SITE CHARACTERIZATION WORK PLAN

NOVEMBER 20, 2025

Republic Airport – East Farmingdale, NY Site Number 152259

Prepared for:

New York State Department of Environmental Conservation

CONTRACT D009805-WA #33

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*Will be completed prior to field activities commencing and submitted under this cover as a revision.

Acronyms and Abbreviations

%	percent
AFFF	aqueous film-forming foam
bgs	below ground surface
CAMP	Community Air Monitoring Plan
CDM Smith	CDM Smith Inc.
COC	contaminant of concern
DER	Division of Environmental Remediation
DPT	Direct Push Technology
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
FAP	Field Activities Plan
gpm	gallons per minute
GPR	ground-penetrating radar
HASP	Health and Safety Plan
HDPE	high-density polyethylene
IDW	investigation-derived waste
ng/L	nanograms per liter
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PCB	polychlorinated biphenyl
PFAS	Per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonic acid
pH	potential of Hydrocarbons
PID	photoionization detector
PVC	polyvinyl chloride
QAPP	quality assurance project plan
Site	Republic Airport
SCWP	Site Characterization Work Plan
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	semivolatile organic compound
TCLP	toxicity characteristic leaching procedure
VOC	volatile organic compound

Certification

I, Daniel O'Rourke, Professional Geologist in the State of New York, certify that I am currently a Qualified Environmental Professional, as defined in 6 New York Codes, Rules and Regulations Part 375, and that this Site Characterization Work Plan was prepared in accordance with all applicable statutes and regulations and is in substantial conformance with the New York State Department of Environmental Conservation's *Technical Guidance for Site Investigation and Remediation* (DER-10).

Signature:

Date: 9/19/25

1.0 Introduction

This Site Characterization Work Plan (SCWP) details exploratory activities for the Republic Airport, New York State Department of Environmental Conservation (NYSDEC) Site Number 152259. The Republic Airport, herein referred to as 'Site", is located at 7150 Republic Avenue, in the Village of East Farmingdale, Town of Babylon, Suffolk County, New York (**Figure 1**). This project is a part of NYSDEC Contract D009805-WA #33. The project scope of work includes groundwater and soil investigation to determine whether per- and polyfluoroalkyl substances (PFAS) contamination at the Site poses a risk to public health and the environment. The Site characterization activities will be performed in accordance with the Generic Quality Assurance Project Plan (QAPP) (**Appendix A**),the Field Activities Plan (FAP) (**Appendix B**), the Site-Specific Health and Safety Plan (HASP) (**Appendix C**), and the NYSDEC Standby Engineering Services Contract D009805 Health and Safety Manual (**Appendix C-1**) (Appendix A-3 of DER-10; NYSDEC 2010). These documents were prepared by CDM Smith Inc. (CDM Smith) under Contract D009805 and are in compliance with NYSDEC's Division of Environmental Remediation (DER) *Technical Guidance for Site Investigation and Remediation* (DER-10) (NYSDEC 2010).

The site covers approximately 525 acres and was historically used as a general aviation airport and an aircraft test facility where emergency response and fire training exercises using aqueous film-forming foam (AFFF) took place. The site is currently owned and operated by the New York State Department of Transportation and is used as a general aviation facility for business and recreational flights. A Class B fire suppression foam, Chemguard 3%, was bought and stored on-site as late as 2015 (**Appendix D**). In 2016, at the request of the East Farmingdale Fire District, 180 gallons of foam was dispensed outside of the airport property in an emergency response that was unrelated to the site.

The site borders the Fairchild Republic Main Plant Site (NYSDEC Site Number 152004), which manufactured aircraft and aviation components between 1931 and 1987 (U.S. Environmental Protection Agency [EPA] 2006). The Fairchild Main Plant site had developed a tetrachloroethene and trichloroethene plume that migrated in groundwater beneath the Republic Airport. The plume has been treated using a pump and treat system located at the southern edge of the airport that was installed in 2003, in association with the remedial measures specified in the *Record of Decision, Fairchild Republic Main Plant Site* (NYSDEC 1998). An Emerging Contaminant Sampling Initiative sampling event was conducted in October 2018 at the Republic Airport as part of the Fairchild Main Plant site's long-term monitoring plan (Malcolm Pirnie, Inc. 2009). The groundwater samples showed various levels of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) above EPA's Health Advisory Level of 70 nanograms per liter (ng/L). PFOA sample concentrations ranged from 24.3 to 117 ng/L, and PFOS concentrations ranged from 16.1 to 73.8 ng/L. PFAS are not currently a contaminant of concern (COC) at the Fairchild Republic Main Plant Site. **Table 1** summarizes the impacted groundwater COCs from the sampling event. The groundwater data are provided in attachments provided by NYSDEC located in **Appendix D**.

Table 1. PFAS Contaminants of Concern Summary

Well Identification (ID)	PFOS (ng/L)	PFOA (ng/L)	PFOS + PFOA (ng/L)	TOTAL PFAS (ng/L)
Influent	33.7	28.4	62.1	158.73
MW-21S	73.8	117	187.5	910.24
MW-43S	34.9	24.5	59.4	175.59
MW-49S	16.1	24.3	43.4	1154.09
S-66157	18.7	44.1	62.8	380.89

1.1 Purpose and Objectives

This SCWP details the Site characterization methods to be performed to obtain information to support remedial decisions for the Republic Airport site. The characterization aims to obtain information necessary to determine whether the on-site extent of groundwater and soil impacts related to historical site operations presents a significant threat to public health or the environment.

2.0 Background

2.1 Site Description and Surrounding Use

The Republic Airport is located at 7150 Republic Avenue, East Farmingdale, New York. The site is a general aviation facility for business and recreational flights that consists of two main intersecting runways running north-south and northwest-southeast. The site layout is shown on **Figure 2**. The southwestern portion of the site includes hangars, maintenance buildings, and a refueling area. The northern portion of the site holds additional hangars. In the west-central portion of the Site, is the main terminal, which also is the location of the firehouse. Operators based at the airport include Atlantic Aviation Long Island, SheltAir Aviation Services Farmingdale, and Republic Jet Center. The American Air Power Museum, the Long Island Republic Airport Historical Society, numerous flight schools, and two hotels are also located at the facility.

The Republic Airport site currently has land use codes of Air Transportation and Vacant Land in Commercial Areas. To the west of the site are various commercial properties, and further west is a residential area. North and south of the site, the property classes are industrial; to the east are several cemeteries. To the immediate south, the groundwater remediation facility for the Fairchild Main Plant site extracts an average of 200 gallons per minute (gpm) at each pump. Four private wells are within 0.25 miles of site, and one additional private well is within 0.5 miles of the site. Four domestic supply water wells are within 1 mile of the site. Three public supply wellfields owned and operated by the Suffolk County Water Authority are approximately 7,000 feet to the south of the site. The three wellfields withdraw an annual average of 700, 1,200, and 815 gpm based on reported 2023 pumpage.

The site is adjacent to 24 other sites that are managed in the DER remedial program, which are shown on **Figure 3**.

2.1.1 Site Topography

The surface topography of the site is relatively flat. According to the U.S. Geological Survey topographic map, the property is approximately 75 feet above mean sea level (USGS 2023).

2.1.2 Site Geology and Hydrogeology

Sediments beneath the site consists of tan to brown, fine to coarse sand and gravel, which make up the Upper Glacial Aquifer (shallow) aquifer. Based on geologic logs collected from the Fairchild Main Plant site to the northwest (NYSDEC Site Number 152004), the Gardiners Clay geological formation is present from approximately 75 to 95 feet below ground surface (bgs). The Magothy Aquifer is beneath the Upper Glacial Aquifer or the Gardiners Clay (where present). The Upper Magothy is considered the intermediate aquifer in previous site investigations; it extends down to a clay layer at 270 to 295 feet bgs. Below this depth, the Magothy is classified by site investigations as the deep aquifer. No distinctive historic fill layer was identified.

From a previous investigation at the southern parcels of the Republic Airport site, monitoring well data indicate groundwater beneath the site is present between 12 to 23 feet bgs (Stratosphere Development Co. LLC 2022). Groundwater flow direction near the Republic Airport is to the south, with minor easterly and westerly flow components. The groundwater remediation pump and treat system for the Fairchild Main Plant site extracts groundwater at a rate of 200 gpm at each pump, creating a steep groundwater gradient on the southern portion of the Republic Airport site. The pump and treat system is designed to mitigate VOC contamination and was not designed to treat PFAS contaminants (Malcolm Pirnie, Inc. 2009).

2.2 Previous Investigation

The wells that were sampled as part of the October 2018 Emerging Contaminant Sampling are shown in the attachments in **Appendix D**. The findings from the sampling are summarized as follows:

- Within an attached Class B fire suppression usage survey completed by the New York State Department of Transportation (NYSDOT); it is stated that AFFF was stored on “open pallets in a storage area, indoors.” This area is presumed to be within the firehouse at the main terminal.
- NYSDOT also indicated that AFFF has been used for training purposes at the site, however the exact locations of AFFF use are currently unknown.
- PFAS compounds were confirmed in five groundwater monitoring wells (Influent well PW-2, and MW-21S, MW-43S, MW-49S, and S-66157).
- As a result of the PFAS detections, the Republic Airport was designated by the state as a potential Inactive Hazardous Waste Disposal Site, resulting in the need for future investigations to characterize the site.
- Based on the available data, the presence or magnitude of soil contamination is not known at this time.

3.0 Scope of Work

The planned Site characterization will be performed in accordance with the Generic QAPP (**Appendix A**), the FAP (**Appendix B**), the Site-Specific HASP (**Appendix C**), and the NYSDEC Standby Engineering Services Contract D009805 Health and Safety Manual (**Appendix C-1**) and will include the following:

- Drilling and sampling of seven soil borings
- Drilling and sampling of six vertical profile borings for groundwater
- Installation of five permanent monitoring wells
- Sampling of 22 existing and newly installed monitoring wells, and one catch basin
  - Seventeen existing monitoring wells
  - Five new permanent monitoring wells
  - One catch basin (aqueous)

Table 2 summarizes the investigation activities. The well and boring locations are shown on **Figure 4**. **Table 3a** details the well construction information for the existing wells to be sampled. **Figure 4** shows the proposed soil sampling locations, vertical profile sampling locations and the existing and proposed groundwater monitoring wells. All work will adhere to the Site-Specific Health and Safety Plan Addendum, which is being prepared by CDM Smith and will be completed prior to fieldwork.

The vertical profile borings will be drilled to a depth of approximately 100 feet bgs or deeper if drilling conditions permit. While deeper borings can be obtained using sonic drilling technology, the intent of this Site characterization is to evaluate the areal distribution of PFAS within the Upper Glacial Aquifer and upper Magothy Aquifer where possible. The intent is to evaluate potential shallow PFAS that may have originated at the airport. It is assumed that PFAS concentrations found in the deeper Magothy are not likely because of a source at the airport, but from an upgradient source. Should concentrations increase with depth or be detected in the deeper monitoring wells (not previously detected), deeper vertical profiling will be further evaluated.

3.1 Utility Survey

Before fieldwork, a utility survey will be conducted at all proposed drilling locations (soil borings, vertical profile borings, and monitoring wells). Survey activities will consist of the following:

- CDM Smith's subcontracted driller will notify the state One-Call.
- A geophysical survey will be conducted using electromagnetic methods, utility-locating instruments, a metal detector, and ground-penetrating radar (GPR) to identify underground utilities and subsurface anomalies that may be present at the drilling locations. The GPR depth of penetration may be up to 10 feet, but is highly site specific; therefore, obstructions at depths greater than 10 feet may not be identifiable using GPR. The geophysical subcontractor will mark out subsurface utilities and underground anomalies with colored paint. The proposed drilling locations may be revised based on the results of the geophysical survey.

- CDM Smith, its drilling subcontractor, and a representative from Republic Airport will meet to review and finalize the proposed well/boring locations.
- The locations will be manually cleared to approximately 5 feet bgs using a hand auger, or equivalent, to clear the borehole prior to intrusive activities.

3.2 Soil Borings and Soil Sampling

Soil samples will be collected at eleven locations to assess the presence of COCs in soil. Borings will be drilled via direct-push drilling methods in accordance with QAPP Section 3.14, Soil Boring Logs/Geoprobe*.* Field activities will consist of the following:

Soil Collection Methods

- Sample locations SB-1, SB-2, SB-3, SB-4, SB-5, SB-6, and SB-7 a Geoprobe will be used to drive stainless steel rods equipped with detachable stainless steel drive points until the water table in encountered.
- Soil cores will be collected using 2.25-inch-inner-diameter Macrocore tooling.
- During drilling, soil cores will be collected continuously for logging and screened with a photoionization detector (PID).
- Borings will be backfilled with unused soil and bentonite.
- Sample locations SB-8, SB-9, SB-10, and SB-11 will be collected with hand augers to a maximum depth of 2 feet,

Soil Sampling

- Soil samples will be collected from the following intervals at each location: 0 to 2 inches, 2 to 12 inches, 1 to 2 feet bls (hand auger only), and 1 to 2 feet above the water table (DPT rig only).
- All soil samples will be analyzed for PFAS. Soil samples collected from the 2-12 inch interval will be analyzed for SPLP PFAS, TOC, and pH. A subset of 20 percent (%) of the samples will also be analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) including 1,4 dioxane, metals (including mercury), cyanide, polychlorinated biphenyls (PCBs), pesticides, and herbicides. The subset of 25% will be biased toward locations with historical observed detections associated with the Fairchild Main Plant site. An analytical summary, including the sample methods, preservatives, holding times, bottleware, and quality control samples, is provided in **Table 3**, which will be populated in full prior to fieldwork**.**
- Field personnel will label, package, and deliver samples to Pace Analytical at 575 Broadhollow Road, Melville, New York, 11747. Custody seals will be placed on all samples and sample containers during transport.
- Soil sample IDs will be as follows:
  - SITE ID-SB-#-INTERVAL

    Where SITE ID is the site ID, SB indicates a soil boring, “#” designates the location number, INTERVAL is the corresponding interval as follows:

A – 0-2 inches bgs

B – 2-12 inches bgs

C – 1 foot above the water table or deepest interval collected

- Samples collected with hand augers will reach a maximum depth of 2 feet

Example: WA33-SB-4-A

- For field blanks: SITE ID-SB-FB-#
- For equipment blanks: SITE ID-SB-EB-#
- For trip blanks: SITE ID-SB-TB-#

- Community Air Monitoring Plan (CAMP) monitoring will be performed during drilling activities as discussed in Section 3.7.
- The field sampling team will maintain a sample log sheet summarizing the following:
  - Sample ID
  - Date and time of sample collection
  - Sample depth
  - Sampling methods and devices
  - Soil classification per QAPP Section 3.14.2, Soil Classification
  - COC protocols and records used to track samples from sampling collection to analysis

Any pertinent observations, such as odors, reading from field instruments, and significant activities occurring in the vicinity (e.g., operation of heavy equipment) will be recorded.

3.3 Vertical Profile Borings and Groundwater Sampling

Vertical profile sampling will be conducted at six locations to assess the presence of COCs in the groundwater. Soil borings will be installed via direct-push drilling methods in accordance with QAPP Section 3.6.3, Direct-Push Groundwater Sampling. Field activities will consist of the following:

Vertical Profile Borings

- At each location, a Geoprobe will be used to drive stainless steel rods equipped with detachable stainless steel drive points to a maximum of 100 feet bgs.
- Borings will be backfilled with bentonite.
- CAMP monitoring will be performed during drilling activities as discussed in Section 3.7.

Vertical Profile Sampling

- Samples will be collected every 20 feet to a maximum of 100 feet bgs using a screen point sampler set to a target depth.
- If refusal is met, it will be at the discretion of the CDM Smith project manager to offset borings and continue to attempt the sampling or to abandon the location altogether.

- All groundwater samples collected from the vertical profile borings will be analyzed for PFAS. An analytical summary, including the sample methods, preservatives, holding times, bottle ware, and quality control samples, is provided in **Table 3.**
- Field personnel will label, package, and deliver the samples to Pace Analytical.
- Custody seals will be placed on all samples and sample containers during transport.
- Groundwater sample IDs will be as follows: SITE ID-MW ID
- Where SITE ID is the site ID and MW ID indicates the well location being sampled

  Example: WA33-MW-10S
- Vertical Profile sample ID will be as follows: SITE ID-VPB-#-INTERVAL

  Similar to soil samples, "#" designates the location number and INTERVAL is the corresponding interval as follows:

  A – 19-20 feet bgs

  B – 39-40 feet bgs

  C – 59-60 feet bgs

  D – 79-80 feet bgs

  E – 99-100 feet bgs

  Example: WA33-VPB-1-B
    - For field blanks: SITE ID-GW-FB-#
    - For equipment blanks: SITE ID-GW-EB-#
    - For trip blanks: SITE ID-GW-TB-#
- The field sampling team will maintain a sample log sheet documenting the following:
  - Sample ID
  - Date and time of sample collection
  - Sampling depth
  - Sampling methods and devices
  - Purge volumes
  - Water quality parameters
  - COC protocols and records used to track samples from sampling point to analysis

Any pertinent observations, such as odors, readings from field instruments, and significant activities near the sampling location (e.g., operation of heavy equipment) will be recorded.

3.4 Monitoring Well Installation

Monitoring well installation will be conducted at five proposed locations to add to the existing monitoring well network to further evaluate groundwater quality at the site. Monitoring wells will be installed via hollow-stem auger drilling methods in accordance with QAPP Section 3.15, Monitoring Well Installation. Field activities will consist of the following:

- Newly installed monitoring wells will be named DEC-MW-1, DEC-MW-2, DEC-MW-3, DEC-MW-4, DEC-MW-5.
- At each location, a Geoprobe will use 4-inch-inner-diameter hollow-stem augers to a maximum of 35 feet bgs to install the well based off the vertical profile boring.
- Five soil borings will have been completed per Section 3.2, co-located with the proposed monitoring well locations. The lithology of the soil cores will be recorded and used to identify the screened interval for the monitoring wells.
- Monitoring wells will be constructed of 2-inch Schedule 40 polyvinyl chloride (PVC) casings and 10-foot 0.020-slot PVC screens.
- Newly installed monitoring wells will be developed and completed with flush-mount well pads.
- CAMP monitoring will be performed during drilling activities as discussed in Section 3.7.
- The field sampling team will maintain a sample log sheet documenting the following:
  - PID reading
  - Depth of boring
  - Soil characterization
  - Apparent moisture content (e.g., dry, moist, saturated) of the sampling zone

Well construction details, any pertinent observations, such as odors, readings from field instruments, and significant activities near the well installation (e.g., operation of heavy equipment) will be recorded.

3.5 Groundwater and Catch Basin Sampling

Sampling will be conducted at 22 proposed groundwater locations to delineate the extent of the contamination plume at the site. An additional aqueous catch basin sample will be collected. Monitoring wells will be sampled via low-flow methods in accordance with QAPP Section 3.17, Low-Flow Groundwater Sampling. The catch basin sample will be collected using a peristaltic pump and high-density polyethylene tubing (HDPE) tubing. **Figure 4** shows the proposed monitoring well and catch basin locations. Field activities will consist of the following:

- A synoptic round of water level measurements will be collected at the monitoring wells shown on **Figure 4**.
- All groundwater samples will be analyzed for PFAS. A subset of 20% of groundwater samples will also include analysis of VOCs, SVOCs including 1,4 dioxane, metals, cyanide, PCBs, pesticides,

and herbicides. An analytical summary, including the sample methods, preservatives, holding times, bottleware, and quality control samples, is provided in **Table 3**.

- Monitoring well sampling will be performed using EPA's low-flow purging technique, in general accordance with QAPP Section 3.17, Low-Flow Groundwater Sampling, and FAP Section 2.6, Monitoring Well Purging and Sampling. Since the samples will be also analyzed for PFAS, precautions will be taken to avoid exposing the groundwater to items that may contain PFAS. A submersible pump using HDPE will be used.
- Field personnel will label, package, and deliver the samples to Pace Analytical.
- Groundwater and catch basin sample IDs will follow the same format as the soil sample IDs except for the media and sample type codes. Aqueous sample IDs will be as follows:
  - Groundwater: SITE ID-GW-MW-# (Example: WA33-GW-MW-21S)
  - Catch basin: SITE ID-CB-# (Example: WA33-CB-1)
  - Field blanks: SITE ID-GW-FB-#
  - Trip blanks: SITE ID-GW-TB-#
- The field sampling team will maintain a low-flow sampling sheet that documents the following:
  - Sample ID
  - Date and time of sample collection
  - Sample depth
  - Model and serial number of instruments used
  - Purged volumes
  - Depth to water
  - Flow rates
  - Drawdown
  - pH, specific conductivity, dissolved oxygen, temperature, redox potential, and turbidity

Any pertinent observations, such as odors, readings from field instruments, and significant activities near the sampling (e.g., operation of heavy equipment) will be recorded.

3.6 Data Validation

Category B deliverables will be provided for all analytical data, except Investigation-derived waste (IDW) samples, which will be Category A. The laboratory will also provide electronic data deliverables (EDDs) for all data. Data will be validated by a subcontractor, Environmental Data Services of Newport News, Virginia. Environmental Data Services will provide a data usability summary report and revised EDDs containing validation qualifiers. CDM Smith will review the validated groundwater monitoring EDDs to ensure compliance to the NYSDEC Environmental Information Management System database. NYSDEC will provide CDM Smith with the required EDD format. CDM Smith will submit the validated EDDs for upload to NYSDEC's Environmental Information Management System database.

3.7 Community Air Monitoring

The New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP) and Fugitive Dust and Particulate Monitoring Plan (**Appendix E**) (Appendix A-1 and A-2, respectively, of DER-10; NYSDEC 2010), will be implemented during all ground-intrusive sampling activities.

The field team will include a description of CAMP activities, exceedances of action levels (and duration), and measures taken to address/mitigate exceedances in the daily field reports. CAMP data will be appended to the daily report; daily summary reports will be sent within a timely manner to both NYSDEC and NYSDOH. In addition to the daily reports, any exceedances of CAMP action levels and CAMP reports will be reported within 24-hours to NYSDEC and NYSDOH project managers.

3.8 Surveying

A New York-licensed surveyor will survey and provide the coordinates (X, Y) for the five newly installed monitoring wells and the 17 existing monitoring wells to be sampled. The surveyor will also provide the well coordinates (X, Y), ground surface elevation, and top of inner casing elevation (in North American Vertical Datum of 1988) for the well locations in tabular form.

3.9 Decontamination Procedure

All nondedicated, nondisposable sampling equipment and tools used to collect samples for chemical analysis will be decontaminated prior to and between each sample interval using an Alconox rinse and potable water rinse prior to reuse. Unless disposable sampling equipment is used, the equipment will be decontaminated using the following procedure:

- Wash with nonphosphate detergent
- Tap water rinse
- Deionized water rinse
- PFAS-free water rinse
- Air dry

Additional cleaning of drilling equipment with steam may be needed if elevated contamination levels appear to be present using field monitoring equipment, or if stained soil/odors and/or discoloration from groundwater are observed. Decontamination water will be contained in a 55-gallon drum, staged, labeled and properly disposed of.

