted for recycling or reuse.

Solid Waste Material	Date	Disposed or Diverted	Volume (Ton or CY)	Disposal/Recycling Facility Name	Comments (if not diverted, state why)
TSCA Contaminated Sediment					
Non-TSCA Contaminated Sediment					
Cleared Vegetation					
Spent Granular Activated Carbon					
Monitoring Well Removal Debris					
Other:					
Other:					
Other:					
Other:					
Other:					
Other:					

Provide descriptions in the space provided on the certification page of all wastes that were redirected for recycling or reuse. Indicate full names and addresses of facilities.

Energy Usage: Quantify the amount of energy used on-site and portion of that voluntarily derived from renewable energy sources.

	Current Reporting Period (KWh)	Total to Date (KWh)
Total electricity usage		
Of that total amount, provide quantity:		
• Derived from renewable source (i.e., solar, wind)		
• Other:		

Provide descriptions in the space provided on the certification page of all reported energy use reduction programs appropriate to this project, including use of electricity derived from renewable sources.

Water Usage: Quantify the volume of water used on-site from difference sources.

	Current Reporting Period (Gallons)	Total to Date (Gallons)
Total quantity of water used on-site		
Of that total amount, provide the quantity obtained from:		
• Public potable water supply		
• Surface water		
• On-site treated groundwater		
• Reclaimed treated water		
• Collected or diverted storm water		
• Re-Injected groundwater		
• Other:		
• Other:		

Provide descriptions in the space provided on the certification page of any reported water use reduction programs applied. Please note if reused/injected groundwater is pre-treated.

Emissions: Quantify the distance traveled for delivery of supplies and removal of waste.

	Current Reporting Period (Miles)	Total to Date (Miles)
Off-site mobile fuel combustion		
Other:		

Provide descriptions in the space provided on the certification page of practices such as use of local vendors within 150 miles of the site and on-site stationary fuel use reduction programs.

Quantify the number of hours that diesel and other equipment with the potential to emit hazardous air pollutants (HAPs) or greenhouse gas (GHG) emissions was operated on-site.

	Current Reporting Period (Hours)	Total to Date (Hours)
On-site diesel excavation/construction equipment usage		
Other on-site processes generating emissions		
Other:		

Quantify the VOC emissions from active remediation systems on-site.

	Current Reporting Period (lbs VOCs emitted)	Total to Date (lbs VOCs emitted)
Operating soil remediation equipment		
Operating groundwater remediation equipment		
Other:		

Provide descriptions in the space provided on the certification page of the type of equipment used, rating, emission control devices used and other means to reduce emissions.

Land and Ecosystem: Quantify the amount of land and/or ecosystems disturbed by construction and the area of land and/or ecosystems restored to a natural condition.

	Current Reporting Period (Acres)	Total to Date (Acres)
Total land area disturbed		
Total land area restored		
Increase in area for storm water infiltration (vs pre-disturbed conditions)		
Increase in area of native species plantings (vs pre-disturbed conditions)		
Other:		

Quantify the amount of land and/or ecosystems remediated.

	Current Reporting Period (Acres)	Total to Date (Acres)
Total area of land impacted by contamination		
Total area of land remediated to unrestricted use		
Total area of land remediated to other future site use		

Additional Comments on Green Remediation Programs Implemented: *Provide descriptions in the space provided of other green remediation practices performed during the project.*

Descriptions of green remediation programs reported above (Attach additional sheet if needed)
Materials and Products Imported:
Waste Generation:

Descriptions of green remediation programs reported above (Attach additional sheet if needed)
Recycled and Bio-Based Content in Imported Products and Materials:
Solid Waste Disposal and Diversion:
Energy Use:
Water Use:
Emissions:
Land and Ecosystem:
Other:

CERTIFICATION BY CONTRACTOR
I, _____ (**Name**) do hereby certify that I am _____ (**Title**) of the Company/Corporation herein referenced and contractor for the work described in the foregoing application for payment. According to my knowledge and belief, all items and amounts shown on the face of this application for payment are correct, all work has been performed and/or materials supplied, the foregoing is a true and correct statement of the contract account up to and including the last day of the period covered by this application. _____ _____ **Date** **Contractor**

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Appendix E – NYSDOH Generic Community Air Monitoring Plan

Community Air Monitoring Plan

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

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

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

Continuous monitoring will be required for all ground intrusive activities. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil samples. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuing monitoring may be required during sampling activities.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. A third CAMP monitor station will be setup and ran if receptors are determined to be in close proximity to any active work areas as any added measure of protection. The particulate monitoring will 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 will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities. Work will be completed in accordance with Appendix 1B: Fugitive Dust and Particulate Monitoring of DER-10.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than the background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work may continue with dust suppression techniques provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work will be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures

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

All readings will be recorded and be available for State (DEC and DOH) personnel to review.

VOC Monitoring, Response Levels, and Actions

VOCs will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using a photo ionization detector (PID) equipped with a 10.2 eV bulb. The PID will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

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

- 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 will be halted, the source of the 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.

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

All 15-minute readings will be recorded and be available for State (NYSDEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded. Readings are to be provided at least on a weekly basis with all exceedances reported to the NYSDEC and NYSDOH on the same day, or next business day if exceedances are identified after work hours, along with any suspected reasoning, any corrective measures executed, and a conclusion if the corrective measures were effective.

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 predetermined). 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 mcg/m3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m3 or less at the monitoring point.

- Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen sulfide, carbon monoxide) may also need to be monitored. Response levels and actions 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 F – Access Agreements (Pending)