3.10 Investigation-Derived Waste

A drum staging location will be identified at the site by NYSDEC and will be stored pending characterization and pick-up of the waste. CDM Smith will be responsible for collecting IDW samples and submitting the samples to Pace Analytical. Disposable personal protective equipment will be disposed of as municipal waste. Soil, purge water, and decontamination water generated from the investigation activities will be contained in 55-gallon drums and samples will be collected for waste characterization in accordance with QAPP Section 3.13.2, Waste Sampling Procedure.

IDW samples will be analyzed for toxicity characteristic leaching procedure (TCLP) VOCs, TCLP SVOCs, 1,4 dioxane, herbicides, TCLP RCRA metals, PCBs, PFAS, cyanide reactivity, sulfide reactivity, ignitability, and corrosivity (pH), as detailed in **Table 3**. Transportation and disposal of the IDW will be managed by Brookside Environmental.

3.11 Reporting

Draft data and well survey data will be sent to the NYSDEC and NYSDOH project managers as soon as available. CDM Smith will provide daily summary reports to NYSDEC and NYSDOH project managers within two business days.

CDM Smith will prepare a site characterization report in general accordance with DER-10 Section 3.14. The report will include:

- Description of the work performed
- Presentation of analytical data in tabular format
- Maps showing sample locations and soil and groundwater contaminant exceedances
- Copies of field forms such as well purging logs
- Stratigraphic logs and well construction diagrams
- Groundwater elevation contour map
- Summary of the general nature of the source(s) and extent of contamination at the site
- Discussions of the findings, conclusions, and recommendations

4.0 Schedule

The general sequence of construction anticipated during the planned investigation at the site is provided in **Table 4**. A detailed project schedule will be provided following approval of this work plan.

Table 4 General Schedule

Field Activity	Task(s)	Time Frame	Tentative Date
Utility Clearance	Clear and locate eight drilling locations	One 8-hour day	January 2026
Soil Borings	Drill seven soil borings and collect soil samples	Two 10-hour days	January 2026
Vertical Profile Borings	Drill six vertical profile borings and collect soil samples	Six 10-hour days	January 2026
Monitoring Well Installation	Install five monitoring wells	Five 10-hour days	January 2026
Groundwater/Catch Basin Sampling	Collect groundwater and catch basin samples; collect water quality measurements	Seven 10-hour days	January 2026
Surveying	Survey 20 monitoring wells	During GW sampling	February 2026
IDW Pickup	Oversee IDW collection	One 8-hr day	February 2026

5.0 References

CDM Smith. 2020. *Health and Safety Manual.* Latham, NY: CDM Smith, Inc. Report prepared for New York State Department of Environmental Conservation Division of Environmental Remediation.

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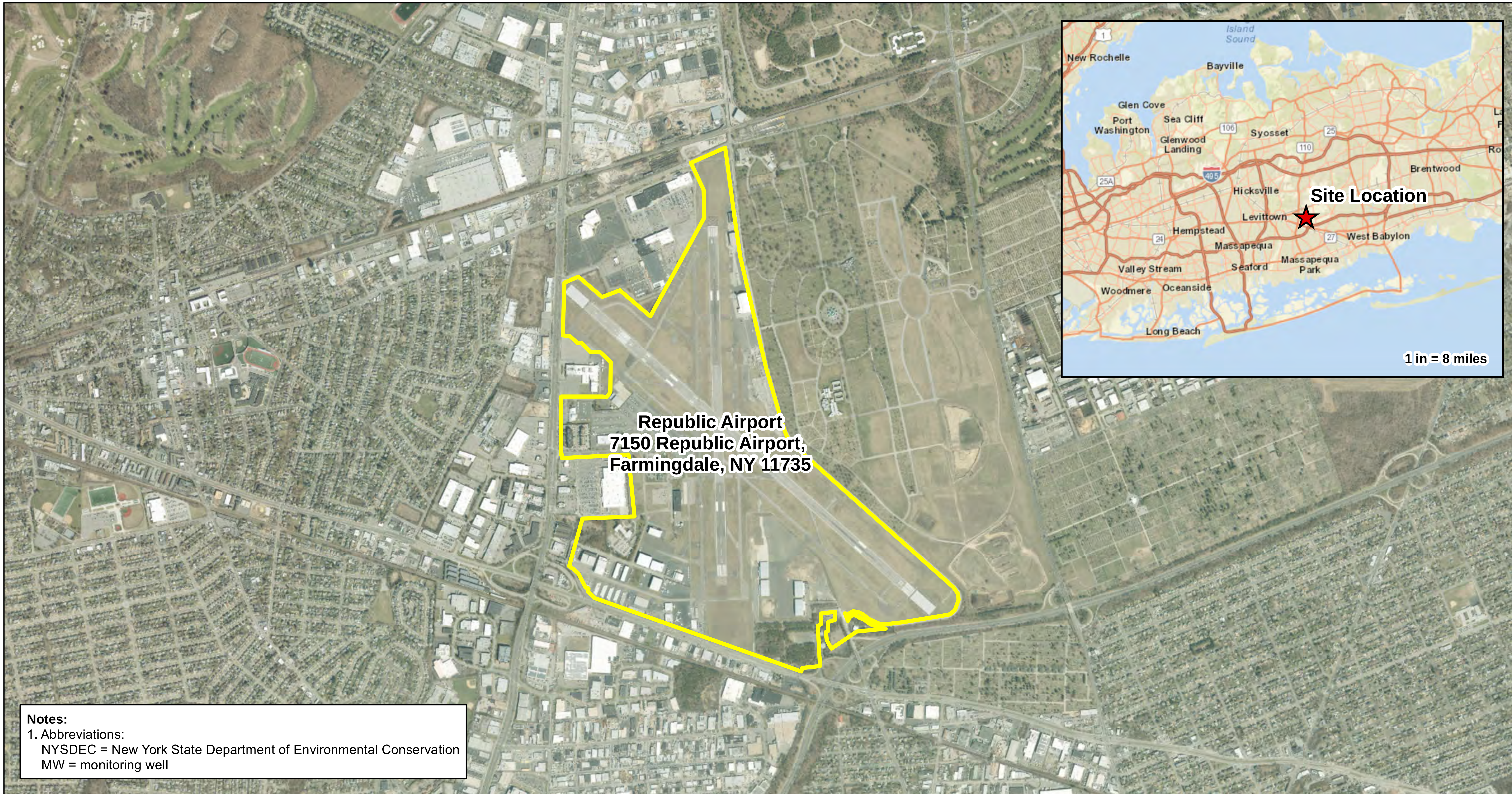
Figures



Notes:
1. Abbreviations:
   NYSDEC = New York State Department of Environmental Conservation
   MW = monitoring well

CDM Smith

Legend

Site Boundary

N

1,500 750 0 1,500 Feet

Figure 1
Site Location Map
Republic Airport
Region 1 Suffolk County,
Village of Farmingdale, New York
NYSDEC Site No. 152259

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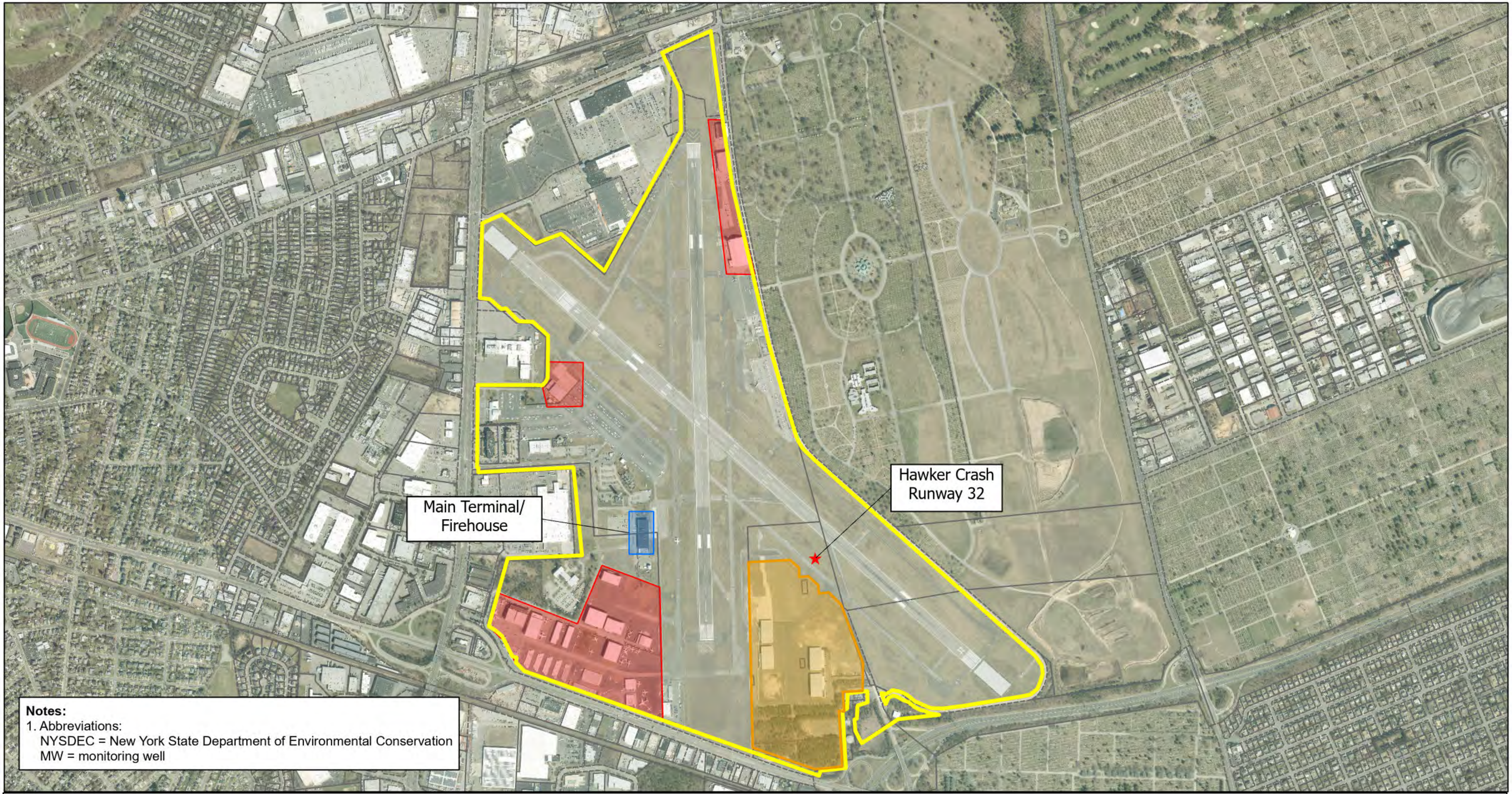

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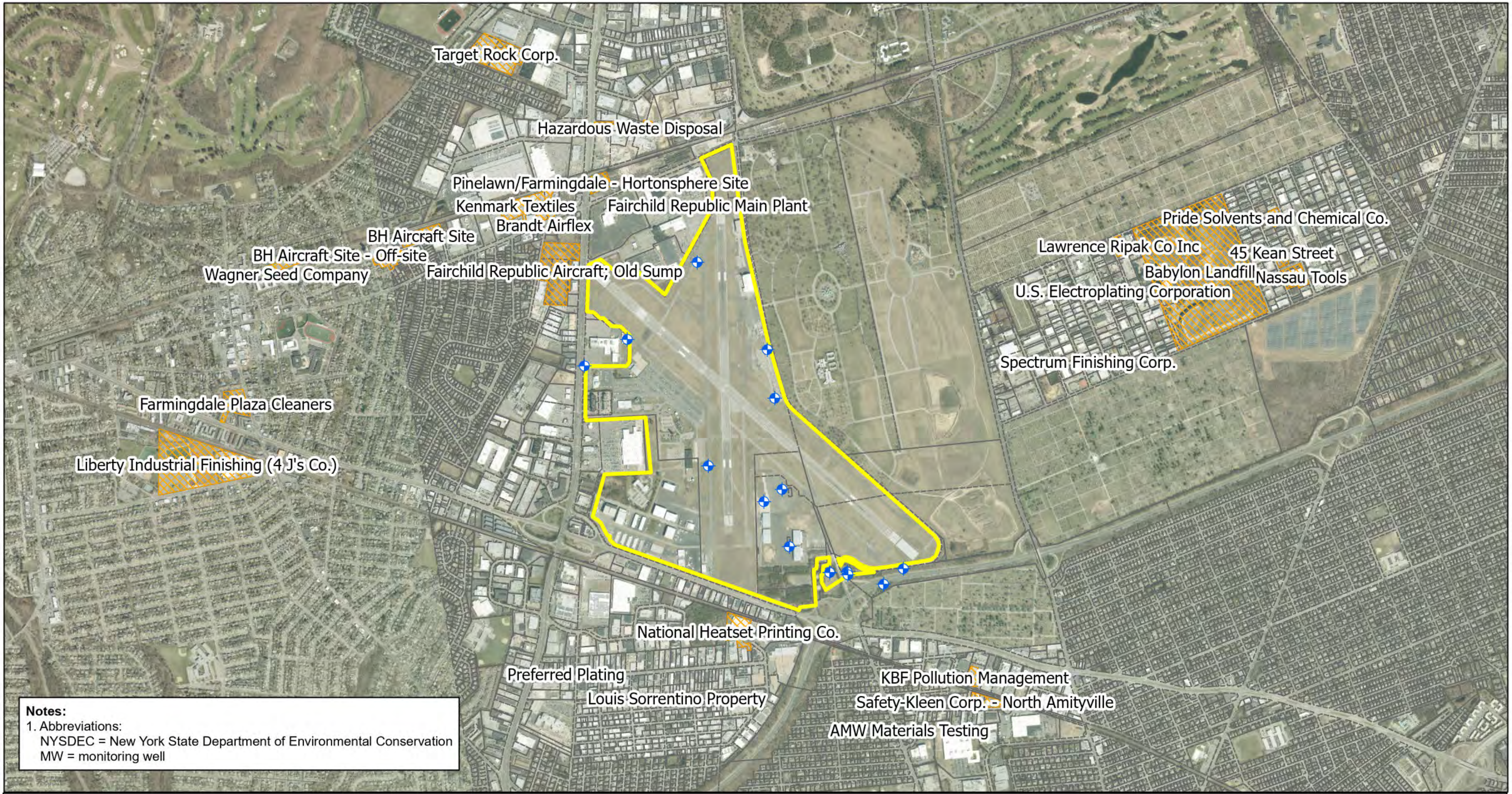
Legend

- Tax Parcels
- Exisiting Airplane Hangers
- Site Boundary
- Development Area
- ★ Hawker Crash

N

1,000 500 0 1,000 Feet

Figure 2
Site Layout
Republic Airport
Region 1 Suffolk County,
Village of Farmingdale, New York
NYSDEC Site No. 152259



Notes:
1. Abbreviations:
NYSDEC = New York State Department of Environmental Conservation
MW = monitoring well

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Legend
- Existing Well Locations and Sampling Points
- Site Boundary
- DEC Remediation Site Boundaries
- Tax Parcels

N

1,000 500 0 1,000 Feet

Figure 3
Adjacent NYSDEC Remedial Sites
Republic Airport
Region 1 Suffolk County,
Village of Farmingdale, New York
NYSDEC Site No. 152259

Notes:

1. Abbreviations:
   NYSDEC = New York State Department of Environmental Conservation
   CB = catch basin
   MW = monitoring well
   SB = soil boring
   VPB = vertical profile boring
2. Co-located samples include proposed MW, SB, and VPB.

Legend

- Site Boundary
- Existing Well Locations and Sampling Points
- Proposed Co-Located Sample
- Proposed Soil Boring Location
- Proposed Shallow Soil Boring Location
- Proposed Vertical Profile Boring
- Proposed Catch Basin Sample

N

1,000 500 0 1,000 Feet

Figure 4
Proposed Sampling Locations
Republic Airport
Region 1 Suffolk County,
Village of Farmingdale, New York
NYSDEC Site No. 152259

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Tables

Table 2
Summary of Investigation Activities: Republic Airport – East Farmingdale, NY
Site Characterization
Contract Number: D009805 - 33

Site Name	Site Number	Site Address	Soil Borings		Vertical Profile Borings		Groundwater		Catch Basin (Aqueous)
			Number of Borings	Number of Soil Samples[1]	Number of Borings	Number of Groundwater Samples[1]	Number of New Monitoring Wells to be Installed	Number of Monitoring Wells to be Sampled	Number of Samples
Republic Airport	#152259	7150 Republic Avenue, East Farmingdale, Suffolk County, New York 11735	11	33	6	30	5	22	1

Notes
[1]Does not include QC samples

Table 3
Sample Analyses and Quantities: Republic Airport – East Farmingdale, NY
Site Characterization
Contract No: D009805-WA-33

Sample Type	Sample Frequency	Analysis	Method	Sample Quantity	Container	MS/MSD Quantity	Field Duplicates	Equipment Blank Quantity	Trip Blank Quantity	Preservative	Holding Time
Groundwater + Catch Basin	One groundwater sample per monitoring well location Five groundwater samples per vertical profile boring location One groundwater (grab) sample from te catch basin	PFAS	EPA Method 1633	53	TBD	3	3	4	Not required	TBD	TBD
		1,4-Dioxane	Modified EPA Method 8270 SIM	5	TBD	1	1	1	Not required	TBD	TBD
		TAL Metals, Hg (total and dissolved)	SW-846 6010D & 7470A	5	TBD	1	1	1	Not required	TBD	TBD
		Cyanide (total and dissolved)	SW-9010C	5	TBD	1	1	1	Not required	TBD	TBD
		TAL VOCs including TICs	SW-846 8260D	5	TBD	1	1	1	1	TBD	TBD
		TAL SVOCs including TICs	SW-846 8270D	5	TBD	1	1	1	Not required	TBD	TBD
		Pesticides	SW-846 8081B	5	TBD	1	1	1	Not required	TBD	TBD
		Herbicides	SW-846 8151A	5	TBD	1	1	1	Not required	TBD	TBD
		TAL PCBs	SW-846 8082A	5	TBD	1	1	1	Not required	TBD	TBD
Soil	Three soil samples per soil sampling location	PFAS	EPA Method 1633	33	TBD	2	2	2	Not required	TBD	TBD
		SPLP PFAS	EPA Method 1312/1633	11	TBD	Not required	1	Not required	Not required	TBD	TBD
		pH (corrosivity)	9045D	11	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		TOC	Lloyd Kahn	11	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		TAL Metals, Hg	SW-846 6010D & 7470A	7	TBD	1	1	1	Not required	TBD	TBD
		Cyanide	SW-9010C	7	TBD	1	1	1	Not required	TBD	TBD
		TAL VOCs Including TICs	SW-846 8260D	7	TBD	1	1	1	1	TBD	TBD
		TAL SVOCs Including TICs and 1,4 Dionxane	SW-846 82670D	7	TBD	1	1	1	Not required	TBD	TBD
		Pesticides	SW-846 8081B	7	TBD	1	1	1	Not required	TBD	TBD
		Herbicides	SW-846 8151A	7	TBD	1	1	1	Not required	TBD	TBD
		TAL PCBs	SW-846 8082A	7	TBD	1	1	1	Not required	TBD	TBD
Aqueous IDW	One composite sample	TCLP VOCs	SW-846 8260D	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		TCLP SVOC	SW-846 8270D	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		TCLP RCRA Metals	EPA Method 6010D/7470A	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		Herbicides	SW-846 8151A	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		PFAS	EPA Method 1633	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		1,4-Dioxane	Modified EPA Method 8270D-SIM	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		Total Sulfide	EPA Method 9034	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		Reactive Cyanide	EPA Method 9014	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		pH (corrosivity)	EPA Method 9040C	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		Ignitability	EPA Method 1020B	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		PCBs	SW-846 8082A	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
Solid IDW	One composite sample	TCLP VOCs	SW-846 8260D	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		TCLP SVOC	SW-846 8270D	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		TCLP RCRA Metals	EPA Method 6010D/7470A	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		Herbicides	SW-846 8151A	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		PFAS	EPA Method 1633	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		1,4-Dioxane	Modified EPA Method 8270D-SIM	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		Total Sulfide	EPA Method 9034	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		Reactive Cyanide	EPA Method 9014	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		pH (corrosivity)	EPA Method 9040C	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		Ignitability	EPA Method 1030	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD
		PCBs	SW-846 8082A	1	TBD	Not required	Not required	Not required	Not required	TBD	TBD

Abbreviations:

Hg - mercury
IDW - investigation-derived waste
MS - matrix spike
MSD - matrix spike duplicate
PCB - polychlorinated biphenyl
PFAS - per- and polyfluorinated substances
RCRA - Resource Conservation and Recovery Act
SIM - selective ion monitoring
SVOC - semivolatile organic compound
TAL - target analyte list
TBD - to be determined
TCLP - toxicity characteristic leaching procedure
SPLP - Synthetic Precipitation Leaching Procedures
pH - potential of Hydrogen
TIC - tentatively identified compounds
VOC - volatile organic compound

Table 3a
Monitoring Well Construction: Republic Airport – East Farmingdale, NY
Site Characterization
Contract Number: D009805 - 33

Well Number	Existing or Proposed	Monitoring Well ID	Well Diameter (Inches)	Well Completion	Total Depth (feet bgs)	Depth (feet bgs)		Casing Elevation (feet amsl)	Location
						Screen Top	Screen Bottom		
1	Existing	PW-1 (Effluent)	8	Unknown	240.00	Unknown	240.00	Unknown	On-site; south property near P&T plant
2	Existing	PW-2 (Influent)	8	Unknown	240.00	Unknown	240.00	Unknown	On-site: south of property along Southern State Pkwy
3	Existing	MW-4S	Unknown	Unknown	38.69	Unknown	38.69	Unknown	On-site; west property
4	Existing	MW-4D	Unknown	Unknown	59.36	Unknown	59.36	Unknown	On-site; west property
5	Existing	MW-10S	Unknown	Unknown	33.31	Unknown	33.31	Unknown	On-site; west property along Fairchild Hiller Ln
6	Existing	MW-10D	Unknown	Unknown	91.93	Unknown	91.93	Unknown	On-site; west property along Fairchild Hiller Ln
7	Existing	MW-19S	Unknown	Unknown	35.60	Unknown	35.60	Unknown	On-site; north property along N-S runway
8	Existing	MW-19D	Unknown	Unknown	69.73	Unknown	69.73	Unknown	On-site; north property along N-S runway
9	Existing	MW-21S	Unknown	Unknown	30.33	Unknown	30.33	Unknown	On-site; south property near redevelopment area
10	Existing	MW-23D	Unknown	Unknown	310.00	Unknown	310.00	Unknown	On-site; east property along NW-SE runway
11	Existing	MW-37I	Unknown	Unknown	193.00	Unknown	193.00	Unknown	On-site; south property at end of NW-SE runway
12	Existing	MW-41	Unknown	Unknown	140.00	Unknown	140.00	Unknown	On-site; east property near airplane storage
13	Existing	MW-42I	Unknown	Unknown	179.00	Unknown	179.00	Unknown	On-site; south property near redevelopment area
14	Existing	MW-43S	Unknown	Unknown	80.00	Unknown	80.00	Unknown	On-site; south property near redevelopment area
15	Existing	MW-46I	Unknown	Unknown	149.00	Unknown	149.00	Unknown	On-site; central property along N-S runway
16	Existing	MW-49S	Unknown	Unknown	30.00	Unknown	30.00	Unknown	On-site; south property near redevelopment area
17	Existing	S-66157	Unknown	Unknown	53.60	Unknown	53.60	Unknown	On-site; south property near redevelopment area
18	Proposed	DEC-MW-1	2	Flush Mount	TBD	TBD	TBD	TBD	On-site; north property along perimeter
19	Proposed	DEC-MW-2	2	Flush Mount	TBD	TBD	TBD	TBD	On-site; west property along NW-SE runway
20	Proposed	DEC-MW-3	2	Flush Mount	TBD	TBD	TBD	TBD	On-site; southwest property near airplane hangars
21	Proposed	DEC-MW-4	2	Flush Mount	TBD	TBD	TBD	TBD	On-site; south property at end of N-S runway
22	Proposed	DEC-MW-5	2	Flush Mount	TBD	TBD	TBD	TBD	On-site; south property at end of NW-SE runway

Abbreviations

amsl - above mean sea level

bgs - below ground surface

DEC - New York State Department of Environmental Conservation installed well

ID - identification

P&T - pump and treat

N-S - north-south oriented

NW-SE - northwest-southeast oriented

MW - monitoring well

PW - pumping well

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Appendix A - Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN

New York State Department of Environmental Conservation

Standby Engineering Services
Contract D009805

Prepared for:
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, NY 12233-7017

Prepared by:
Camp Dresser McKee & Smith
11 British American Boulevard
Suite 200
Latham, NY 12110

August 2024

CDM Smith

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Appendix A Field Log Sheets

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Section 1

Introduction

This generic Quality Assurance Project Plan (QAPP) has been prepared by Camp Dresser McKee & Smith (CDM Smith) for the New York State Department of Environmental Conservation (NYSDEC) to document quality assurance/quality control (QA/QC) under the NYSDEC Standby Contract for Engineering Services D009805. Site-specific procedures will be included in the Field Activities Plan (FAP) as an attachment to the site-specific Work Plan for each work assignment, as needed. The FAP is not included as part of this QA/QC plan.

1.1 Purpose

The principal purpose of this document is to specify QA/QC procedures for the collection, analysis, and evaluation of data that will be legally and scientifically defensible.

1.2 Objectives

The QAPP provides general information and procedures applicable to the field activities and analytical program detailed in each site-specific Work Plan provided by NYSDEC for each work assignment. This information includes definitions and generic goals for data quality and required types and quantities of QA/QC samples. The procedures address field documentation; sample handling, chain of custody, and shipping; instrument calibration and maintenance; auditing; data deliverable and reduction, validation, and reporting; corrective action requirements; and QA reporting specific to the analyses performed by the laboratories subcontracted by CDM Smith.

Section 2

Project Organization and Responsibility

2.1 Overview

The project management organization for each work assignment is to provide a clear delineation of functional responsibility and authority. The project manager for CDM Smith is the primary point of contact with the NYSDEC project manager. He/she is responsible for development and completion of the site-specific investigation, project team organization and supervision of all project tasks. In this role, he/she will communicate directly with the NYSDEC.

For the fieldwork, field teams consisting of CDM Smith personnel and subcontractors will be assembled and will be responsible for implementing all aspects of the fieldwork. Several key activities will be performed as part of the field and analytical work. These activities include:

- Ensuring that sample collection, sample analysis, data validation, and electronic data deliverable procedures are performed according to Division of Environmental Remediation (DER)-10 requirements.

- Ensuring that health and safety procedures, as outlined in CDM Smith Corporate Health and Safety Manual and the site-specific health and safety plan (HASP) for each work assignment, are adhered to.

- Ensuring that field QA/QC procedures are implemented

- Ensuring that laboratory analysis, data validation, data processing, data QC and electronic data deliverables (EDD) activities are performed in accordance with applicable NYSDEC guidelines including DER-10.

- Ensuring that minority business enterprise/women business enterprise (MBE/WBE) goals are achieved.

2.2 Responsibility

The primary responsibilities for program management activities rest with the Program Manager (PGM). The PGM will have ultimate contract responsibility for the project, including responsibility for the technical content of all engineering work. The PGM will direct, review and approve all project deliverables, schedule staff and resources, resolve scheduling conflicts and identify and solve potential program problems. He/she will be directly accountable to NYSDEC's Division of Hazardous Waste Remediation for program execution. He/she has authority to assign staff, negotiate and execute contracts and amendments, as well as execute subcontracts. The PGM will communicate directly with CDM Smith's Project Manager.

The Project Manager will have overall responsibility for the technical and financial aspects of this project.

He/she will assign technical staff, maintain control of the project budget and schedule, prepare monthly progress reports, review and approve project invoices, evaluate the technical quality of the project deliverables as well as the adherence to QA/QC procedures and manage subcontractors. He/she will serve as CDM Smith's point of contact for this project.

The Program Quality Assurance Officer will monitor QC activities of program management and technical staff, as well as identify and report the needs for corrective action to the PGM. He/she will also conduct an internal review of all project deliverables prepared by CDM Smith staff and sign off on the final investigation reports.

The Program Health and Safety Officer will review and make recommendations to the Subcontractors on health and safety plans for compliance with Occupational Safety and Health Administration (OSHA) requirements. He/she will develop a HASP for CDM Smith and NYSDEC employees, handle over-sight activities, evaluate the performance of health and safety officers and maintain required health and safety records. He/she will report to the PGM.

The Health and Safety Site Supervisor/Coordinator will be responsible for ensuring that the HASP is implemented during field activities and that a copy of the site-specific HASP is maintained at the site at all times. He/she will also be responsible for upgrading or downgrading personnel protection based on actual conditions at the time of the investigation. The Coordinator must also present an overview of the HASP to field personnel prior to initiating any field activities and is responsible for assuring that field personnel sign off on this plan. He/she will contact the Program Health and Safety Officer if any questions or issues arise during the field activities that he/she cannot answer.

2.3 Subcontractors

The following subcontractor services may be required as part of the site characterization or site investigation activities and performed by subcontractors under CDM Smith's supervision:

- Geophysical Survey
- Geoprobe Installation (including Membrane Interface Probes (MIPs))
- Drilling (including soil boring and monitoring well installation)
- Vapor, Soil and Groundwater Sampling
- Analytical Services
- Construction Oversight and O&M
- Site Survey
- Investigation Derived Waste Removal
- Data Validation

Section 3

Field Procedures

CDM Smith's point of contact for any field investigation activities is the field team leader and the onsite NYSDEC representative or PM. Any minor changes in sampling activities that are within the proposed scope of the project will be documented each day in the field logbook and signed by both representatives. Any modifications that are inconsistent with the approved work plan are to be approved by the NYSDEC PM prior to implementation.

3.1 Documentation (Field Logbook)

Information recorded in field logbooks include at a minimum, field observations, data, calculations, time, weather, description of the data collection activity, methods, field instruments and calibrations, field screening results and sample identification. Additionally, the logbook may contain descriptions of wastes, biota, geologic material, and site features including sketches, maps or drawings, as appropriate.

3.1.1 Preparation

In addition to this QAPP, site personnel responsible for maintaining logbooks must be familiar withthe site-specific FAP. These should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation.

Prior to use in the field, each logbook should be marked with the specific NYSDEC site number, name and location. The field notebook will then be assigned to an individual responsible for its care and maintenance.

Field logbooks will be bound with lined, consecutively numbered pages. All pages must be numbered prior to initial use of the logbook. The following information will be recorded inside the front cover of the logbook:

- Site name, number and location
- Person and organization to whom the book is assigned, office address and phone number(s)
- Start date

3.1.2 Operation

The following is a list of requirements that must be followed when using a logbook:

- Record work, observations, quantity of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by the FAP, this information need not be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.

- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Before an entry has been signed and dated, any changes may be made but care must be taken not to obliterate what was written originally. Indicate any deletion by a single line through the material to be deleted.
- Do not remove any pages from the book.
- Record as much information as possible.
- Specific requirements for field logbook entries include:
  - Initial and date each page.
  - Initial and date all changes.
  - Multiple authors must sign out the logbook by inserting the following:
- Above notes authored by:
  - (Sign name)
  - (Print name)
  - (Date)
- A new author must sign and print his/her name before additional entries are made.
- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:
  - Date and time.
  - Description of activity being conducted, including station (i.e., well, boring, sampling location number) if appropriate.
  - Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data.
  - Level of personnel protection to be used.
  - Subcontractors on site.

Entries into the field logbook will be preceded with the time (written in military units) of the observation. The time should be recorded at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form. In these cases, the logbook must reference the automatic data record or form.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities.
- Deviations from procedures outlined in any governing documents. Also, record the reason for any noted deviation.
- Problems, downtime, or delays.
- Upgrade or downgrade of personnel protection equipment.
- Visitors to the site.

3.1.3 Post-Operation

To guard against loss of data due to damage or disappearance of logbooks, completed pages will be scanned periodically (weekly, at a minimum) and submitted to the project manager. Documents that are separate from the logbook will be scanned and submitted regularly to the project manager. This includes all automatic data recording media (printouts, logs, disks or tapes) and activity-specific data collection forms required by other FAP.

At the conclusion of each activity or phase of site work, the individual responsible for the logbook will confirm all entries have been appropriately signed and dated, and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook will be submitted to the records file.

3.2 Sample Collection, Documentation and Identification

The following procedures describe proper sample collection and documentation to be included in field logbooks. Documentation includes describing data collection activities, logging sample locations, sample IDs, container labeling and chain of custody (COC) forms. Procedures for sample classification to assure proper labeling of samples are also included.

3.2.1 Responsibilities

The field task manager or field engineer is responsible for overseeing field operations such as, soil vapor intrusion, soil borings, Geoprobe, well drilling, collection of vapor, soil or groundwater samples, field logbooks, sample documentation, COC forms and labeling of any Investigative Derived Waste (IDW) drums, if required. Additionally, the field manager and/or field engineer is responsible for ensuring that all field activities adhere to the site-specific HASP and that samples are sent to the laboratory as soon as practicable. Generally, samples should be received by the laboratory within 48 hours of sampling.

3.2.2 Sample Collection

3.2.2.1 Water Samples

- Volatile Organic Compounds (VOCs), if analyzed, are to be sampled first. Pour water slowly into the 40-ml vial, tipping the vial and allowing water to run down the side to prevent aeration. Fill until a meniscus forms and tightly seal the vial. Invert the vial and check for bubbles. If bubbles are present, add water and repeat. It may be necessary to discard the vial and use another if bubbles continue to appear.

- Remaining bottles should then be filled, again preventing aeration.
- If filtering is required (filtering is sometimes requested when samples are to be analyzed for metals and turbidity is high), use a dedicated 0.45 micron filter for each sample and filter prior to preservation.
- Label bottles with sample designation, project, date, time, preservative and required analysis. Clear tape may be used to cover the completed label.
- Place sample in a cooler with ice to maintain temperature at 4°C +/- 2°C. Samples will be maintained at this temperature throughout the sampling and transportation period. COC and shipping procedures are discussed in Section 3.3 and field logbook procedures in Section 3.1.

3.2.2.2 Soil/Sediment/Sludge Samples

- VOCs, if analyzed, are to be sampled first. Fill the jar completely such that there is no air space. VOCs must not be homogenized. En Core® samplers or similar may be used to collect undisturbed soil samples. In such case, the appropriate sample collection volume and preservation methods should be followed.
- For the remaining parameters, homogenize the samples with a decontaminated stainless bowl (Section 3.12) and trowel prior to filling the remaining bottles. Use of dedicated disposable trowels is permitted.
- Label bottles with sample designation, project, date, time, preservative and required analysis. Clear tape may be used to cover the completed label.
- Place sample in a cooler with ice to maintain temperature at 4°C +/- 2°C. Samples will be maintained at this temperature throughout the sampling and transportation period. COC and shipping procedures are discussed in Section 3.3 and field logbook procedures in Section 3.1.

3.2.2.3 Soil Vapor/Ambient Air Samples

- Soil vapor samples will be collected with either a 1.4-liter or 6-liter Summa canister, a 2-hour or 24-hour flow controller (regulators) and particulate filters (if required). Flow rate shall not exceed 200 ml/min. The size of Summa canister and duration of sample are dependent on the type of soil vapor sample.
- Sub slab soil vapor samples will be collected with 6-liter Summa canisters, with 24-hour (unless otherwise specified in project-specific work plan) flow controllers (regulators) and particulate filters (if required). Sample flow rate shall not exceed 200 ml/minute.
- Indoor and outdoor ambient air samples will be collected with 6-liter Summa canisters, with 24-hour (unless otherwise specified in project-specific work plan) flow controllers

(regulators) and particulate filters (if required). Sample flow rate shall not exceed 200 ml/minute.

- Instantaneous grab samples may also be collected, as permitted by NYSDEC.
- Record vacuum prior to and at conclusion of sampling. Prior to sampling, vacuum should read 25-30 inches of mercury (Hg).
- At conclusion of sampling, vacuum should be 5 inches Hg +/- 1 inch Hg.
- Label Summa canister and prepare for shipping. Summa canisters are not chilled or otherwise preserved.

3.2.3 Field Logbooks

Complete and thorough notes of all field events are essential to a timely and accurate completion of each project. The field task manager and/or field engineer is responsible for accounting for actions of the subcontractor and the times for said actions while in the field. Include identification (numbers and description) of field samples, duplicates samples, and field or trip blank samples in the field logbook. For a given workday, the field logbook should contain the following:

- Names of field personnel, names of subcontractors (if any), number of persons in crew, equipment used and any calibrations completed, weather, date, time, and location at start of day (boring number).
- Sample identification number, depth, amount of sample recovery, PID readings, odors, and soil descriptions.
- Description of any unusual surface or subsurface soil conditions
- Record of Health and Safety monitoring; time, equipment and results
- Record of site accidents or incidents
- Record of any visitors
- Any field work delays and the cause of the delay, i.e. subcontractor equipment breakdown
- Materials and equipment used during borehole installation
- Final daily summary of work completed, including a list of samples obtained
- Completion of daily QA/QC log sheet
- Contractor downtime, decontamination time, equipment breakdowns, movement tracking throughout the day, etc.
- Any other data that may be construed as relevant information in the future.

The field logbooks should confirm the subcontractor's data. Field notes should be scanned weekly and submitted to the project manager.

If a borehole is completed (regardless of whether a monitoring well is installed), field personnel shall record the lithography, PID measurements, and any samples collected in the field logbook. Additionally, a soil boring log shall be completed, an example is provided in **Appendix A**. The field task manager should review field forms at the end of each day.

Monitoring well logs are required if the borehole is completed as a monitoring well. These are to be completed in the field after a monitoring well is installed. They should include data such as screen length, riser length, materials used, etc. An xxample monitoring well construction log is provided in **Appendix A**. The completed monitoring well logs should be reviewed by the field task manager.

3.2.4 Drum Labeling

Labeling of drums is essential for tracking hazardous materials. The subcontractor is responsible for collecting, handling, and transporting the drums for disposal, but field personnel are responsible for labeling drums appropriately. There is a significant cost implication if drums are not property labeled. Unknown material must be disposed of as hazardous waste if any hazardous waste is found on-site.

The following drum labeling procedures are to be adhered to:

- Field staff shall secure packing list envelopes to the side of the drum(s) at the completion of a boring.
- Field staff shall print with an indelible marker on information cards all information pertaining to the contents of the drum(s). If more than one drum is collected from the same borehole, each information card shall be numbered sequentially in parenthesis starting with the number one after the boring number. The information shall include:
    - Program Area
    - Boring No.(s)
    - Date collected
    - Description of contents (i.e., soil cuttings, well water, etc.)
    - Amount of contents (specify in inches)
    - Fullness of drum (not including free liquid, specify in fractional form)
- Field staff shall insert information card into packing list envelope. The packing list envelope shall be sealed at this time.
- Field staff shall record in field logbook all information pertaining to the contents of the drum that was printed on the information card.

- Project manager, upon receipt of the analytical data for the drums, shall prepare a summary table of the analytical results on a weekly basis, and provide to the designated coordinator.
- Based on the tabulated information, the designated coordinator will determine and prepare the appropriate storage labels required:
  - Hazardous waste label
  - Non-hazardous label
- The designated coordinator will fill out these labels.
- Field staff shall attach these labels to the appropriate drums. If the information cards inside the packing list envelopes are damaged, they shall be reprinted at this time.

It is noted that waste material is expected to be transported off-site once testing is completed and disposal requirements are obtained.

3.2.5 Sample Identification

Each sample collected will be designated by an alphanumeric code that will identify the type of sampling location, matrix sampled, and the specific sample designation (identifier). The sample identification for all samples will begin with the Site ID for the site.

The following terminology shall be used for the **soil** sample identification:

SITE ID - BORING/SAMPLE LOCATION ID – DEPTH- DATE

The sample ID for the soil vapor and groundwater samples will then include the sample type designation, followed by the sample number. The following terminology shall be used for the **soil vapor** sample identification:

SITE ID – SV – # - DATE

Where there are shallow and deep samples at a location, the shallow samples will be designated "S" and the deep samples designated "D".

The following terminology shall be used for the **groundwater** sample identification:

SITE ID-GW-MW # - DEPTH- DATE (if necessary) for monitoring well samples
SITE ID-GW-TP# - DEPTH- DATE (for temporary well point or hydro-punch samples)

For sub-slab and indoor/outdoor air samples, the site ID will be followed by the sample type designation, the sample number and then the date. The following terminology shall be used for the **structure** sample identification:

SITE ID-SS-xx-DATE (for sub-slab locations)
SITE ID-IA-xx-DATE (for indoor ambient air)
SITE ID-A-xx-DATE (for outdoor ambient air)

Field blank and **trip blank** samples will be designated as follows:

SITE ID-FB-DATE (for field blanks)
SITE ID-TB-DATE (for trip blanks)

Field **duplicates** will be designated by using the next consecutive sample number for the site.

3.3 Chain of Custody Procedures

This section describes the procedures used to ensure that sample integrity and COCs are maintained throughout the sampling and analysis program.

COC procedures provide documentation of sample handling from the time of collection until its disposal by a licensed waste hauler. This documentation is essential in assuring that each sample collected is of known and ascertainable quality.

The COC begins at the time of sample collection. Sample collection is documented in the field logbooks in accordance with the specified Standard Operating Procedure (SOP). At the same time, the sampler fills out the label on the sample container with the following information:

Sample ID code

- Required analyses
- Sampler initials
- Date and time of sample collection

3.3.1 Chain of Custody Forms

The COC forms are a paper trail system that follows the samples collected and indicates which laboratory analyses are to be performed on which samples. Each sample should be clearly labeled and listed on the COC. The laboratory will only perform analyses on samples indicated and all other samples should be indicated with a "HOLD" designation. By labeling a sample "HOLD", the laboratory will store the sample until further instruction is given. Do not check the request for analysis blocks on the COC for samples designated with "HOLD" Status. Never indicate duplicate or blank samples on a COC.

It is the responsibility of the field manager to coordinate COC forms and supply copies of all COC to the project manager for data management use.

A COC form is filled out for each sample type at each sampling location. Each time the samples are transferred to another custodian or to the laboratory, the signatures of the people relinquishing the sample and receiving the sample, as well as the time and date, are documented. Labels will be filled out with an indelible, waterproof, marking pen.

3.3.2 Chain of Custody Records

The COC record is a three-part form. The laboratory retains the original form and the person relinquishing the samples keeps a copy of the form at the time of sample submittal. This form is then returned to the project manager or person in charge of data coordination.

The COC record will be placed in a Ziplock bag and placed inside of all shipping and transport containers. All samples will be hand delivered or shipped by Federal Express to the laboratory identified for the project . Samples should be packed so that no breakage or leakage will occur (e.g. placed upright in the cooler surrounded by packing materials). Custody seals will be placed on all coolers/packages containing laboratory samples during shipment.

3.4 Field Quality Control Samples

In order to maintain QA/QC in both the field and the laboratory, additional samples such as trip blanks, duplicates, field blanks, performance evaluation samples and background samples will be collected. Each type of QA/QC sample is described below. Details of the QA/QC samples collected will be provided to the project data validator for use in their evaluation.

3.4.1 Quality Control for Soil Sampling

At a minimum, five percent of all soil samples analyzed should be QA/QC samples. These samples act as a verification of appropriate field and laboratory procedures. These samples should be recorded in the field book but should not be identified on the COC form other than with an MD (Miscellaneous Discrete). All QA/QC samples should be numbered sequentially with other field samples on the soil log form. The following is a breakdown of types of QA/QC samples that are to be taken:

3.4.1.1 Duplicate Samples

At minimum, field duplicate samples should be collected at a frequency of one per twenty soil samples analyzed. Soil duplicates shall be field-homogenized samples, excluding VOCs. To ensure laboratory "blind" analyses, duplicate samples will be identified with the next sequential sample number on sample containers and the COC forms. The actual identification of the duplicate samples shall be recorded in the field logbook. Duplicate samples are collected from the same split spoon sampler, homogenized in the field and analyzed for the same compounds.

3.4.1.2 Field Blanks

Approximately five percent of all soil samples analyzed should be field blanks. Rinsate blanks are collected after a sample is taken and the equipment used (i.e., split spoon sampler) has been decontaminated. Distilled water is then poured over the decontaminated sampling equipment and collected in sample jars for analysis. It should be documented in the field logbook which soil sample preceded the field blank and which soil sample followed the field blank for the equipment used.

3.4.2 Quality Control for Soil Vapor and Air Sampling

Approximately five percent of all soil vapor (including sub-slab soil vapor) samples analyzed should be duplicate samples. Soil vapor duplicates will be collected in a manner so that the sample and duplicate are being collected simultaneously from the same sample location. One duplicate indoor air sample will be collected per site where indoor air sampling is being conducted. Duplicate outdoor air samples will be collected only at the sites where indoor air sampling is also being conducted. Duplicate samples are analyzed for the same compounds. All Summa canisters must be certified to be free of contaminants in accordance with QA/QC protocol.

3.4.3 Quality Control for Groundwater Sampling

Approximately five percent of all groundwater samples analyzed should be QA/QC samples. These samples act as a verification of appropriate field and laboratory procedures. These samples should be recorded in the field book but should not be identified on the COC form as a QA/QC sample. All QA/QC samples should be numbered sequentially with other field samples. The following is a breakdown of types of QA/QC samples that are to be taken:

3.4.3.1 Duplicate Samples

Approximately five percent of all groundwater samples analyzed should be duplicate samples.

To ensure laboratory "blind" analysis, duplicate samples will be recorded with the well I.D. number and the next sequential sample number on sample containers and the COC forms. Duplicate samples should be collected using the same method as the parent sample and analyzed for the same compounds.

3.4.3.2 Trip Blanks

Each cooler packed and shipped for aqueous VOC analysis should also contain a trip blank. Trip blanks are VOC vials filled with distilled water. These pre-filled vials are to be carried with the sample bottles and samples and should remain sealed the entire time. It should be documented in the field book which aqueous samples were collected and transported with the trip blank.

3.4.3.3 Field Blanks

One field blank sample will be collected per day of sampling. Field blanks are collected after a sample is taken and the equipment used (i.e., bailer) has been decontaminated. Distilled water is then poured over the decontaminated sampling equipment and collected in sample jars for analysis. It should be documented in the field logbook which groundwater sample preceded the field blank and which sample followed the field blank for the equipment used.

3.5 Pre-Mobilization

Prior to initiating fieldwork, the following preparatory activities will be completed:

- Utility clearance and permitting. The drilling subcontractor is responsible for contacting the appropriate local utility or “one-call” service to locate subsurface and aboveground utilities in the vicinity of the soil gas survey area.
- Site-specific issues resolved.
- Site-specific HASP completed and approved.
- Geophysical survey completed, as necessary.
- Sample analysis will be scheduled with the laboratory.
- Appropriate sample containers and preservatives for the various sample parameters will be obtained. Extra containers will be obtained to account for possible breakage.

- Field blank water will be obtained from the laboratory performing the analysis. This water shall be specified as VOC free water.
- Necessary field sampling and monitoring equipment will be obtained. Prior to use, the equipment will be checked to confirm that it is in good working condition, properly calibrated, and decontaminated. The suggested field equipment for the procedures detailed in Sections 3.6 through 3.34is listed in Table 3-1.
- Materials necessary for personal protection and decontamination will be obtained.
- Coordinate with subcontractors and all Task Orders completed and signed.

3.6 Direct Push Groundwater Sampling

3.6.1 Macro Core Sampling

Direct push methods will be used to collect 48 or 60 inch macro-core samples continuously at each of the groundwater sample locations. The samples will be used by the CDM Smith engineer, geologist, or field scientist to determine the depth to groundwater at each location. Once saturated soil is verified, a screen point groundwater sampler will be set approximately 5 feet into the water table. The depth to water will be used to determine the depth of the soil vapor probes.

3.6.2 Purge and Sampling

Standard purge techniques will be utilized to purge and sample groundwater. Standard purge and sampling techniques consist of using a check valve and tubing to purge the well at a low flow rate. The check valve intake is set approximately in the middle of the screen. The well is purged at the low rate until the water flows clear or the turbidity is reduced to 50 nephelometric turbidity units (NTUs) or less, or to a level deemed acceptable by NYSDEC. The sample is then collected directly from the tubing or bailer.

3.6.3 Direct Push Groundwater Sampling Procedure

Personal protective equipment will be donned in accordance with the requirements of the site-specific HASP.

- Assemble the screen point groundwater sampler.
- Attach the mill-slotted screen point groundwater sampler, onto the leading probe rod.
- Thread the drive cap onto the top of the probe rod and advance the sampler using either the hydraulic hammer or hydraulic probe mechanism. Replace the 30 centimeter (cm) rod with the 90 cm rod as soon as the top of the sampler is driven to within 15 cm of the ground surface.
- Advance the sampler to the interval to be sampled using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.

- Move the probe unit back from the top of the probe rods and remove the drive cap.
- Attach the pull cap to the top probe rod, retract the probe rods, push the screen into the formation, remove extension rods from the probe rods, and measure and record the water level, allowing time for the water level to reach equilibrium.
- Purge the groundwater until the water flows clear or the turbidity has been reduced to 50 NTUs or less. If the well is purged dry, the sample may be collected after the well recharges.
- Collect the samples using a check valve and flexible tubing system.
- Label and store samples. Samples will be preserved, labeled, and placed immediately into a cooler and maintained at 4°C throughout the sampling and transportation period.

  Samples should be labeled, recorded on the COC and shipped according to the proper procedures. Custody seals will be placed on all coolers/packages containing laboratory samples during shipment.

3.7 Soil Vapor Sampling

Soil vapor sampling will be conducted in accordance with the New York State Department of Health (NYSDOH) *"Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006,"* including the May 2017 Updates to Soil Vapor/Indoor Air Decision Matrices, and the NYSDEC *"DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010".*

3.7.1 Soil Vapor Probe Installation

A soil vapor probe installation at all locations will be performed according to the following procedures:

- At each location, a Geoprobe will be used to drive stainless steel rods equipped with detachable stainless steel drive points to the desired depth (approximately 8 feet bgs).
- Once the probe is in place, retract the drive rod slightly to expose a 6 inch sampling screen and sampling port. Insert Teflon®-lined tubing through the rods and attach it to the soil gas probe just above the tip.
- Seal the probe at the surface using electrical conduit putty or non-shrink bentonite grout.
- The borehole will then be backfilled with sand to a minimum depth of 6 inches above the screen interval.
- Bentonite slurry will then be placed from approximately 6 inches above the screen to the ground surface and immediately hydrated. The bentonite will be allowed to set-up for a minimum of 24 hrs.
- Repeat steps 1 through 4 at a second co-located borehole to the second depth (~2 feet above the water table).

3.7.2 Tracer Testing

Tracer tests will be conducted at fifty percent of soil vapor locations to verify the integrity of the soil vapor probe seal. Tracer tests will be conducted according to the following procedures:

- Set up the tracer test apparatus by first sealing the open area around the Teflon®-lined tubing with wax or bentonite.
- A bucket is then placed upside down over the borehole with the tubing coming out through a hole at the top.
- Helium will then be injected through a hole near the bottom of the bucket to enrich the atmosphere to at least 80 percent helium. The concentration of helium inside the bucket will be monitored by a helium detector located at a second hole near the bottom of the bucket.

  Once the atmosphere is enriched to the appropriate concentration, the helium detector will then be used to monitor the concentration coming out of the tubing from the borehole located at the top of the bucket. If the reading is below 10 percent tracer gas, the probe seal is sufficient; proceed with sampling, as described in the following sections. If the reading is above 10 percent tracer gas, the probe seal is insufficient; reseal the probe surface with bentonite and repeat the tracer test until the reading is below 10 percent tracer gas.

3.7.3 Soil Vapor Sampling Procedures for Laboratory Analysis

Once the soil gas probe is installed and a tracer test is conducted, soil gas samples for laboratory analysis will be collected according to the following procedures:

- The soil vapor samples will be collected using a laboratory-certified clean Summa canister with a regulator ensuring that the sample flow rate less than 200 milliliters per minute (ml/min) to minimize outdoor air infiltration during sampling. The Summa canisters will have a vacuum of 28 inches mercury (in Hg) ± 2 inches prior to the collection of the soil vapor sample.
- Calculate the volume of the tubing including the screen interval as part of the volume. The tubing has an inside diameter of ¼ inch and a volume of 9.65 ml/foot.
- Attach the vacuum pump and purge at least 3 tube volumes from the Teflon®-lined tubing.
- A Tedlar™ bag will be filled toward the end of the purge volume to be screened using the PID meter. The PID readings will be observed and recorded on the appropriate field form.
- After purging is complete, the tubing will be connected to the Summa canister.
- Record the initial pressure in the stainless steel Summa canister to be used for the sample prior to connecting the tubing. The samples will be collected using laboratory-certified clean Summa canisters with flow regulators and a vacuum of 28 inches Hg, ± 2 inches. Vacuum readings in the canister should be approximately 25-30 inches of Hg. If no vacuum reading is obtained, use a different canister as this indicates the canister was not properly evacuated.

- Connect the end of the tubing directly to the Summa canister intake valve.
- Collect the sample into the Summa canister, which will be provided by CDM Smith's subcontract laboratory. An additional canister and regulator will be ordered as backup. Sample flow rate will not exceed 200 ml/min.
- When the vacuum gauge reads 5 inches Hg, close the valve. Sampling is complete. A vacuum of 5 inches Hg ± 1 inch must be present when sample collection is terminated to prevent contamination during transit. Record the final pressure reading in the Summa canister.
- Field personnel will label, pack and ship the samples to an NYSDOH Environmental Laboratory Approval Program (ELAP) approved laboratory.

  The serial numbers for the Summa canisters and the regulators as well as the initial and ending pressures of each canister will be recorded on the COC and in the logbook. Custody seals will be placed on all coolers/packages containing laboratory samples during shipment.
- The field sampling team will maintain a sample log sheet summarizing the following:
  - Sample identification;
  - Date and time of sample collection;
  - Sampling depth;
  - Serial numbers for Summa canisters and regulators;
  - Sampling methods and devices;
  - Purge volumes;
  - Volume of soil vapor extracted;
  - Vacuum of Summa canisters before and after sample collection;
  - Apparent moisture content (dry, moist, saturated, etc.) of the sampling zone; and
  - COC protocols and records used to track samples from sampling point to analysis

It is critical to ensure that moisture does not enter the Summa canister which can compromise the analytical results.

3.8 Temporary Sub-Slab Soil Vapor Sampling Procedures

Sub-slab soil gas samples for laboratory analysis will be collected according to the following procedures:

- Prior to installation of the sub-slab vapor point, the building floor should be inspected and any penetrations (cracks, floor drains, utility, sumps, etc.) should be recorded. Sub-slab points should be installed at locations where the potential for ambient air infiltration via floor penetrations is minimal.
- After the slab has been inspected and the location of any subsurface utilities determined, the ambient air surrounding the proposed sampling location will be screened with a PID.
- A hammer drill, equipped with a 1.25-inch diameter drill bit, will be used to advance a hole to a depth of approximately three to 6 inches beneath the slab. When drilling is complete, clean around drilled area.
- Insert tubing constructed with 3/8-inch outer diameter poly, ¼-inch inner diameter Teflon® tubing. The tubing should not extend further than 2 inches into the sub-slab material.
- The annular space between the borehole and the sample tubing will be filled and sealed with electrical conduit putty (or equivalent) at the surface.
- Conduct tracer testing in accordance with the procedures detailed in Section 3.7.2 above.
- The tubing will be connected to a low-flow sample pump. A three-way valve will be used to allow purging of all the lines. Flow rates for both purging and collection must not exceed 200 ml/min to minimize the ambient air infiltration during sampling.
- Approximately 1 liter of gas will be purged from the subsurface point and captured in a Tedlar™ bag using the low-flow pump. PID readings will be observed from this sample and the highest reading shall be recorded on the appropriate field form.
- Record the initial pressure in the stainless steel Summa canister to be used for the sample prior to connecting the tubing. The samples will be collected using laboratory-certified clean Summa canisters with flow regulators and an initial vacuum of 28 inches Hg ± 2 inches. If no vacuum reading is obtained, close the valve and try a new regulator. If no vacuum reading is observed a second time, use a different canister as this indicates the canister was not properly evacuated.
- The end of the tubing will be connected directly to the Summa canister's regulator intake valve via the three-way valve. Flexible silicone tubing will be used at a minimum and as a tubing adapter only. The sample shall be collected with a 6 liter laboratory-certified Summa canister with dedicated regulator lab calibrated for a 24-hour sample collection.
- When the vacuum gauge reads 5 inches of Hg, close the valve. Sampling is complete. A vacuum of 5 inches Hg ± 1 inch must be present when sample collection is terminated to prevent contamination during transit. Record the final pressure reading in the Summa canister.
- CDM Smith personnel will label, pack and ship the samples to an NYSDOH ELAP approved laboratory. The serial numbers for the Summa canisters and the regulators as well as the

initial and ending pressure of each canister will be recorded on the COC and in the field logbook. Custody seals will be placed on all packages containing laboratory samples during shipment.

- Remove the sample port and patch the floor with concrete.

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:

- 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).
- The use of heating or air conditioning systems during sampling should be noted.
- Floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, Heating, Ventilation, and Air Conditioning (HVAC) system air supply and return registers, compass orientation (north), footings that create separate foundation sections, and any other pertinent information should be completed.
- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas.
- Weather conditions (e.g., precipitation and indoor and outdoor temperature) and ventilation conditions (e.g., heating system active and windows closed) should be reported.
- Any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via PID, Jerome Mercury Vapor Analyzer, etc.), should be recorded.
- Photograph documentation should be taken of all sample locations and materials stored at each sample location.

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.

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;
- Soil vapor purge volumes;
- Volume of soil vapor extracted;
- If canisters used, vacuum of canisters before and after samples collected;
- Apparent moisture content (dry, moist, saturated, etc.) of the sampling zone; and
- COC protocols and records used to track samples from sampling point to analysis.

3.9 Permanent Port Sub-Slab Soil Vapor Sampling Procedures for Vapor Intrusion

Sub-slab soil vapor samples for laboratory analysis will be collected from permanent sub-slab ports according to the following procedures:

- 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.
- After the slab has been inspected and the location of any subsurface utilities determined, the ambient air surrounding the proposed sampling location will be screened with a PID.
- A hammer drill with a 3/8 inch diameter drill bit will be used to drill an inner pilot hole into the concrete slab to a depth of approximately 2 inches.
- Using the pilot hole as the center, drill 1 inch diameter outer hole to an approximate depth of 1 3/8 inch.
- Clean any cuttings out of the hole.
- Using the 3/8-inch drill bit, continue to drill the pilot hole through the slab and several inches into the sub-slab material.
- Assemble the stainless steel permanent point:
  - Determine the length of stainless steel tubing required to reach from the bottom of the outer hole, through the slab, and into the open cavity below the slab. To avoid obstruction of the probe tube, insure that it does not contact the sub-slab material.
  - Attach the measured length of ¼ inch OD stainless tubing to the female connector with the swagelock™ nut and tighten the nut.
  - Insert the ¼ inch hex socket plug into the female connector. Tighten the plug. Do not over tighten.

- Place the completed probe into the outer hole. The probe tubing should not contact the sub-slab material and the top of the female connector should be flush with the surface of the slab and centered in the outer hole.

- Fill the space between the probe and the inside of the outer hole with anchoring cement and allow to cure.

- Wrap one layer of Teflon thread tape onto the NPT end of the male connector.

- Remove the ¼ inch hex socket plug from the female connector.

- Screw and tighten the male connector into the female connector.

- A length of Teflon®-lined tubing is attached to the probe assembly and connected to the sample system for purging and sample collection.

- A three-way valve will be used to allow purging of all the lines. Flow rates for both purging and collection must not exceed 100 ml/min to minimize the ambient air infiltration during sampling.

- Purge at least 3 volumes from the subsurface probe and captured in a Tedlar™ bag using a 60 cc syringe. PID readings will be observed from this sample and the highest reading shall be recorded on the appropriate field form.

- Record the initial pressure in the stainless steel Summa canister to be used for the sample prior to connecting the tubing. The samples will be collected using laboratory certified clean Summa canisters with flow regulators and a vacuum of 28 inches Hg ± 2 inches. Vacuum readings in the canister should be approximately 25-30 in Hg. If no vacuum reading is obtained, use a different canister as this indicates the canister was not properly evacuated.

- The end of the tubing will be connected directly to the Summa canister's regulator intake valve via the three-way valve. Flexible silicone tubing will be used at a minimum and as a tubing adapter only. The sample shall be collected with a 6 liter laboratory certified Summa canister with dedicated regulator lab calibrated for a 24 hour (unless otherwise specified in the project-specific work plan) sample collection.

- Collect the sample into the Summa canister, which will be provided by the subcontracted laboratory.

- When the vacuum gauge reads 5 inches Hg, close the valve. Sampling is complete. A vacuum of 5 inches Hg ± 1 inch must be present when sample collection is terminated to prevent contamination during transit. Record the final pressure reading in the Summa canister.

- CDM Smith personnel will label, pack and ship the samples to an NYSDOH ELAP-approved laboratory. The serial numbers for the Summa canisters and the regulators as well as the initial and end pressure of each canister will be recorded on the COC. Custody seals will be placed on all coolers/packages containing laboratory samples during shipment.

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:

- 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).
- The use of heating or air conditioning systems during sampling should be noted.
- 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.
- 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.
- Weather conditions (e.g., precipitation and indoor and outdoor temperature) and ventilation conditions (e.g., heating system active and windows closed) should be reported.
- Any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via PID, 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.

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;
- Soil vapor purge volumes;
- Volume of soil vapor extracted;

- If canisters are used, vacuum of canisters before and after samples collected;
- Apparent moisture content (dry, moist, saturated, etc.) of the sampling zone; and
- COC protocols and records used to track samples from sampling point to analysis.

3.10 Indoor (Ambient) Air Sampling Procedures Vapor Intrusion

All indoor air samples will be collected with a 6 liter laboratory certified Summa canister regulated for a 24 hour sample collection. Sample collection will be similar to outdoor ambient air sample collection. The Summa canister will be placed in an appropriate location as to collect a representative sample from the breathing zone at 4 or 6 feet above the floor. Personnel should avoid lingering in the immediate area of the sampling device while samples are being collected.

The NYSDOH *Indoor Air Quality Questionnaire and Building Inventory* shall be completed for each structure where indoor air testing is being conducted. The following actions should be taken to document conditions during indoor air sampling and ultimately to aid in the interpretation of the sampling results:

- 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).
- 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.
- The use of heating or air conditioning systems during sampling should be noted.
- 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.
- 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.
- Weather conditions (e.g., precipitation and indoor and outdoor temperature) and ventilation conditions (e.g., heating system active and windows closed) should be reported.
- Any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via PID, 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.

The field sampling team should maintain a sample log sheet summarizing the following:

- Sample identification;
- Date and time of sample collection;
- Sampling height;
- Identity of samplers;
- Sampling methods and devices;
- Volume of air sampled;
- Vacuum of canisters before and after samples collected; and
- COC protocols and records used to track samples from sampling point to analysis.

3.11 Outdoor (Ambient) Air Sampling Procedures for Vapor Intrusion

All outdoor air samples will be collected with a laboratory certified Summa canister regulated for a 24 hour sample collection using a 6 liter Summa canister. The Summa canister will be placed in an appropriate location as to collect a representative sample from the breathing zone at 4 or 6 feet above the ground.

Personnel will avoid lingering in the immediate area of the sampling device while samples are being collected. Ambient air samples will be collected in a location that will not be impacted by any boring or dust generating activities.

The following actions will be taken to document conditions during ambient air sampling:

- Outdoor plot sketches will be drawn that include the building site, area streets, ambient air sample locations, the location of potential interferences, compass orientation, and paved areas.
- Weather conditions (e.g. precipitation, temperature, wind direction and barometric pressure)
- Any pertinent observations, such as odors, reading from field instruments, and significant activities in the vicinity (e.g. operation of heavy equipment) will be recorded.

The field sampling team will maintain a sample log sheet summarizing the following:

- Sample identification;
- Date and time of sample collection;

- Sampling height;
- Identity of samplers;
- Sampling methods and devices;
- Volume of air sampled;
- Vacuum of canisters before and after samples collected; and
- COC protocols and records used to track samples from sampling point to analysis.

3.12 Decontamination

All non-dedicated, non-disposable sampling equipment and tools used to collect samples for chemical analysis will be decontaminated prior to and between each sample interval using an Alconox rinse and potable water rinse prior to reuse. Unless disposable sampling equipment is used, the equipment will be decontaminated by the following procedure:

- Wash with a non-phosphate detergent
- Tap water rinse
- Deionized water rinse
- Air dry and wrap in aluminum foil, shiny side out

Additional cleaning of the drilling equipment with steam may be needed under some circumstances if elevated levels of contamination appear to be present using field monitoring equipment or if there are visible stained soils. Decontamination fluids will be discharged to the ground surface unless visible sheen or odor is detected either on the equipment or the fluids, at which point the decontamination water will be contained in a 55 gallon drum, staged, labeled and properly disposed of.

3.13 Investigative Derived Waste

All IDW such as drill cuttings and other soil generated during investigation activities, shall be handled in accordance with DER-10 Section 3.3 (e). Transport, storage and disposal of IDW are generally subject to one or more solid or hazardous waste regulations (e.g. 6 New York Codes, Rules, and Regulations (NYCRR) Parts 360,364 and 370 series). All material from onsite activities, with the exception of test pits, is considered hazardous and must be containerized and properly stored onsite for offsite disposal.

Test pit material may be placed back into the hole if the material is from the same general strata from which it was removed and there is no non-aqueous phase liquid (NAPL) or free product present.

Investigation derived water/fluid resulting from well development or well purging before sampling must be collected, handled and discharged/disposed of pursuant to applicable guidance and regulations. It shall be properly labeled and stored onsite. If the water/fluid meets any of the following criteria, it must be properly disposed of offsite:

- Visual evidence of contamination, consisting of discoloration, sheens, free product or NAPL.
- Olfactory evidence of contamination.
- Concentrations of contaminants of above groundwater standards at levels of concern that are known to be present in the monitoring wells based on previous sampling of groundwater.

If none of the conditions above apply, the containerized water/fluid may be discharged to an unpaved ground into the same groundwater unit, within or adjacent to a source area in a manner which does not result in surface water runoff, with DER approval.

3.13.1 Waste Sampling

Waste classification sampling will occur before the completion of site investigation activities. Representative soil samples will be collected from waste containers with a decontaminated stainless steel or disposable trowel.

The samples will be homogenized (except for VOC samples) in a stainless steel bowl and transferred to the sample container(s) for subsequent analysis. Grab samples will be collected from each container containing aqueous wastes.

The requirements for waste characterization will be determined by the disposal facility. The containers of waste will be stored in an area designated by NYSDEC until the analytical results are received and the waste can be characterized for disposal.

3.13.2 Waste Sampling Procedure

3.13.2.1 Soil Waste

- Scan the sample with the PID and record readings.
- Collect a sample of the soil from the container using a decontaminated stainless steel or disposable trowel and place the sample in a stainless steel bowl (for VOC samples, place sample directly in the sample container). Homogenize the soil using the trowel. Samples will be collected and homogenized in the steel bowl to represent each drum.
- Remove the cap from the container.
- Fill the sample container as completely as possible by transferring the sample to the container immediately after collected the sample with a stainless steel trowel, and screening the sample with the PID.
- Close the sample container tightly.
- Label the container and place it in a cooler with bagged ice sufficient to cool the samples to 4°C.

- Maintain COC forms for samples.
- Log the description of IDW sampled in the field book, i.e. number of drums and locations from which IDW originated.

3.13.2.2 Aqueous Waste

- Remove the cap from the drum containing the aqueous waste.
- Fill a sample container(s) as completely as possible by transferring liquid sample from the waste container to the sample container and screening the sample with a PID.
- Close the sample container(s) tightly.
- Place sample container(s) in cooler with bagged ice sufficient to cool the samples to 4°C.
- Maintain COC forms.

3.14 Soil Boring Logs/Geoprobe

Geological logging includes keeping a detailed record of drilling (or excavating) and a geological description of materials on a prepared form.

Geological logs are used for all types of drilling and exploratory excavations and include descriptions of both soil and rock. Accurate and consistent descriptions are imperative.

3.14.1 Log Form

When drilling in soils or unconsolidated deposits, the log should be kept on a standard Soil Boring Log Form (Appendix A). The following basic information should be entered on the heading of each log sheet:

- Project name and number
- Boring or well number
- Locations (approximate in relation to an identifiable landmark; will be surveyed)
- Elevations (approximate at the time; will be surveyed)
- Name of drilling contractor
- Drilling method and equipment
- Water level
- Start and finish (times and date)

The following technical information is recorded on the logs:

- Depth of sample below surface
- Sample interval

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- Sample type and number
- Length of sample recovered
- Standard penetration test (American Society of Testing Materials (ASTM-D1586)) results, if applicable
- Soil description and classification
- Graphic soil symbols
- PID readings

In addition to the items listed above, all pertinent observations about drilling rate, equipment operation, or unusual conditions should be noted. Such information might include the following:

- Size of casing used and method of installation
- Rig reactions such as chatter, rod drops, and bouncing
- Drilling rate changes
- Material changes
- Zones of caving or heaving

3.14.2 Soil Classification

The soil description should be concise and should stress major constituents and characteristics. Soil descriptions should be given in a consistent order and format. The following order is as given in ASTM D2488:

- Soil name. The basic name of the predominant constituent and a single-word modifier indicating the major subordinate constituent.
- Gradation or plasticity. Granular soil (sand or gravel) should be described as well graded, poorly graded, uniform, or gap-graded, depending on the gradation of the minus 3 inch fraction. Cohesive soil (silts or clays) should be described as non-plastic, slightly plastic, moderately plastic, or highly plastic, depending on the results of the manual evaluation for plasticity as described in ASTM D2488.
- Particle size distribution. An estimate of the percentage and grain-size range of each of the soil's subordinate constituents with emphasis on clay-particle constituents. This description may also include a description of angularity. This parameter is critical for assessing hydrogeology of the site and should be carefully and fully documented.
- Color. The color of the soil using Munsell notation.
- Moisture content. The amount of soil moisture, described as dry, moist, or wet.

- Relative density or consistency. An estimate of density of a granular soil or consistency of a cohesive soil, usually based on standard penetration test results (see **Table 3-2** and **Table 3-3).**
- Local geologic name. Any specific local name or a generic name (i.e., alluvium, loess). Also use of Unified Soil Classification System of symbols.

The soil logs should also include a complete description of any tests run in the borehole; placement and construction details of piezometers, wells, and other monitoring equipment; abandonment records; geophysical logging techniques used; and notes on readings obtained by air monitoring instruments.

- Additional data in sedimentary rocks includes:
  - Sorting
  - Cementation
  - Density or compaction
  - Rounding

The core should be logged as quickly as possible after removal from the hole. Some materials may degrade rapidly upon exposure.

Check each core end carefully and try to determine if the fracture is natural or mechanical in origin. Mechanical fractures often can be identified by their orientation, the absence of secondary coatings or filling and slicken sides, and its fit with the adjacent core piece. If doubt exists, consider it a natural fracture. If it is determined that the fracture is mechanical, consider the two pieces of core as a single piece.

Table 3-2
Relative Density of Non-Cohesive Soil

Blows/Ft	Relative Density	Field Test
0-4	Very Loose	Easily penetrated w/ ½-inch steel rod pushed by hand
5-10	Loose	Easily penetrated w/ ½-inch steel rod pushed by hand
11-30	Medium	Easily penetrated w/ ½-inch steel driven with a 5- lb hammer
31-50	Dense	Penetrated one foot with a ½-inch steel road driven with 5-lb hammer
>50	Very Dense	Penetrated only a few inches with a ½-inch steel rod driven with a 5-lb hammer

Blows/Ft= Blows per foot
lb = pound

Table 3-3
Relative Consistency of Cohesive Soil

Blows/Ft	Consistency	Pocket Penetrometer (TSF)	Torvance (TSF)	Field Test
<2	Very Soft	<0.25	<0.12	Easily penetrated several inches by fist
2-4	Soft	0.25-0.8	0.12-0.25	Easily penetrated several inches by thumb
5-8	Firm	0.50-1.0	0.25-0.5	Can be penetrated several inches by thumb with moderate effort
9-15	Stiff	1.0-2.0	0.5-1.0	Readily indented by thumb but penetrated only with great effort
16-30	Very Stiff	2.0-4.0	1.0-2.0	Readily indented by thumbnail
>30	Hard	>4.0	>2.0	Indented with difficulty by thumbnail

TSF= Tons per square foot

3.15 Monitoring Well Installation

This section provides procedures for well design and well construction to aid in the development of drilling subcontracts. Drilling operation and well development guidelines are presented to aid the reader in the oversight of the installation of monitoring wells.

The principal reason that monitoring wells are constructed is to collect groundwater samples that, upon analysis, can be used to delineate a contaminant plume and track movement of specific chemical or biological constituents.

A secondary consideration is the determination of the physical characteristics of the groundwater flow system to establish flow direction, transmissivity, quantity, etc. The spatial and vertical locations of monitoring wells is important. Of equal importance are the design and construction of monitoring wells that will provide easily obtainable samples and yield reliable, defensible, and meaningful information. In general, monitoring well design and construction follows production well design and construction techniques. However, emphasis is placed on the effect these practices may have on the chemistry of the water samples being collected rather than on maximizing well efficiency.

From this emphasis, it follows that an understanding of the chemistry of the suspected pollutants and of the geologic setting in which the monitoring wells are constructed plays a major role in determining the drilling technique and materials used.

3.15.1 Well Siting

The following procedures should be followed:

- Review pertinent proposal sections, specifications, and subcontractor's contracts. Review any regulations governing how, where or when the well is drilled. Review data (supplied by the Client, or any other data available) used for program planning.

- Identify well site on a topographic map or other suitable project base map. Contact landowner at the beginning of well siting. Inquire whether the proposed drill locations will interfere with the landowner's established land use. Unless the property is owned by the client, the landowner is always contacted before entering the property, even if he/she is leasing back the property from the client.

- Check route to confirm a drill rig can access the proposed well site. Plan routes that require the least disturbance of natural vegetation or natural conditions and which would not require grading or other types of work using mechanical equipment.
- The well site should be reasonably level and absent of large boulders or other hazardous obstructions.
- Check to insure absence of buried high-pressure gas, oil or water lines. If any lines are present relocate the well site a safe distance away from them. Be sure to check with the subcontractor to insure his/her agreement.
- Check to insure absence of overhead power transmission lines. If any overhead power lines are present, relocate the well site a safe distance away from them. Be sure to check with the subcontractor to insure his/her agreement.
- Consult landowner about water source and access, and then notify the driller of these decisions.
- Explain to the driller the need for care and accurate retrieval of drill cuttings and, if necessary, placement and accounting of materials during well completion.
- If necessary, request access agreement to the well site.

3.15.2 Well Design

The following procedures should be followed:

- Examine the geophysical log and determine the exact interval(s) and depth(s) of the completion zone(s). Calculate the quantity of slotted casing or screen, blank casing, sealing materials, gravel pack and cement necessary to complete the well.
- Calculate the quantities of gravel pack, sealing materials and cement figuring the volume of the bore hole [borehole radius squared time the length of the borehole (rB2 x L)] minus the volume of the casing [radius of the casing squared times the length of the casing (rC2 x L)] which will yield the volume per linear foot.
    - A cubic foot of silica sand weighs 100 pounds. Frequently silica sand is packaged in 100 pound sacks but should be purchased and delivered in bulk quantities. A 5-gallon bucket is equal to 0.67 cubic feet. Dividing the determined or calculated volume between the well bore and the outside of the casing(s) into 0.67 cubic feet per bucket will yield approximately the number of feet per bucket of silica sand. Dividing the total interval of the intended gravel pack by the number of feet per bucket of gravel pack will yield approximately how many buckets of gravel will be required. This same method can be used if the silica sand arrives in 1 cubic foot sacks (100 pounds) except the final value is approximately the number of feet per sack of silica sand.

- Cement typically comes in 94 pound sacks and can be mixed in the field to obtain volumes between 0.88 cubic feet per sack to 1.50 cubic foot per sack. See **Table 3-4** for the most common cement slurry mixtures.

- Clay seals are routinely placed in a well completion above the gravel or filter pack and below the cement or grout cap or plug. The clay seals are generally a bentonite clay and, before swelling (in the borehole), has the form of ¼ inch to ½ inch pellets. The pellets generally come in plastic containers of 20 and 50 pounds, but can also arrive in boxes or cloth sacks.

Table 3-4
Monitoring Well Grout

Water-Cement Ratio (gallons water per sack)	Weight per Gallon of Slurry (pounds)	Volume of Mixture per Sack (cubic feet)
7 1/2	14.1	1.50
7	14.4	1.43
6 ½	14.7	1.35
6	15.0	1.28
5 ½	15.4	1.21
5	15.8	1.14
4 ½	16.25	1.08
4	16.50	1.00
3 ½	17.35	0.95
3	18.1	0.88

The volume of the bentonite pellets needed for a specific seal thickness is calculated in the same manner as was done for the gravel pack and cement requirements.

Measure all materials twice during the well construction. First, when estimating the quantity of supplies needed for the completion, second, during well construction. Keep the first estimate in the daily log book. Record the following; the actual (second measurement) intervals top and bottom), as well as the quantity and type of materials placed in the well. recorded

3.15.3 Well Construction

The following procedures should be followed:

3.15.3.1 Final Design of Casing - Screen/Slotted Casing String(s)

- If there is any doubt about the final design of the casing string, based on data from the pilot hole or the individual drill holes scheduled for completion, verify the design with the hydrogeologist in charge.

- It is the hydrogeologist's responsibility to insure adequate supplies are maintained at each well site even though it may be the contractor's responsibility for supplying the materials.

3.15.3.2 Installing Casing (Slotted/Screen Casing String(s))

- Plastic or Polyvinylchloride (PVC) Casing - Join all 5 or 10 foot lengths of casing (solid and slotted screen) by flush-joint threading. All pipe is cut with a cutting tool which leaves a smooth, square end.
- Both the hydrogeologist and the contractor keep a complete casing-slotted/screen string tally. Seal the bottom of the casing or slotted/screen casing string with a cap screwed permanently in place.

3.15.3.3 Installing Filter Material (Gravel Pack)

- Place the filter material downhole by gravity feed.
- The filter material shall be installed to levels pre-determined by the hydrogeologist. The exact depth for each well is determined from the final well design. However, generally the top of the filter material will be 5 feet above the top of the highest slotted screen interval.
- Following placement of the filter material "sound" or "tag" this depth with the tremie pipe to insure it is at the prescribed level.

3.15.3.4 Installing Bentonite Pellet Seals (Blanket)

Following the installation of the filter material, place a Bentonite pellet blanket seal on top of the filter material to prevent contamination of the filter pack by the grout.

The actual amount of the annulus that is filled with Bentonite pellets may vary from completion to completion but a minimum of 12 inches of the annulus should be filled with Bentonite by gravity feed from the surface. The tremie pipe remains in the bore hold during gravity feed of the Bentonite pellets. Calculate the exact volume of pellets needing placement.

3.15.3.5 Grouting

- Grout the annular space above the Bentonite pellets as directed by the hydrogeologist.
- The grouted volume of annular space will vary from well to well, and sometimes within the same completion. Generally, if the annular space exceeds approximately 20 feet then the grouting is done in more than one stage. Take care that the grout does not displace the Bentonite seal or exceed (in weight) the collapse strength of the casing.
- The methods for mixing grout in the field vary. The first concern is that the slurry mixture is fluid enough for placement by tremie pipe and heavy enough to give the desired strength and sealing properties required. Reference the table from Halliburton Cementing Tables, 1979 or other suitable source for the amount of water per sack, and then measure accurately into a large tub (water trough) or steel pit. Mix the correct number of bags of cement with the water at a rate which prevents, clotting or settling out of dry, unmixed cement. Usually this procedure is accomplished with a portable pump that sucks the water or cements mixtures in and then expels it under pressure through a hose that is used in a jetting fashion at the opposite end of the tank, pit or trough.

- Grout also can be mixed using a shovel or hoe. Generally, the grout is placed on the side of the tub, the bag is ruptured, and the cement is slowly added to the water. If the cement has hard spots place on a screen of approximately ¼ inch mesh attached to some type of frame that is placed across the mixing tub. The cement is then "filtered" for the larger; hard pieces or blocks.

▪ Pumping or Pouring Grout

- Place the mixed grout above the Bentonite pellets. The time between placement of the Bentonite pellets and the grout should not be less than 15 to 20 minutes. This allows the pellets to settle to the top of the gravel pack and to begin to swell, while not allowing the grout to harden.

- The grout can either be pumped down the tremie pipe by the same pump used for jetting or it can be poured by buckets through a funnel into the tremie pipe. Displacement of the bore hole fluid is almost certain because the grout slurry weighs more than the residual borehole fluid (10 or 11 pounds per gallon for the mud versus 14 to 18 pounds per gallon for the grout).

- Except under rare circumstances, grout is never poured from the surface nor is it ever poured into standing water.

- Grout the remainder of the hole by gravity feed from the surface, as directed by the hydrogeologist. The quantity of grout placed from the surface should not exceed the collapse strength of the casing and should not be initiated prior to the curing of the grout seal above the Bentonite pellets.

3.16 Monitoring Well Development

All completed wells, whether the production or monitoring type, must be developed in order to facilitate unobstructed and continuous groundwater flow into the well. Well development is the process of cleaning the fines from the face of the borehole and the formation near the well screen. During any drilling process the side of the borehole becomes smeared with drilling mud, clays or other fines. This plugging action substantially reduces the permeability and retards the movement of water into the well screen. If these fines are not removed, especially in formations having low permeability, it then becomes difficult and time consuming to remove sufficient water from the well before obtaining a fresh groundwater sample because the water cannot flow easily into the well.

The development process is best accomplished for monitoring wells by causing the natural formation water inside the well screen to move vigorously in and out through the screen in order to agitate the clay and silt, and move these fines into the screen. The use of water other than the natural formation water is not permitted.

3.16.1 Development Methods

The following well development methods may be used including:

- Surge Block - A surge block is a round plunger with pliable edges such as belting that will not catch on the well screen. Moving the surge block forcefully up and down inside the well screen causes the water to surge in and out through the screen accomplishing the desired cleaning action. Surge blocks are commonly used with cable-tool drilling rigs, but are not easily used by other types of drilling rigs.

- Bailer - A bailer sufficiently weighted that will sink rapidly through the water and can be raised and lowered through the well screen. The resulting agitating action of the water is similar to that caused by a surge block. The bailer, however, has the added advantage of removing the fines each time it is brought to the surface and dumped. Bailers can be custom-made for small diameter wells, and can be hand-operated in shallow wells.

- Surging and pumping - Starting and stopping a pump so that the water is alternately pulled into the well through the screen and backflushed through the screen is an effective development method. Periodically pumping to the surface will remove the fines from the well and permit checking the progress to assure that development is complete.

Well development should continue until the water becomes free of sediment or contains sediment in a lesser amount than was initially present. Conductivity, pH, temperature and turbidity (as measured by a YSI meter or equivalent) of the development water must all have stabilized prior to ceasing development. Disposal of development water shall be in accordance with Section 3.13.

3.17 Low Flow Groundwater Sampling

Low-flow purge and sampling is appropriate at locations where disturbance of the media around the well screen needs to be minimized. A common concern is turbidity in the monitoring wells and the consequent undesirable effects on metals sampling results. Groundwater samples will be collected from permanent monitoring wells at least two weeks after development is completed, allowing the aquifer to stabilize and return to steady-state conditions.

The low-flow purge and sample method creates less disturbance and agitation in the well, and therefore excess turbidity is not generated during the purging and sampling process. The result is a more rapid stabilization of turbidity and other parameters (pH, temperature, specific conductivity, oxidation reduction potential (ORP), and dissolved oxygen), and a sample more representative of conditions in the formation is collected.

The low flow purge and sample method consists of using a submersible, peristatic or bladder pump to purge the well at a very low flow rate (0.5 to 1.5 liter/minute). The pump intake is set approximately in the middle of the well screen, with a stagnant water column over the top of the pump. The well is purged at the low rate until the field parameters (temperature, pH, specific conductivity, turbidity, dissolved oxygen, and ORP) have stabilized. The sample is then collected directly from the pump discharge at a low flow rate. Procedures for collecting groundwater sampling using low flow methods are as follows:

- Check and record the condition of the well for any damage or evidence of tampering.

- Remove the well cap.

- Measure well headspace with a PID and record the reading in the field logbook. For wells installed on a landfill, also measure the headspace with a combustible gas indicator.
- Measure and record the depth to water with an electronic water level device and record the measurement in the field logbook. Do not measure the depth to the bottom of the well at this time (to avoid disturbing any sediment that may have accumulated). Obtain depth to bottom information from installation information in the field logbook or drilling logs. Calculate volume of the water column by depth of water column times the cross-sectional area of the well.
- Lower pump to desired sampling depth. During purging, monitor the water level and field parameters (temperature, pH, turbidity, specific conductance, ORP and dissolved oxygen) approximately every 3 to 5 minutes or using a flow through cell such as a YSI. Continue monitoring until the water level stabilizes and field parameters have stabilized to within 10 percent (plus or minus 5 percent) over a minimum of three readings. Turbidity and dissolved oxygen are typically the last parameters to stabilize. Note: once turbidity readings get below 10 NTUs, then the stabilization range can be amended to 20 percent (plus or minus 10 percent) over a minimum of three readings.
    - If a flow through cell is not used, readings should be taken in a clean container and the monitoring instrument allowed to stabilize before collection of the next sample. The Horiba instrument takes the readings consecutively and therefore the process to record all the measurements may take longer than five minutes. If so, measurements should be taken as often as practicable.
- Once the water level and field parameters have stabilized, collect the samples from the pump. Collect samples per Section 3.2.2.1.
- Decontaminate equipment in accordance with Section 3.12.

3.18 Monitoring Well Purging

Well purging can be performed on a volume basis or on a field parameter stabilization basis. In both cases, field parameters are recorded; however, for the former case purging is concluded after a target number of well volumes (typically 3 to 5) regardless of whether parameters have stabilized. In the latter case, purging continues until field parameters stabilize within 10 percent.

3.18.1 Volumetric Method of Well Purging

The following steps should be followed when purging a well by the volumetric method:

- Don personal protective clothing and equipment as specified in the site-specific HASP.
- Open the well cover and check the condition of the wellhead, including the condition of the surveyed reference mark, if any.
- Monitor the air space at the wellhead, using a PID or equivalent, as soon as well cover is removed according to health and safety requirements.

- Calibrate the required field parameter meters according to manufacturer's specifications.
- Determine the depth to static water level and depth to bottom of well casing. Calculate the volume of water within the well bore based on the following well volumes.

Table 3-5
Well Volumes

Well Diameter (inches)	Gallons (per foot)
2	0.16
4	0.65
6	1.5
8	2.6
10	4.1
12	5.9

Note: Record all data and calculations in the field logbook.

- Set up field parameter probes at the discharge orifice or dedicated probe port of the pump assembly or within the flow-through chamber.
- Prepare the pump and tubing, or bailer, and lower it into the casing.
- Remove the number of well volumes specified in the site-specific plans. Generally, three to five well volumes will be required. Field parameters should be measured and recorded, if required by site-specific plans. In low recharge aquifers, the well commonly will be pumped or bailed to dryness before three well volumes of water are removed. If this is the case, there is no need to continue with purging operations. Record pertinent data in the field logbook.
- Remove the pump assembly or bailer from the well, decontaminate it (if required), and clean up the site. Lock the well cover before leaving. Containerize and/or dispose of development water as required by the site-specific plan.

3.18.2 Indicator Parameter Method of Well Purging

- Don personal protective clothing and equipment as specified in the site-specific HASP.
- Open the well cover and check the condition of the wellhead, including the condition of the surveyed reference mark, if any.
- Monitor the air space at the wellhead, using a PID or equivalent, as soon as well cover is removed according to health and safety requirements.
- Calibrate the required field parameter meters according to manufacturer's specifications.
- Determine the depth to static water level and depth to bottom.
- Set up field parameter probes at the discharge orifice or dedicated probe port of the pump assembly or within the flow-through chamber.

- Assemble the pump and tubing, or bailer, and lower into the casing.
- Begin pumping or bailing the well. Record indicator parameter readings for every purge volume. Maintain a record of the approximate volumes of water produced.
- Continue pumping or bailing until indicator parameter readings remain stable within ±10 percent for three consecutive recording intervals, or in accordance with site-specific plans. Purging should continue until the discharge stream is clear or turbidity becomes asymptotic-low or meets project requirements. In a low recharge aquifer, the well may pump or bail to dryness before indicator parameters stabilize. In this case, there is no need to continue purging. Record pertinent data in the field logbook.
- Remove the pump assembly or bailer from the well, decontaminate (if required), and clean up the site. Lock the well cover before leaving. Containerize and/or dispose of development water as required by the site-specific plans.

3.19 Groundwater Sampling by Bailer

Groundwater is typically sampled by bailer after purging 3 to 5 well volumes per Section 3.18.

- Don personal protective clothing as specified in the site-specific HASP.
- Prepare the area for sample acquisition. If required, cover ground surface around well head with plastic sheeting.
- Open well head and immediately check for organic vapors with PID or flame ionization detector as appropriate.
- Determine static water level and calculate water volume in well.
- Purge well in accordance with Section 3.18.
- Allow water level to recover to a depth at least sufficient for complete submergence of the bailer without contacting well bottom. Ideally, the water level should recharge to 75 percent of static level. Samples shall be collected within 3 hours of purging if recharge is sufficient. Wells with a low recharge rate must be collected within 24 hours of purging.
- Securely attach the bailer to the line and test the knot. The opposite end of the line should be secured to prevent loss of bailer into well.
- Lower bailer slowly into the water to prevent aeration, particularly when VOC samples are collected.
- Retrieve filled bailer and fill sample bottles in accordance with Section 3.2.2.1.
- Collect required field parameters and depth to water.
- Decontaminate non-disposable sampling equipment in accordance with Section 3.12.
- Secure well, clean up area.

3.20 Well Abandonment

Once it is deemed that the temporary or permanent monitoring well is no longer needed, the well will be abandoned by a New York State certified well driller as follows:

- The well will be sounded (its depth measured with a weighted line or appropriate method) immediately before it is destroyed to make sure that it contains no obstructions that could interfere with filling and sealing. If an obstruction is present over drilling the well to its original depth to remove obstruction(s) may be required.
- Where possible, remove all material within the original borehole – including the well casing, filter pack and annular seal. If the casing, filter pack and annular seal materials cannot be removed, they may be left in place.
- The casing left in place may require perforation or puncturing to allow proper placement of sealing materials. Where the casing is left in the hole, the casing may be cut at the surface.
- Fill well screen with sand per NYSDEC specifications.
- The monitoring well should be filled to the surface with cement grout, or within 20 feet of the surface with Bentonite grout. After the placement of the Bentonite grout (if used), the remaining portion of the well then should be sealed with a Portland Type I, II or Type I/II cement with 2 percent to 5 percent Bentonite.

3.21 Surface Water Sampling

Four surface water sampling scenarios are provided below. These include 1) shallow surface water samples for VOC analysis (preserved and unpreserved), 2) shallow surface water samples for non-VOC or inorganic compound analysis (preserved and unpreserved), 3) deep surface water samples using a weighted bottle sampler and 4) deep surface water samples using a peristaltic pump.

The following steps should be taken when preparing for sampling surface water:

- Don the appropriate personal protective clothing as dictated by the site-specific HASP.
- Identify stream/river sampling locations as directed in work plan.
- Prepare sampling site by laying out clean plastic sheeting on the ground or any flat, level surfaces near the sampling area and place equipment to be used on the plastic.
- Make field measurements as required by the project plans in physical, chemical, and biological characteristics of the water (e.g., temperature, turbidity, dissolved oxygen, conductivity, ORP, pH).
- The samples shall be collected from areas of least to greatest contamination (when known) and, when collecting several samples in 1 day, always collect from downstream to upstream.
- The sampler should be facing upstream when sampling.

- Document the sampling events, recording all information in the designated field logbook and take photographs if required or if possible. Document all deviations from this SOP and include rationale for changes.

3.21.1 Collecting Shallow Surface Water Samples

The following steps must be taken when collecting shallow surface water samples:

- Approach the sample location from downstream; do not enter the sample area. Slowly submerge VOC vials completely into an area of gently flowing water and fill. Do not disturb bottom sediments. The sampler and open end of the vials should be pointed upstream. If wading is necessary, approach the sample location from downstream; do not enter the actual sample area. When using gasoline-powered vessels, make sure the engine is turned off.

- Collect samples per Section 3.2.2.1; if preserved bottles are used, collect sample in a dedicated non-preserved bottle and transfer to the preserved bottle.

Note: When collecting samples for VOC analysis, avoid collecting from a surface water point where water is cascading and aerating. Cap the VOC vial while it is under water. After the vial is capped, check the vial to see if there are any air bubbles trapped in it. If air bubbles are present discard the sample and re-collect.

3.21.2 Collecting Deep Surface Water Samples at Specified Depth Using a Weighted Bottle Sampler

The following steps must be followed when collecting surface water samples at specific depths using a weighted bottle sampler:

- Lower the weighted bottle sampler to the depth specified in the site-specific plan.

- Remove the stopper by pulling on the sampler line; allow the sampler to fill with water.

- Release the sampler line to reseat the stopper and retrieve the sampler to the surface.

- Wipe the weighted bottle sampler dry with a Kimwipe or clean paper towel.

- Remove the stopper slowly. Collect samples per Section 3.2.2.1.

- Decontaminate equipment according to the Section 3.12.

3.21.3 Collecting Deep Surface Water Sample Collection Using a Peristaltic Pump

The following steps must be followed when collecting deep surface water samples using a peristaltic pump:

- Install clean silicon or Teflon®-lined tubing on the pump head. Leave sufficient tubing on the discharge side for convenient dispensing of liquid directly into sample containers.

- Select the appropriate length of Teflon®-lined intake tubing necessary to reach the specified sampling depth. Attach the intake sampling tube to the intake pump tube.
- Lower the intake tube into the surface water at the specified sampling location to the specified depth; make sure the end of the intake tube does not touch underlying sediments.
- Start the pump and allow at least three tubing volumes of liquid to flow through and rinse the system before collecting any samples. Do not immediately dispense the purged liquid back to the surface water body. Instead, collect the purged liquid and return it to the source after sample collection is complete.
- Fill the specified number of sample containers directly from the discharge line, in accordance with Section 3.2.2.1.
- Drain the pump system, rinse it with deionized water, and wipe it dry. Replace all tubing with new tubing before sampling at another sampling location. Place all used tubing in plastic bags to be discarded or decontaminated according to the Section 3.12.

3.22 Sediment/Sludge Sampling

The following steps should be taken when preparing for sampling sediment/sludge:

- Don the appropriate personal protective clothing as dictated by the site-specific HASP.
- Identify stream/river sampling locations in accordance with the site-specific work plan.
- Prepare sampling site by laying out clean plastic sheeting on the ground or any flat, level surfaces near the sampling area and place equipment to be used on the plastic.
- The samples shall be collected from areas of least to greatest contamination (when known) and, when collecting several samples in 1 day, always collect from downstream to upstream.
- When sampling sediment and surface water from the same surface water body, collect surface water samples prior to sediment samples.

3.22.1 Sediment/Sludge Sample Collection from Shallow Waters

- Use a decontaminated stainless steel or Teflon, long-handled scoop, corer, push tube, or dredge to collect the entire sample in one grab. If wading is necessary, approach the sample location from downstream. Do not enter the actual sample area.
- Retrieve the sampling device and slowly decant off any liquid phase.
- Collect samples in accordance with Section 3.2.2.2.

3.22.2 Subsurface Sediment/Sludge Sample Collection Using a Corer or Auger from Shallow Waters

- At the specified sampling location, force or drive the corer to the specified depth.

- Twist and withdraw the corer in a smooth motion.
- Retrieve the sampling device, remove the corer nosepiece (if possible), and extrude the sample into the specified sampling container(s). Use a clean stainless steel or Teflon spoon or spatula to completely fill the container(s), ensuring no headspace.
- Collect samples in accordance with Section 3.2.2.2.

3.22.3 Sediment/Sludge Sample Collection Using a Dredge from Deep Waters

- Attach a clean piece of 12 to 19 mm (½ to ¾ inch) braided nylon line or Teflon-coated wire rope to the top of the sampler. The line must be of sufficient length to reach sediment or sludge and have enough slack to release the mechanism. Mark the distance to the bottom on the line.
- Attach the free end of the sampling line to a fixed support to prevent loss of the sampler.
- At the specified sampling location, open the sampler jaws and slowly lower the sampler until contact with the bottom (sediments/sludge) is felt.
- Release tension on the line; allow sufficient slack for the mechanism (latch) to release. Slowly raise the sampler.
- Once the sampler is above the water surface, place the sampler in a stainless steel or Teflon lined tray or pan. Open the sampler.
- Collect samples in accordance with Section 3.2.2.2.

3.22.4 Restrictions/Limitations

Core sampling devices may not be usable if cobbles exist in the sediment/sludge. Bumping of core sampling devices and Ponar dredge samplers may result in the loss of some of the sample.

For VOC analysis or for analysis of any other compound(s) that may be degraded by aeration, grab sampling is necessary to minimize sample disturbance and, hence, analyte loss. The representativeness of this sample, however, is difficult to determine because the collected sample represents a single point, is not homogenized, and has been disturbed.

3.23 Subsurface Soil Sampling

Subsurface soil samples may be collected using a hand auger at depths of up to 10 feet (typical). In such cases, CDM Smith typically performs the boring and collects the samples for analysis. For deeper depths, a drilling subcontractor is typically used to perform a boring and collect subsurface soil samples by split spoon or Shelby tube via rotary drilling methods, or by direct push methods. In such cases, the driller provides the soil samples to CDM Smith, and CDM Smith then collects the laboratory samples.

The following steps should be taken when preparing for subsurface soil sampling:

- Don the appropriate personal protective clothing as dictated by the site-specific HASP.

- Locate sampling location(s) in accordance with project documents (e.g., work plan) and document pertinent information in the appropriate field logbook. When possible, reference locations back to existing site features such as buildings, roads, intersections, etc.
- Processes for verifying depth of sampling must be specified in the site-specific plans.
- Clear away vegetation and debris from the ground surface at the boring location.
- Prepare an area next to the sample collection location for laying out cuttings by placing plastic sheeting on the ground to cover the immediate area surrounding the borehole.

The following general steps must be followed when collecting all subsurface soil samples:

- VOC samples or samples that may be degraded by aeration shall be collected first and with the least disturbance possible.
- Sampling information shall be recorded in the field logbook and on any associated forms.
- Describe lithology, including color, grains size, moisture, odor and other observations.

3.23.1 Manual (Hand) Auger Sampling

The following steps must be followed when collecting hand-auger samples:

- Auger to the depth required for sampling. Place cuttings on plastic sheeting or as specified in the site-specific plans. If possible, lay out the cuttings in stratigraphic order.
- Throughout the sampling, make detailed notes concerning the geologic features of the soil or sediments in the field logbook.
- Cease augering when the top of the specified sampling depth has been reached. If required, remove the auger from the hole and decontaminate the auger or use a separate decontaminated auger, then obtain the sample.
- Scan sample with PID, as appropriate.
- Collect samples in accordance with Section 3.2.2.2. Collect VOCs quickly to minimize loss of volatiles.
- When all sampling is complete, dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans.
- Decontaminate all equipment in accordance with Section 3.12

3.23.2 Split-Spoon/ Split Barrel Sampling

Note: the first 15 bullets describe activities to be performed by a licensed drilling contractor, not CDM Smith personnel.

The following steps must be followed when collecting split-spoon samples:

- Remove any pavement and subbase material from an area of twice the bit diameter, if necessary.
- The drilling rig will be decontaminated at a separate location prior to drilling.
- Attach the hollow-stem auger with the cutting head, plug, and center rod(s) to the drill rig.
- Begin drilling and proceed to the first designated sample depth, adding auger(s) as necessary.
- Upon reaching the designated sample depth, slightly raise the auger(s) to disengage the cutting head and rotate the auger without advancement to clean cuttings from the bottom of the hole.
- Remove the plug and center rods.
- If required by the site-specific sampling plan, install decontaminated liners in the split-spoon/split barrel sampler.
- Install a decontaminated split-spoon on the center rod(s) and insert it into the hollow-stem auger. Connect the hammer assembly and lightly tap the rods to seat the drive shoe at the top of undisturbed soil or sediment.
- Mark the center rod in 15 cm (6 inch) increments from the top of the auger(s).
- Drive the split-spoon using the hammer. Use a full 76 cm (30 inch) drop as specified by the ASTM Method D-1586. Record the number of blows required to drive the spoon or tube through each 15 cm (6 inch) increment.
- Cease driving when the full length of the spoon has been driven or upon refusal. Refusal occurs when little or no progress is made for 50 blows of the hammer. ASTM D1586-99 § 7.2.1 and 7.2.2 defines “refusal” as greater than 50 blows per 6 inch advance or a total of 100 blows.
- Pull the split-spoon free by using upswings of the hammer to loosen the sampler. Pull out the center rod and split-spoon.
- Unscrew the split-spoon assembly from the center rod and place it on the plastic sheeting.
- Remove the drive shoe and head assembly. If necessary, tap the split-spoon assembly with a hammer to loosen threaded couplings.
- With the drive shoe and head assembly off, open (split) the split-spoon, being careful not to disturb the sample.
- Scan sample with PID, as appropriate.
- Collect samples in accordance with Section 3.2.2.2. Collect VOCs quickly to minimize loss of volatiles.

- When all sampling is complete, dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans.
- Decontaminate all equipment in accordance with Section 3.12.

3.23.3 Direct Push Drilling

Note: The first six bullets describe activities to be performed by a licensed drilling contractor, not CDM Smith personnel.

- Decontaminate equipment, if required.
- Install acetate sleeve in direct push sampler (no acetate sleeve required for split-spoon).
- Drive samples from the surface to the desired depth, using either 4 foot or 5 foot long direct push samplers, or 2 foot split-spoons.
- Use discrete interval sampling (sampler end is plugged while driving to top of desired sample interval to exclude soil from non-desired depths) when appropriate (for example, deeper than 8 feet or below the water table).
- At top of sampling interval, release plug (if used) and drive sampler across desired sample interval.
- Retrieve sample and provide to CDM Smith.
- Cut open acetate sleeve with two parallel slices, scan with PID as appropriate.
- Collect samples in accordance with Section 3.2.2.2.
- At the conclusion of the boring, grout the borehole and decontaminate equipment in accordance with Section 3.12.

3.23.4 Restrictions/Limitations

- Basket or spring retainers may be needed for split-spoon sampling in loose, sandy soils.

3.24 Surface Soil Sampling

The following steps must be followed when preparing for sample collection:

- Don the appropriate personal protective clothing as dictated by the site-specific HASP.
- Locate sampling location(s) in accordance with project documents (e.g., work plan) and document pertinent information in the appropriate field logbook. When possible, reference locations back to existing site features such as buildings, roads, intersections, etc.
- Processes for verifying depth of sampling must be specified in the site-specific plans.
- Carefully remove vegetation, stones etc. from the ground surface to expose soil.

- Place clean plastic sheeting on a flat, level surface near the sampling area, if possible, and place equipment to be used on the plastic; place the insulated cooler(s) on separate plastic sheeting.
- A clean, decontaminated trowel, scoop, or spoon will be used for each sample collected. Other equipment may be used (e.g., shovels) if constructed of stainless steel.
- Surface soil samples are normally collected from the least contaminated to the most contaminated areas, if known.
- Document the sampling events, recording the information in the designated field logbook. Document any and all deviations from SOPs in the field logbook and include rationale for changes.
- Collect samples in accordance with Section 3.2.2.2.
- Decontaminate sampling equipment in accordance with Section 3.12.

3.25 Water Level/NAPL Measurement

Water levels can be measured by several instruments. The three most common are covered here – electric water level meter (measures depth to water only), interface probe (measures depth to water and depth to non-aqueous phase liquid NAPL and pressure transducer (typically used to measure depth to water for long term monitoring or aquifer testing).

3.25.1 Procedures for Use of Water Level Meter

- Standing upwind of the well, open the well head and monitor with PID as dictated by the site-specific HASP.
- Check that water level meter is functioning correctly (test button, or immerse probe in tap water to test).
- Lower probe slowly into well until contact with water surface is indicated (tone and/or light).
- Slowly raise and re-lower probe until a precise, repeatable depth to water can be measured.
- Record the depth to water from the measuring point of known elevation, usually marked at the top of the casing. If no mark is present, measure from the highest point of the casing or as otherwise instructed in the site-specific work plan.
- Remove and decontaminate probe, secure well.

3.25.2 Procedures for Use of Interface Probe

The interface meter is used to measure the depth to water and the depth to non-aqueous phase liquid (light and/or dense).

- Standing upwind of the well, open the well head and monitor with PID as dictated by the site-specific HASP.

- Check that the interface level meter is functioning correctly (test button, or immerse probe in tap water and NAPL to test).
- Lower probe slowly into well until contact with water or NAPL surface is indicated. Water is typically indicated by a beeping tone; NAPL is typically indicated by a steady tone – check manufacturer's specifications.
- Slowly raise and re-lower probe until a precise, repeatable depth to water/NAPL can be measured.
- Record the depth to water/NAPL from the measuring point of known elevation, usually marked at the top of the casing. If no mark is present, measure from the highest point of the casing or as otherwise instructed in the site-specific work plan.
- Measurement of interface depth between Light Non-Aqueous Phase Liquid (LNAPL) and water: For LNAPL, the non-aqueous phase is floating on top of the water column, and the probe must be lowered through the NAPL before encountering water. In this case, shake the probe after water is encountered to help dislodge any NAPL droplets stuck to the probe. Then raise the probe slowly until it re-enters the NAPL. Perform this procedure until a repeatable result is obtained. The interface depth should be recorded in the up direction, never the down direction. When the probe is moving down, past the LNAPL, it may still be coated with product and can therefore yield misleading results. Therefore, it must be shaken in the water and raised to the interface for an accurate result. Record depth from measuring point, as noted above.
- Measurement of interface depth between Dense Non-Aqueous Phase Liquid (DNAPL) and water: For DNAPL, the non-aqueous phase is at the bottom of the well, below the water column. Lower the probe until NAPL is encountered. Then raise the probe, shake it in the water to dislodge any NAPL droplets, and lower it again. Perform this procedure until a repeatable result is obtained. The interface depth should be recorded in the down direction, never in the up direction. When the probe is moving up from the DNAPL it may still be coated with product and can therefore yield misleading results. Therefore, it must be shaken in the water and lowered to the interface for an accurate result. Record depth from measuring point, per item 5 above.
- Remove and decontaminate probe, secure well.

3.26 Tap Water Sampling

Tap water sampling may be performed in residential, commercial or industrial areas for several reasons. The most common tap water samples are used to obtain groundwater samples from private wells.

- Obtain permission to access the property and collect samples.
- Obtain the name(s) of the resident(s) or water supply owner/operator, the exact mailing address, and telephone numbers. This information is required to obtain access to the property to be sampled and to submit a letter of introduction to the owner/representative.

- Determine the location of the tap to be sampled based on its proximity to the water source. It is preferable that the tap water sampling be conducted at a tap located prior to any holding or pressure tanks, filters, water softeners, or other treatment devices that may be present.

- If possible, obtain well construction details, holding tank volumes etc. to evaluate standing volume of water in the system.

- If the sample must be collected at a point in the water line beyond a pressurization or holding tank, a sufficient volume of water should be purged to provide a complete exchange of fresh water into the tank and at the location where the sample is collected.

  If the sample is collected from a tap or spigot located just before a storage tank, spigots located inside the building or structure should be turned on to prevent any backflow from the storage tank to the sample tap or spigot. It is generally advisable to open as many taps as possible during the purge, to ensure a rapid and complete exchange of water in the tanks.

- Samples collected to determine if system related variables (e.g., transmission pipes, water coolers/heaters, holding/pressurization tanks, etc.) are contributing to the quality of potable water should be collected after a specific time interval (e.g., weekend, holiday, etc.). Sample collection should consist of an initial flush, a sample after several minutes, and another sample after the system has been purged.

- Devices such as hoses, filters, or aerators attached to the tap may harbor a bacterial population and therefore should be removed prior to sampling.

- Sample containers should not be rinsed before use when sampling for bacterial content, and precautions should be taken to avoid splashing drops of water from the ground or sink into either the bottle or cap.

- Samples of the raw water supply and the treated water after chlorination should be collected when sampling at a water treatment plant.

- In the logbook, record the location and describe the general condition of the tap selected for sampling. The rationale used in selecting the tap sampling location, including any discussions with the property owner, should also be recorded. Provide a sketch of the water supply/distribution system noting the location of any filters or holding tanks and the water supply source (i.e., an onsite groundwater well or surface water intake or a water service line from a public water main). If an onsite water supply is present, observe and record the surrounding site features that may provide potential sources of contamination to the water supply.

- Don the appropriate personal protective clothing as dictated by the site-specific HASP. Gloves should be changed between sampling locations to avoid possible cross-contamination of the tap water samples.

- Prior to sample collection, the supply system should be purged by turning the cold-water tap on. The following general guidelines should be followed to determine when the system is adequately purged (refer to the site-specific sampling plans for any other requirements):
- Onsite Water Supply; A minimum of three standing volumes of water (i.e., the static volume of water in the well and holding tank, if present) should be purged. Obtain water temperature, conductivity, and pH measurements after each volume of water is purged. If the standing volume of water in the supply system is unknown, the tap should be allowed to run for a minimum of 15 minutes and temperature, conductivity, and pH measurements, or other parameters as specified by the project plan, should be collected at approximately 3- to 5-minute intervals. (In general, well construction details and holding tank volumes should be obtained prior to conducting the sampling event to estimate the standing volume of the water supply system.) The system is considered adequately purged when the temperature, conductivity, and pH stabilize within 10 percent for three consecutive readings. If these parameters do not stabilize within 15 minutes, then purging should be discontinued and tap water samples may be collected.
- Large Distribution Systems; Because it is impractical to purge the entire volume of standing water in a large distribution network, a tap should be run for a minimum of 5 minutes, which should be adequate to purge the water service line. Obtain temperature, conductivity, and pH measurements at approximately 1-minute intervals. The system is considered adequately purged when the temperature, conductivity, and pH readings, or other parameters as specified by the project plan, stabilize within 10 percent for three consecutive readings. If these parameters do not stabilize within 5 minutes, then purging should be discontinued and tap water samples may be collected. During purging, a 5 gallon bucket and stopwatch may be used to estimate the flow rate if required by the site-specific plans. Dispose of the purged water according to the site-specific plans.

  Record the temperature/conductivity/pH readings, or other parameters as specified by the project plan, the volume of water purged, the flow rate if measured, and the method of disposal in the field logbook.
- After purging the supply system, collect the samples directly from the tap (i.e., if a hose was used for purging, the hose should be disconnected prior to sampling). Any fittings on the end of the faucet that might introduce air into the sample (i.e., a fine mesh screen that is commonly screwed onto the faucet) should be removed prior to sample collection also.
- Obtain a smooth-flowing water stream at moderate pressure with no splashing. Collect samples in accordance with Section 3.2.2.1 COC forms.

3.26.1 Restrictions/Limitations

To protect the sample from contamination on the exterior of a tap, a tap should not be chosen for sampling if any of the following conditions exist:

- A leaky tap allowing water to flow out from around the stem of the valve handle and down the outside of the faucet.

- A tap located too close to the bottom of the sink or the ground surface.
- A tap that allows water to run up on the outside of the lip.
- A tap that does not deliver a steady stream of water. A temporary fluctuation in line pressure may cause sheets of microbial growth, lodged in some pipe sections or faucet connections, to break loose.

Careful sampling for VOC analysis, or for any other compound(s) that may be degraded by aeration, is necessary to minimize sample disturbance and, hence, analyte loss.

3.27 Sample Handling, Packaging, and Shipping

The shipping containers (coolers or shuttles) will be provided by the laboratory providing the analysis. These containers, once filled, will be secured with fiber tape, wrapped entirely around the container and will either be shipped or delivered directly to the laboratory by the field crew or picked up by a laboratory provided courier. Consequently, the strict packaging, labeling and shipping of hazardous wastes and substances requirements set forth by the U.S. Department of Transportation (DOT) under Code of Federal Regulations (CFR) 49 will not be necessary. However, the following sample packaging procedures will be followed to guard against sample breakage and to maintain COC.

- Check to ensure that the sample is properly filled; tighten cap securely.
- Enclose and seal sample containers in a clear plastic bag.
- Place freezer packages of ice in large ziplock plastic bags and place the bags in a sample cooler so that ice is not in direct contact with sample bottles. Sufficient ice will be added to cool the samples to 4°C.
- Use appropriate packing material such as bubble wrap to protect sample bottles from breaking during shipping.
- Complete COC records and other shipping/sample documentation including air bill numbers for each shipment of samples using a ballpoint pen. Seal documentation in a waterproof plastic bag and tape the bag inside the shipping container under the container lid. Include a return address for the cooler.
- Close the container and seal it with fiber tape and custody seals in such a manner that the custody seals would be broken if the cooler were opened.

3.28 Rock Coring

Rock core will be collected as follows:

- Decontaminate all equipment in accordance with Section 3.12.
- Advance borehole to the desired depth using auger, rotary, air hammer or other drilling method, as appropriate.

- Collect core (using specified core barrel) in accordance with ASTM D2113-06, as appropriate for site conditions.
- Record penetration rate.
- Record any fluid loss and depth of loss.
- Place core in new, sturdy, wooden, core boxes.
- Clearly label boxes with borehole number and depth.
- Drilling/coring induced breaks should be marked with 3 parallel lines across the break.
- Photograph full core box, with hole's number and depths clearly visible in the photo.
- Record core data including rock type, fractures and other pertinent information.
- Determine Rock Quality Designation (RQD) for each core run:

$$RQD = \frac{\text{the total length of core pieces greater than four inches long}}{\text{total core run}}$$

  - Measure core lengths along the center line of the core.
  - Do not count core pieces that are not "hard and sound" as part of the RQD; however, record such lengths separately.
  - Core breaks known to be induced by drilling or core handling should be fitted together and counted as one piece when determining RQD.

3.29 Packer Testing

Packer testing is performed to obtain groundwater samples from discrete intervals within a larger open borehole in bedrock. A dual straddle packer system or single packer system can be used, as appropriate. The single packer is often used when collecting a groundwater sample from near the bottom of the borehole. Inflatable packers, with a submersible pump between the packers (or below the single packer) are typically used. Geophysical logging can be used prior to packer testing to design the packer interval. If packer testing occurs concurrent with drilling, then a single packer is typically used at progressively deeper depths.

Packer testing will be conducted as follows:

- Decontaminate all down hole equipment as needed in accordance with Section 3.12.
- Assemble packer(s) lift pipe and pump. If a straddle packer system will be used, assemble packers at desired spacing.
- Lower packer assembly to desired depth.
- Measure static water level using a water level indicator.

- Inflate packers with nitrogen, with sufficient pressure to seal against borehole wall.
- Calculate volume of water in packer zone and lift pipe using Table 3-5.
- Begin purging with submersible pump; record totalizer readings and flow rates. Contain and dispose of water in accordance with Section 3.13 above and DER-10 Section 3.3 (e).
- Monitor water quality parameters, if appropriate.
- Collect water sample based upon volume of water pumped and/or water quality parameters.
- Deflate packers.
- Move system to next test zone or remove from borehole, as appropriate.
- Decontaminate all down hole equipment prior to demobilization from the site.

3.30 Aquifer Performance Test

Aquifer performance tests are typically performed to characterize the hydraulic properties of wells and aquifers. Properties evaluated include specific capacity, hydraulic conductivity, transmissivity and storativity.

3.30.1 Continuous Background Monitoring

- Baseline groundwater level measurement data will be used to evaluate the effects of outside influences (i.e., influences other than the proposed pump test withdrawal) on groundwater levels. These influences will then be considered when analyzing the pump test data.
- Groundwater level data will be recorded with electronic data loggers at selected well, at 30 minute intervals.
- The loggers will be synchronized to record water levels at the same time.
- A synoptic round of water levels will be made at the wells prior to installing the transducers. After the transducers have been installed and recording has been started, a second round of synoptic water levels will be collected on the day of transducer installation to confirm proper data recording.
- A third round of manual groundwater level measurements will be collected from continuous monitoring points and any other existing wells just prior to beginning pump testing to:
    - Confirm proper data recording by transducers.
    - Obtain a broader baseline groundwater level data set.
- Groundwater level data will also be downloaded from data loggers at this time, saved to electronic media, and reviewed to confirm that groundwater levels have stabilized.

- Precipitation and barometric pressure data will be obtained for the aquifer performance test period from the local weather station (within approximately 5 miles of the project).

3.30.2 Step Drawdown Test

The step drawdown test (or step test) is required to determine the specific capacity and short-term yield of the recovery well and select the pumping rate for the long-term pump test.

- During the test, continuous groundwater levels at the pumping well and select observation points will be recorded logarithmically. An example of a logarithmic schedule is provided on **Table 3-6**.

Table 3-6
Step Drawdown Test Logarithmic Schedule

Log Cycle	Elapsed Time	Sample Interval	Points/Cycle
1	0-20 seconds	0.2 second	101
2	20-60 seconds	1 second	40
3	1-10 minutes	10 seconds	54
4	10-100 minutes	2 minutes	45
5	100-480 minutes	10 minutes	38

- The drawdown versus time data shall be plotted semi-logarithmically.
- The drawdown (y-axis) shall be plotted on a linear scale and time (x-axis) shall be plotted on a logarithmic scale.

  The drawdown curves shall be extrapolated to the specified time of the proposed long-term test. The rate that results in the maximum drawdown without dropping the water level below the design pumping level within the time period of the long-term test shall be considered the flow rate to be used for the long-term test.

- The specific capacity versus pumping rate should also be plotted to determine if excessive well losses occur at the selected rate.
- A variable rate submersible pump capable of operating across the above flow range will be used to complete testing. A vertical check valve will be placed on the discharge line immediately above the pump. A 1 inch diameter polyvinylchloride line will be placed in the well, with the open, bottom end extending to within one foot of the pump. This 1 inch line will be used as the stilling pipe for the water level transducer.

After the pumping equipment is installed, the following testing steps will be followed:

- Step 1 - Connect a flow meter, valve, and sample port to the pump discharge line. Extend the pump discharge line from the pumping well to the existing groundwater treatment system influent sump using flexible, chemical-resistant pipe/hose (e.g., garden hose, polyethylene pipe).

- Step 2 - Measure and record the static groundwater level reading in the pumping well.
- Step 3 – Start log cycle for select transducers, and initiate pumping. Set to initial flow rate (Step 1) using the valve (or variable-speed controller). Record the stabilized flow rate and start time for pumping. Confirm proper operation of the pumping well transducer. Confirm that significant leaks are not present along the above-ground hose/pipeline extending between the pumping well and the influent sump.
- Step 4 - Monitor the groundwater level in the pumping well using the transducer and collect manual groundwater level measurements at monitoring points at ± 20 minute intervals.
- Step 5 - After approximately two hours, calculate the specific capacity of the well (flow/drawdown [gpm/ft]), estimate the maximum well yield based upon the calculated capacity and pump depth, and increase the pumping rate to approximately 50 percent (%) of the calculated maximum yield.
- (Step 2). If 50% of the yield has already been exceeded, adjust the rate to approximately 75% of the yield. Record the flow rate and adjustment time. Confirm proper operation of the pumping well transducer.
- Step 6 – Monitor the groundwater level in the pumping well using the transducer, and collect manual groundwater level measurements at monitoring points at ± 20 minute intervals.
- Step 7 – Repeat Steps 5 and 6 for up to two additional steps at approximately 75% and 95% of the maximum well yield (Steps 3 and 4). Be careful not to drop the water level below the top of the pump.
- Step 8 - Shut off the pump at the end of the last step test (after 4 tests and 8 hours, maximum), and download the groundwater level data from all transducers. Also collect manual groundwater level measurements at approximately 20 minutes and 40 minutes after terminating pump operation. Leave the transducers in place.

3.30.3 Long-Term Constant Rate Test

The long-term constant rate test (72-hour pumping test) will be performed at the pumping well on the day after completion of the step test, assuming groundwater levels have recovered to 90% of baseline values. The 72-hour pump test will not commence until this condition is met or a minimum of 72 hours have elapsed since the termination of the step testing. The step test results will be reviewed in advance and used to select the pumping rate for this test, which will equate to approximately 50 to 75% of the calculated short-term, maximum well yield.

- During this test, continuous groundwater levels at the pumping well and select observation points will be recorded logarithmically. An example of a logarithmic logging schedule is provided in **Table 3-7**.

Table 3-7
Long Term Constant Rate Test Logarithmic Schedule

Log Cycle	Elapsed Time	Sample Interval	Points/Cycle
1	0-20 seconds	0.2 second	101
2	20-60 seconds	1 second	40
3	1-10 minutes	10 seconds	54
4	10-100 minutes	2 minutes	45
5	100-480 minutes	10 minutes	38

The following testing steps will be followed:

- Step 1 – Manually measure groundwater levels in recovery well and all observation points prior to initiating pumping.
- Step 2 – Start log cycle for transducers, and initiated pumping at the pre-determined rate by adjusting the valve (or variable-speed controller). Record flow rate and start time. Also check proper data recording at the pumping well transducer.
- Step 3 - Collect manual groundwater level measurements at 20 minute intervals until drawdown begins to stabilize. Also check pump flow rate and adjust valve as necessary to maintain a constant pumping rate until stabilization (difference between consecutive measurements less than 10%).
- Step 4 - Perform manual groundwater level measurements and flow rate checks/adjustments at one-hour intervals after the system has approached stabilization. Download and review pressure transducer data at 6-hour intervals to confirm proper data recording and observe data trends.
- Step 5 - Stop pumping after 72 hours have elapsed, and record time. Leave the transducers in place. Download and review pressure transducer data at 6-hour intervals to confirm proper data recording and observe data trends.

3.30.4 Recovery Water Level Measurement

- Initiate a new log cycle for the transducers immediately upon termination of the constant-rate pumping test.
- Continuous groundwater levels at the pumping well and select observation points will be recorded logarithmically.
- Leave the transducers in place to record continuous groundwater level data until:
  - The groundwater level at the pumping well has recovered to 90% of its baseline value or
  - 72 hours (minimum) have elapsed since termination of pump testing.

3.30.5 Discharge Water Management

The water pumped from the well shall be discharged and managed following the plan specific to the project and in accordance with DER-10 and all applicable local, state and federal regulations.

3.31 Pre-Packed Direct Push Well Installation

A drilling subcontractor will perform the well installation and CDM Smith will oversee the fieldwork.

- Wells will be constructed of a pre-packed 2.5 inch OD (1 inch ID) slotted PVC well screen (pre-packed with sand and stainless steel mesh) and 1 inch ID, schedule 40 PVC riser casings. The pre-packed well screens are manufactured prior to mobilization.
- Thread the drive cap onto the top of the 3.25 inch OD probe rod and advance the drive rod using either the hydraulic hammer or hydraulic probe mechanism.
- Advance the drive rod to the target depth using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.
- Lower the well assembly into the probe rod string with threaded PVC riser pipe to the bottom of the probe rod string.
- Install a sand filter around the well screen to directly above the screen. Grain size of the sand will be appropriate for the slot size of the screen (normally 0.01-inch). Retract the probe rods to a point above the screen.
- Install 2 foot grout penetration seal using “00” gravel or bankrun sand.
- Insert a tremie pipe and backfill the remainder of the hole with bentonite-cement grout until it flows at the surface.
- Square cut the well pipe below grade.
- Install protective flushmount or stick-up casing around new well.

3.32 Membrane Interface Probe (MIP)

In order to provide a screening-level characterization of VOC contamination in subsurface soil in both the vadose and saturated zones, CDM Smith may utilize a MIP to obtain qualitative, depth-continuous, relative instrument response data for VOCs and electrical conductivity data in the subsurface soil. The MIP data will be used to establish an instrument response gradient in subsurface soils to identify “hot spots” for sampling during the soil boring investigation.

- The MIP utilizes a truck-mounted PID, flame-ionization detector (FID), and an electron-capture devise (ECD).
- The 1.5 inch diameter MIP will be pushed into the subsurface at a penetration rate of approximately 1 foot per minute. The tip of the probe contains a thermister, which provides a heat source to volatilize VOCs. The gases that are produced pass into the probe

through a permeable membrane and enter a sampling loop. The gases are then transported to the surface and pass through the PID, FID, and ECD. The MIP will produce a response to all compounds that:

- Volatilize sufficiently to diffuse through the MIP probe membrane,
- Are carried to the detector in the carrier gas, and
- Produce a response on one or more of the detectors (PID, FID, and ECD).

The total response for each detector is related to the total contaminant concentration and the relative response of the detector to the compounds in the carrier gas stream. Therefore, the MIP is considered to produce qualitative data.

Several "performance checks" have been incorporated into the MIP screening program to provide a basis for evaluating MIP performance during subsurface soil screening activities. The following performance checks will be used during the MIP screening activities:

- Ex-situ response check - This performance check will be used to test the response of the probe to a known concentration of a target contaminant in a test cell. This check will be performed in accordance with Geoprobe® Systems Technical Bulletin MK3010 (Geoprobe® 2003).
- Reproducibility check - This performance check includes performance of a replicate push within 5 to 10 feet of a selected push. The MIP profiles for the replicate locations will be compared to assess the reproducibility of the data. As a guideline, MIP responses that are within one order of magnitude will be considered to be reasonable evidence of reproducibility.
- Ex situ response checks will be run at the following times:
  - At the start of each day.
  - If more than 3 hours elapses between the last response check and the next logging run.
  - If the MIP probe, membrane, trunk line, dryer, probe rod, or any major components of the MIP system are repaired or replaced.
- Replicate MIP profiles will be run on approximately 1 in 20 samples.

Performance check results will be reviewed for each sample lot to evaluate MIP performance. If MIP performance issues are identified, the MIP subcontractor will take corrective actions to remedy the issues.

3.32.1 MIP Procedure

Prior to initiating any field activities, the field team will review and discuss, in detail, the site-specific HASP and any appropriate background documentation. All monitoring and protective equipment will be thoroughly checked at this time. All underground and overhead utilities and structures which may interfere with the progress of the work will be located prior to the commencement of subsurface drilling activities.

- The MIP soil screening will be conducted using a Geoprobe® rig or equivalent direct push rig (as discussed above) and will follow the general drilling procedures outlined in Section 3.23.3.
- At each location the direct push rig will continuously collect data on the lithology and the VOC contamination.
- The MIP technology will provide a continuous depth qualitative readout of VOC concentrations. This probe will be used until the final depth is reached.
- The MIP subcontractor will provide CDM Smith with an electronic data file of each push containing qualitative VOC readings and electrical conductivity readings.
- The screening point boreholes will be tremie-grouted with a cement-bentonite mixture after all sampling has been completed and the boring locations will be restored to pre-existing conditions.

3.33 Fish Sampling

Fish samples will be collected from an adequate number of locations in order to characterize and address project objectives, or as directed by the NYSDEC.

- Samples will be collected using site-specific common fisheries techniques (e.g., seine net, electroshocking, etc.). Electroshocking and other techniques may require that sampling personnel obtain required training.
- During each investigation, species representative of the site or individual location (i.e., dominant taxa, high percentage of total biomass, etc.) will be targeted for analysis.
- The age and/or trophic level of species and other pertinent sampling design information will be decided after consultation with the NYSDEC.
- Upon capture, sampling crews will taxonomically identify fish retained for analysis, photograph and record the weight and total length of representative individuals.
- In order to satisfy analytical requirements, it may be necessary in specific cases (e.g., minnow species) to composite samples consisting of an individual species. When required, the total number of individuals and total weight of the composite will be noted.
- After processing, individual samples will be wrapped in aluminum foil, placed in re-sealable plastic bags and placed on wet or dry ice.
- Samples will be shipped via overnight delivery (see Section 3.27) to the subcontracted analytical laboratory for the analyses specified in the site-specific work plan.

3.34 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate (benthos) samples will be collected from an adequate number of locations in order to characterize and address project objectives, or as directed by the NYSDEC.

- Samples will be collected using site-specific sampling techniques (e.g., kick net, surber sampler, etc.).
- During each investigation, species representative of the site or individual location (i.e., dominant taxa, high percentage of total biomass, etc.) will be targeted for analysis. Pertinent sampling design information (e.g., sample size, etc.) will be decided after consultation with the NYSDEC.
- As samples are collected they will be placed into a clean sample vessel (e.g., stainless steal bucket, high density polyethylene bucket, etc.) for sorting.
- Representative species retained for analysis will be taxonomically identified to order.
- Due to analytical requirements, all samples will consist of a given number of individuals composited together until the proper sample mass is achieved.
- After processing, individual samples will be placed into the appropriate sample container, placed in re-sealable plastic bags and placed on wet ice or dry ice.
- Samples will be shipped via overnight delivery (see Section 3.27) to the subcontracted analytical laboratory for the analyses specified in the site-specific work plan.

3.35 Test Pits

All excavation activities will be performed in accordance with the Dig Safely New York *Excavator's Manual: A User's Guide to Safe Excavation Practices in New York State.* Test pits will be performed as described below.

3.35.1 Equipment

- Rubber tired backhoe with extension or larger track mounted excavator (provided by subcontractor)
- Survey stakes to mark corners of the test pits
- Digital camera
- Indelible black ink pen or marker
- Field logbook
- Decontamination equipment (provided by subcontractor)
- Steel or cloth 100-foot tape
- Personal protective equipment (refer to Site-specific HASP)

- Sample containers
- Stainless steel or disposable sample bowls and trowels
- Ice and cooler
- COC forms and custody seals
- Distilled and deionized water
- Alconox
- Paper towels
- Garbage bags
- Water jugs
- Spray paint
- Hand auger

3.35.2 Procedures

A test pit will be conducted as follows:

- Prior to mobilizing to the site or beginning excavation, the subcontractor will contact Dig Safe NY for utility mark outs.
- Decontaminate all equipment as necessary in accordance with Section 3.12 of the generic QAPP.
- Advance excavation to the desired length, width and depth using appropriate equipment.
- Make visual observations of soil conditions including staining and odors and collect samples for headspace readings as needed.
- Take photograph documentation of any staining and at all sample locations.
- Samples will be collected from the bucket of the backhoe and no personnel will enter the excavation. One sample from each test pit will be submitted for laboratory analyses. Sample collection and documentation will be conducted in accordance with Section 3.2 of the Generic QAPP.
- Record the depths of any visual observations made and take digital photos.
- Excavated material shall be placed at an appropriate distance from the test pit to ensure proper slope stability.
- Upon completing the test pit, backfill and compact the excavation to grade.

- Providing that no visual staining, odors or product are observed, the test pit material can be used as backfill. If any of the above is observed the test pit material must be properly disposed of and clean material shall be used for backfilling.
- Mark the corners of the excavation so the location can be surveyed at a later date.
- Decontaminate the backhoe bucket prior to starting the next test pit.

3.35.3 Analytical Program

CDM Smith expects to collect one sample from each test pit. However, field observations may dictate that additional samples be collected. Samples may be obtained from the test pit side walls or bases and will be collected from the bucket of the excavator. All samples shall be field screened, photographed and recorded.

3.36 Per- and Polyfluoroalkyl Substances (PFAS)

Samples collected using this protocol are intended to be analyzed for per- and polyfluoroalkyl substances (PFAS) by Modified (Low Level) Test Method 537. PFAS sampling will be performed using USEPA Method 1633, as required by the NYSDEC for environmental samples. Sampling and analytical methods for PFAS may change based on technological advancement. Any changes will be submitted as an amendment for approval by NYSDEC. The list of PFAS is shown on **Table 3-8**.

3.36.1 Monitoring Wells and Surface Water Sample Protocol

The Modified (Low Level) Test Method 537.1 provides PFAS results with reporting limits of approximately 2 nanograms per liter.

Table 3-8
Full PFAS Target Analyte List

Class	PFAS Name	Abbreviation	Cas No.
Perfluoroalkyl sulfonates	**Perfluorobutanesulfonic acid**	**PFBS**	**375-73-5**
	Perfluorohexanesulfonic acid	**PFHxS**	**355-46-4**
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanessulfonic acid	**PFOS**	**1763-23-1**
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	**PFHpA**	**375-85-9**
	Perfluorooctanoic acid	**PFOA**	**335-67-1**
	Perfluorononanoic acid	**PFNA**	**375-95-1**
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7

Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Bold entries depict the 6 original UCMR3 chemicals
Current acceptable materials for sampling include: stainless steel, high density polyethylene (HDPE), PVC, silicone, acetate and polypropylene. Additional materials may be acceptable if proven not to contain PFAS. Grundfos pumps and bladder pumps are known to contain PFC materials (e.g. Teflon™ washers for Grundfos pumps and low-density polyethylene (LDPE) bladders for bladder pumps). Selection of sampling devices must be carefully researched. All sampling equipment components and sample containers should not come in contact with aluminum foil, LDPE, glass or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer. Standard two step decontamination using detergent and clean water rinse should be considered for equipment that does come in contact with polyfluorinated materials. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with polyfluorinated materials must be avoided. Many food and drink packaging materials and "plumbers thread seal tape" contain PFAS.

All clothing worn by sampling personnel must have been laundered multiple times and dried without using dryer sheets of any type. The sampler must wear nitrile gloves while filling and sealing the sample bottles.

Pre-cleaned sample bottles with closures, coolers, ice, sample labels and a chain of custody form will be provided by the laboratory.

1. Fill two pre-cleaned 500 mL HDPE bottle with the sample.
2. Cap the bottles with an acceptable cap and liner closure system.
3. Label the sample bottles.
4. Fill out the chain of custody.
5. Place in a cooler maintained at 4 ± 2º Celsius.

Equipment blanks should be collected each day that sampling is conducted and at a minimum frequency of 1 per 20 samples. Collect one field duplicate for every sample batch, not to exceed 20 samples. Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, not to exceed 20 samples.

Request appropriate data deliverable (Category B) and an electronic data deliverable.

Prohibited Materials and Equipment

1. Teflon®-containing materials, when possible, should be avoided (e.g., tubing, bailers, tape, and plumbing paste). In cases where Teflon® -containing materials are unavoidable, ensure adequate purging is performed prior to sampling (e.g., in-well pumps) and/or rinse blanks are collected prior to sampling.
2. LDPE or polypropylene containing materials (e.g., bags or containers used to transport samples)
3. Paper products such as waterproof field books, plastic clipboards, binders, spiral hard cover notebooks, sticky notes or glue materials
4. Markers
5. Chemical (blue) ice packs
6. Decontamination soaps containing fluoro-surfactants such as Decon 90
7. Water that is not verified to be "PFAS-free" to be used for trip and decontamination blanks and decontamination processes
8. Water resistant, waterproof, stain-treated clothing or shoes including Gore-Tex™ and Tyvek® materials

Recommended Materials and Equipment

1. HDPE and silicon
2. Materials include: tubing, bailers, tape, plumbing paste
3. Acetate liners for direct push technologies
4. Nitrile gloves – change often
5. Loose paper with Masonite or aluminum clipboards
6. Pens
7. Bags of ice
8. Alconox® or Liquinox®
9. Laboratory supplied and verified "PFAS-free" water to be used for trip and decontamination blanks and decontamination processes
10. Cotton construction is recommended for field clothing and should be laundered a minimum of 6 times from time of purchase due to possible PFAS related treatments. Fabric softener and dryer sheets must be avoided. Rain gear should be made from polyurethane and wax-coated materials.

3.36.2 Shallow Soil Sample Protocol

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS by liquid chromatography-tandem mass spectrometry (LCMSMS) (modified method 537.1). Laboratory reporting limits should be less than or equal to 0.5 micrograms per kilogram. One 8-ounce HDPE container is required for each sample. Pre-cleaned sample containers, coolers, sample labels and a chain of custody form will be provided by the laboratory.

Sampling Location and Survey

Shallow soil sampling will generally be confined to surface or near-surface soils and/or sediments with hand equipment. For screening purposes, sampling of this type should be conducted in depositional areas. Sample locations and depths shall be located and recorded.

Equipment

At this time acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate and polypropylene. Additional materials may be acceptable if proven not to contain PFAS. All sampling equipment components and sample containers **should not** come in contact with aluminum foil, LDPE, glass or PTFE, Teflon™ materials including sample bottle cap liners with a PTFE layer. A list of acceptable equipment is provided below, but other equipment may be considered appropriate at a later date.

1. stainless steel spoon
2. stainless steel bowl
3. carbon steel hand auger without any coatings

Equipment Decontamination

Standard two step decontamination using detergent and clean, PFAS-free water rinse should be considered for equipment that does come in contact with PFAS materials.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a clean stainless steel spoon should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) shall then be collected using a pre-cleaned, stainless steel spoon.

Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the soil sample is obtained, it should be deposited into a stainless-steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized.

Sample Identification and Logging

A label shall be attached to each sample container with an identification consistent with the format indicated below. Each sample shall be included on the COC and labelled in the formats discussed in Section 3.2.5.

Quality Assurance/Quality Control

1. Immediately place samples in cooler maintained at 4 ± 2º Celsius.
2. Collect one field duplicate for every sample batch, not to exceed 20 samples. The duplicate shall consist of an additional sample at a given location.

3. Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, not to exceed 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC.
4. Request appropriate data deliverable (Category B) and an electronic data deliverable.
5. Collect an equipment blank each day sampling is conducted to ensure the equipment does not come in contact with PFAS.

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, duplicate sample, visual description of the material and any other observations or notes determined to be appropriate.

Personal Protection Equipment (PPE)

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

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

3.37 Sampling for 1, 4-Dioxane

All groundwater samples from DER remediation sites that have chlorinated solvents as a contaminant of concern must be analyzed for 1,4-dioxane. 1,4-Dioxane was added as a stabilizer in 1,1,1-trichloroethane (TCA) at percent levels. The detection limit for 1,4-dioxane should be no higher than 0.2 µg/L (ppb).

The only current analytical method that Environmental Laboratory Accreditation Program (ELAP) offers certification for is EPA method 8260C. In order to get the detection limits needed, the laboratory will need to use the mass spectrometer in “selective ion monitoring” (SIM) mode. In addition to EPA 8260C SIM, other analytical methods that can achieve the required detection limits include EPA 8270 SIM and EPA 522. The analytical method accepted by the state currently is 8270SIM, the use of 8260 may be accepted when justified by site conditions. EPA Method 8270 SIM provides a more robust extraction procedure and is the preferred method . EPA 522 is reportedly the lowest cost alternative and has the lowest detection limit (in drinking/potable water).

At sites where solvents are not a contaminant of concern, and where 1,4-dioxane is not otherwise a contaminant of concern, 1,4-dioxane should be included in the analyte list for EPA Method 8260C, but the use of SIM mode is not required.

Samples analyzed by EPA 8260C SIM should be collected in three 40 ml vials. Samples analyzed by EPA Method 8270 SIM should be collected in two 1 Liter amber glass jars. Samples analyzed by EPA Method 522 should be collected in bottles fitted with screw caps.

Clothing that contains 1,4-dioxane materials must be avoided. Avoid laundry detergents, dish soap, shampoos, and other cleaning products that contain 1,4-dioxane when sampling. An example list of detergent products reported to be free of 1,4-dioxane are listed below:

1. Honest Company
2. Seventh Generation Free & Clear laundry detergent
3. Dreft powdered detergent
4. Sun Burst
5. Planet Ultra Liquid laundry detergent
6. Clorox Green Works Natural laundry detergent
7. Ecos laundry detergent (Earth Friendly Products)
8. Life Tree Laundry Liquid
9. Method Squeaky Green Laundry detergent

The list is referenced from https://www.honest.com/about-us/honestly-free-guarantee and https://www.naturalnews.com/028846_laundry_detergents_dioxane.html.

The sampler must wear nitrile gloves while filling and sealing the sample bottles.

Pre-cleaned sample bottles with closures, coolers, ice, sample labels and a chain of custody form will be provided by the laboratory.

1. Fill pre-cleaned bottle with the sample.
2. Cap the bottles with an acceptable cap and liner closure system.
3. Label the sample bottles.
4. Fill out the chain of custody.
5. Place in a cooler maintained at 4 ± 2º Celsius.

Collect one equipment blank for every sample batch, not to exceed 20 samples. Collect one field duplicate for every sample batch, not to exceed 20 samples.

Sampling and analytical methods for 1,4-dioxane may change based on technological advancement. Any changes will be submitted as an amendment for approval by NYSDEC.

Section 4

Instrument Procedures

4.1 Photoionization Detector (PID)

4.1.1 Introduction

This Standard Operating Procedure (SOP) is specific to the MiniRAE 2000 and 3000 PIDs. These portable instruments are designed to measure the concentration of trace gases in ambient atmospheres at industrial and hazardous waste sites, and are intrinsically safe. The analyzers employ PIDs.

The PID sensor consists of a sealed ultraviolet light source that emits photons which are energetic enough to ionize many trace species (particularly organics), but do not ionize the major compounds of air such as O_2, N_2, CO, CO_2, or H_2O. An ionization chamber adjacent to the ultraviolet lamp source contains a pair of electrodes. When a positive potential is applied to one electrode, the field created drives any ions, formed by absorption of UV light, to the collector electrode where the currents (proportional to concentration) are measured. One major difference between a flame ionization detector (FID) and a PID is that the latter responds to inorganic compounds as well as non-methane type organic compounds.

To assess whether the instrument will respond to a particular species, the ionization potential (IP) should be checked. If the IP is less than the lamp energy, or in some cases, up to 0.2-0.3 electron volts (ev) higher than the lamp energy, instrument response should occur. For example, hydrogen sulfide (IP = 10.5 ev) may be detected with a 10.2 ev lamp, but butane (IP 10.6 ev) will not be detected.

4.1.2 Calibration

Qualified personnel trained in calibration techniques for all field items perform calibration of all CDM Smith field equipment. When a field instrument that requires calibration is obtained from the rental facility, the unit will display a calibration tag denoting the date when the instrument was last calibrated and/or maintained. All field instruments are calibrated each time they leave the equipment facility. A maintenance file is kept for each calibrated field item.

PID and FID detector type instruments come with field calibration kits. A field calibration kit would be used if the instrument is to be kept out at the site for extended periods of time, or if the instrument endures prolonged environmental extremes. In either case, a calibration check standard could be introduced in the instrument to verify its accuracy. If an instrument will not calibrate or shows improper field operation, it should be sent back to the office, and another instrument reissued.

Field personnel should not try to maintain the instruments in the field. If long sampling program is required, be prepared to take more equipment for backup in case of instrument failure. Records and procedures of all calibration techniques are on file at the CDM Smith equipment management facility at 153 South Street, Somerville, Massachusetts.

With the instrument fully calibrated, it is now ready for use. Any results obtained should be reported in parts per million (ppm). If you need to convert these numbers based on a benzene standard, HNu offers a conversion table which is available from CDM Smith. Important instrument specifications for each PID detector are listed as follows.

MiniRAE 2000 Performance	MiniRAE 3000
Range - 0.1 to 9999	0 - 9999
Detection limit 0.1 PPM	0.1 PPM

MiniRAE 2000 Power Requirements	MiniRAE3000
Continuous use, battery >10 hours	8 hours
Recharge time, max >14 hours, 3 hours +	8 hours
Alkaline Pack	Alkaline Pack

Unit can be operated on battery charger.

Both units provide protection circuitry for the battery. This prevents deep discharging of the battery and considerably extends the battery life.

4.1.3 MiniRAE 2000

4.1.3.1 Procedure

- To turn on the unit, press and hold the Mode button and allow the unit to run 5-10 minutes in a clean air environment.
- After the warm-up, press and hold the Mode and N/- buttons simultaneously until the unit displays "Calibrate/select gas?"
- Press Y/+ "Fresh Air Cal?" is displayed
- Press N/- "Span cal?" is displayed
- Press N/- "Select Cal Memory?" is displayed
- Press N/- "Change Span Value?" is displayed
- Press Y/+, the unit will display span value. If no Charge is needed. Press and hold the MODE button and "modify cal memory?" is displayed press N/-
- If you wish to change the span value, press the MODE button until SAVE? Is displayed press Y/+, "Modify cal memory?" is displayed press N/-
- "Change Correction Factor?" is displayed. If you desired correction factor is not 1.00 (default setting) press Y/+. Use the same steps as change span value to change the correction factor. If no change is required, Press N/- to continue.

- "Fresh Air Cal?" is displayed (Ensure that you are in a clean ambient air environment.) press Y/+.
- "Zero in process" will be displayed, followed by countdown.   The zero reading will now be displayed. The unit will move to "Span Gas Cal?"
- Fill a 3L Tedlar bag with Span gas.
- From "Span Gas Cal?" Press the Y/+ button "Apply Gas Now" is displayed. Apply Gas to the unit. The unit will countdown and then display "Update Data"" the unit is Updating the calibration =… (Span value). Followed by "Calibration Done". Remove the Tedlar Bag from the unit.
- Press MODE twice to return to the run mode.
- Unit is now calibrated and ready to use.

Note: After the span calibration is completed and the unit is running, it is recommended to perform a function "bump test" to verify the accuracy of the calibration. To perform this test, simply reconnect the span gas to the unit and verify the displayed reading coincide with the actual concentrations of span gas used for calibration. (Manufactures specification is +/- 5% of the value)

4.1.3.2 Limitations

- Environmental factors such as humidity, rain and extreme cold can limit the instrument performance. MiniRAE2000 should be kept out of the rain as much as possible or covered. This will insure longer operating times with less false positive readings.

4.1.4 MiniRAE 3000

4.1.4.1 Procedures

- With the unit being fully calibrated before receiving it, you are ready for operation. Located on the face of the unit is a panel. On the panel is a MODE key. Press and hold the MODE key. When the display turns on, release the MODE key. The instrument is now operating and performs self tests. If any tests (including sensor and memory tests fail), refer to the Troubleshooting sector of the User's Guide. NOTE: if Basic User/Hygiene Mode (the default setting), the instrument stops after self-testing, and asks whether to perform a zero air (fresh air) calibration. You can start this calibration, quit, or abort the calibration. When the zero calibration is done, you see screen telling you that the zero calibration is complete, along with its value. After calibration (or after you abort the calibration), the instrument then shows a numerical reading screen with icons. This indicates that the instrument is fully functional and ready to use.
- To turn off the instrument press and hold the Mode key for 3 seconds. A 5-second countdown to shut off begins. Once the countdown stops, the instrument is off. Release the Mode key. When you see "Unit off…" release your finger from the Mode key. The instrument is now off.

NOTE: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

- The instrument has a built-in flashlight that helps you point the probe in dark places. Press the flashlight key to turn it on. Press it again to turn it off. NOTE: Using the flashlight for extended periods shortens the battery's operating time before it needs recharging.

4.2 pH Meter

4.2.1 Introduction

pH is the negative logarithm of the effective hydrogen ion concentration (or activity) in gram equivalents per liter used. This expresses both acidity, and alkalinity on a scale whose valves run from 0 to 14. Number 7 represents neutrality, and numbers greater than 7 indicate increasing alkalinity while numbers less than 7 indicate increasing acidity. pH is one of the most commonly analyzed parameters. Water supply treatments such as neutralization, softening, disinfection and corrosion control are all pH dependent. CDM Smith has a variety of pH monitoring instruments in the equipment warehouse.

4.2.2 Orion SA 250 pH Procedures

With the instrument fully calibrated, it is now ready for use. Follow the check out procedures:

- Slide power switch to on position. Attach BNC shorting plug to BNC connector on top of meter.
- If LO BAT indicator on LCD remains on, the battery must be replaced.
- Slide mode switch to mV. Display should read 0 + .3.
- Slide mode switch to TEMP. Display should read 25.0. If 25.0 is not displayed, scroll using, and X10 keys, until 25.0 is displayed and press enter.
- Slide mode switch to pH .01. Press iso. Display should read the letters ISO, then a value of 7.000. If 7.000 is not displayed, scroll until 7.00 is displayed and press enter.
- Press slope. Display should read the letters SLP, then a value of 100.0. If 100.0 is not displayed, scroll until 100.0 is displayed and press enter.
- Press sample. Observe the letters pH, then a steady reading of 7.00, +0.02 should be obtained. If not, press CAL and scroll until 200 is displayed and press enter. Press sample and observe a reading of 7.00.
- Remove the shorting plug. After completing these steps, the meter is ready to use with an electrode.
- Attach electrodes with BNC connectors to sensor input by sliding the connector onto the input, pushing down and turning clockwise to lock into position. Connect reference electrodes with pin tip connectors by pushing connector straight into reference input.

- Put the temperature probe in the sample and let it stabilize.
- Once temperature is stable, set the unit to read pH (by 0.1 or 0.01) and take a reading in the aqueous sample (remembering first to remove the cap on the end of the pH probe).

4.2.3 Model Tripar Analyzer Procedures

With the instrument fully calibrated, it is now ready for use:

- Connect the pH probe's BNC input connector to the front of the Tripar.
- Put the pH/mV switch on the pH position.
- Turn the parameter display selection switch to TEMP.
- Plug in the gray temperature plug jack in the input temperature sensor connector.
- Put end of temperature probe in the sample.
- Allow the temperature to stabilize.
- Turn the temperature compensation knob to the temperature shown.
- Turn the parameter display selection switch to pH.
- Put pH probe in the aqueous sample (remembering first to remove the cap on the end of the probe). Let it stabilize and record the reading.

4.3 Conductivity Meter

4.3.1 Introduction

Conductivity is a numerical expression of the ability of an aqueous solution to carry an electrical current. This ability depends on the presence of ions in the solution, and their total concentration. Factors such as mobility valence, relative concentration, and temperature also combine to create this occurrence. Solutions of most inorganic acids, bases and salts are relatively good conductors. Organic compounds in aqueous solutions are not good conductors. For example, freshly distilled water has conductivity reading of 0.5 to 2 mhos/cm and increases with time. This increase is caused by absorption of atmospheric carbon dioxide, and to a lesser extent ammonia. While industrial type wastes have conductivity readings of ±10,000 mhos/cm.

4.3.2 Model SCT Procedures

The model 33 SCT has 3 conductivity scales of 0-500, 0-5000, and 0-50,000 mhos/cm. Salinity is scaled 0-40 parts per thousand in a temperature range of -2 to +45^{B}C. Temperature is scaled -2^{B} to +5^{B}C.

With the instrument calibration verified, the unit is now ready for use. The model 33 S-C-T meter face is scaled and calibrated to give an accurate reading of the conductivity of a water sample by measuring the amount of current flow between two fixed electrodes in the probe.

The unit also measures salinity in a special range conductivity circuit, which includes a user-adjusted temperature compensator. A precision thermistor in the probe measures temperature by changing its resistance in relation to the temperature of the water.

The start-up procedure is as follows:

- Plug the probe plug receptacle in the side of the meter.
- With the mode select in the OFF position, check to see that the meter needle is centered at the zero mark on the conductivity scale and adjust if necessary.
- Turn the mode control switch to Red Line position.
- Adjust the Red Line control knob so the meter needle lines up with the red line on the meter face. If this cannot be accomplished, replace the batteries. If battery replacement is necessary, use only alkaline "D" cells, as regular carbon zinc batteries will cause errors.
- Place the probe into the solution to be measured.
- Set the mode control to TEMPERATURE. Read the temperature on the bottom scale of the meter in Degrees C. Allow time for the probe temperature to come to equilibrium before taking a reading.
- With the probe in the solution to be tested, adjust the conductivity scale until the meter reading is on scale. Multiply the reading by the correction on the calibration sticker on the instrument.
- When using the X10 and X100 scales, depress the CELL TEST button. If the reading on the dial moves +2%, the electrode is fouled and needs to be cleaned. Repeat the measurement on another instrument.
- Store the probe in distilled water when not in use.

4.4 Photovac Portable Gas Chromatograph

4.4.1 Introduction

The Photovac portable gas chromatograph (GC) can provide for accurate and specific identification of volatile organic compounds in a field control laboratory.

4.4.2 Equipment Preparation

- The Photovac portable GC should be set up in a sheltered area and, if possible, within a climate controlled area to minimize temperature changes. Do not place the GC near any equipment that causes vibration. A flat table, large enough to accommodate the GC, the printer, a laboratory size oven, and electrical power packs for the GC should be utilized during operation.
- Fill the GC with carrier gas being sure not to pressurize the GC with more than 1500 pounds per square inch (psi) of carrier gas. Check to ensure the pressure of the air feed to the GC column is 40 psi.

The carrier gas should contain no more than 2.0 parts per million by volume (ppmV) of total hydrocarbons and not less than 0.1 ppmv of total hydrocarbons. The lower the hydrocarbon concentration the lower the baseline of the GC. A lower baseline minimizes interference of compound identification.

- Install new Teflon septa in the injection port being utilized. The septa should be replaced at the start of each day and after every twenty injections.

4.4.3 Calibration Procedures and Frequency

The Photovac portable GC will be calibrated at the beginning of each day prior to sample analysis.

4.4.3.1 Gas Standards

Gas standards used to calibrate the GC will be obtained from certified compressed gas cylinders of known concentration. CDM Smith stocks two compressed gas standard cylinders containing the following gases and concentrations:

Cylinder 1

Benzene - 10 ppmv

Toluene - 10 ppmv

Ethyl Benzene - 10 ppmv

M-xylene - 10 ppmv

O-xylene - 10 ppmv

P-xylene - 10 ppmv

Cylinder 2

Trans 1,2 Dichloroethylene - 1.05 ppmv

1,1,1 Trichloroethane - 19.3 ppmv

Trichloroethylene - 1.13 ppmv

These gas cylinders were purchased from Scott Specialty Gas Corporation and are certified by Scott to be traceable to NBS standards.

The calibration procedure using these cylinders is as follows:

- A two stage pressure regulator (CGA 350) is attached to the standard gas cylinder to be used.

- A 250 ml glass sampling bulb, determined clean by injecting a volume of air obtained from the bulb onto the GC (described later), is labeled and attached to the effluent port of the second stage of the gas regulator. The Teflon stopcocks of the sampling bulb are opened.

- The sample cylinder valve is opened and the first stage of the regulator is pressurized.
- Slowly the diaphragm valve controlling the gas flow entering the second stage is opened until the pressure reads 2 psig.
- The valve allowing the gas to exit the second stage of the regulator is opened until the gas can be heard escaping from the regulator and passing through the glass sample bulb. Purge the bulb for approximately ten seconds. Close the Teflon stopcock located at the discharge end of the sampling bulb, then, the stopcock closest to the regulator. In this way the calibration gas is collected at the same pressure as the delivery pressure of the second stage of the regulator.
- Using a gas tight 1 ml syringe, extract approximately 500 microliters (µl) of the calibration gas from the glass bulb and purge the volume of gas into the atmosphere. Repeat this step.
- Place the syringe needle in the glass bulb. Pull the syringe plunger back approximately 500 µl of calibration gas enters the syringe barrel. Without removing the syringe from the glass bulb depress the plunger. Pump the syringe in this manner several times.
- Extract the syringe from the glass bulb with approximately 500 µl of calibration gas present. Carefully depress the plunger until 300 µl of calibration gas is present in the syringe barrel. Immediately inject this gas volume into the Photovac GC.
- A response factor for each analyte is obtained as the ratio of the known gas concentration injected and the area under the peak produced by that injection. This integration is performed automatically by the internal Photovac data processor and stored in the library.
- The procedure to obtain a calibration gas sample is repeated and the gas volume is injected into the GC. The GC will identify the compounds in the sample stream that have retention times within +/- 20% of the retention times of the compounds in the library. The area of these identified peaks will be compared to the response factor of the compounds stored in the library and integrate a corresponding concentration.
- If the calibration check concentration does not equal +/- 15% of the library concentration, a new calibration check is performed. If this check fails, a new library is created.

4.4.4 Sample Analyses

The following procedure will be followed when performing analysis of samples.

- The Photovac portable GC is set as described above. The GC function and application file is loaded into memory. This includes all previously established calibration data and retention time information.
- 300 µl of sample are obtained from the sample source and injected into the GC. Samples will be injected as soon as possible after it is collected.
- Immediately after injection the GC is started.

- Each chromatograph run will run for a minimum of 5 minutes. At this time the run will be stopped and the results obtained.
- Following completion of the run, the Photovac GC will produce a hard copy printout of the results. This printout will include the sample identification, time of analysis, and appropriate operating parameters.

This procedure will be followed for all sample runs.

4.4.5 Method Blanks and Duplicates

Prior to any calibration or sample injections, the integrity and level of contamination of each syringe used for injections will be verified.

- Plungers will be removed from the barrel of the syringe and placed into a laboratory oven for 5 minutes. The temperature of the oven should not be above 150 degrees Fahrenheit (F) or below 120 degrees F.
- The syringes will be removed from the oven, cooled, and reassembled.
- Pump the syringe plunger several times, purging the syringe with ambient air.
- Collect approximately 500 µl of ambient air in the syringe and carefully depress the plunger to 300 µl. Immediately inject the gas volume into the GC.
- Detection of the target compounds above the detection limit (50 ppbv for most compounds) will require another decontamination procedure before additional analyses.
- Blanks will be performed after every sample and calibration injection. Blanks will not be performed between duplicate sample injections.
- Duplicate samples will be performed at a minimum of 1 every 10 sample injections.

4.5 X-Ray Fluorescence Meter

4.5.1 Introduction

An X-Ray Fluorescence Meter or XRF meter is used to detect metals in soils or solid objects. It works on wavelength-dispersive spectroscopic principles that are similar to an electron microprobe. Several companies have developed portable XRF meters suitable for screening metals in soils for field applications.

4.5.2 Calibration

Since there are different models of XRF meters on the market, the user's manual should be consulted to determine the required calibration procedures for a specific model. The XRF meter will generally be calibrated by the rental company. Additionally, once or twice per day before performing tests or after the meter's software is restarted, it is necessary to standardize the instrument. A standard metal clip is generally included with the meter, which is placed over the analyzer window as prompted by the software.

4.5.3 Operating Procedures

The user's manual for each individual model of XRF meter should be consulted for operating instructions specific to that model. XRF meters use a "point and shoot" system where the analyzer window is held against the sample while squeezing the trigger. When analyzing soil samples, the sample must be dry, this may require oven drying. The soil sample should also be homogenized before testing by mixing the sample and removing objects such as rocks and sticks. For soil testing, use of a test stand is recommended. The test stand allows for longer analysis times, which may be required to obtain desired detection limits for the metals of interest. The accuracy of the results obtained using an XRF meter may vary and are not considered to be as accurate as laboratory analysis. End point samples should be confirmed with laboratory analysis.

4.5.4 Safety Concerns

4.5.4.1 Safe Operation Procedures

XRF meters produce ionizing radiation. The instruction manual for the specific model should be consulted for safe operating information. In general, for all models the following recommendations are provided:

- The meter should not be pointed at anyone or any body part, energized or de-energized.
- A control area should be established during use. The area at least three paces beyond the target should be unoccupied.
- The target should not be hand held and the instrument should be shot into high density materials whenever possible.
- A radiation exposure badge is recommended for the operator for personal exposure monitoring. Some rental companies include a radiation badge with the rental of an XRF meter.

4.5.4.2 Department of Health Permit Requirements

Because XRF meters contain an x-ray tube, the NYSDOH requires that XRF instruments be registered with their agency by the owner. In addition, when an XRF meter is rented, the company renting the meter must apply for a usage permit from NYSDOH at least three weeks prior to the date of intended usage. When done using the meter, NYSDOH must again be notified. These permits may require a fee and NYSDOH will want to know where the meter will be used.

4.5.4.3 Shipping Requirements

Some XRF meter models have a radioactive source, which must be shipped ground as a hazardous material by an employee trained in hazardous materials shipping. Other models of XRF meters do not have a radioactive source and may be shipped by standard shipping methods. It may be necessary to contact the manufacturer of the specific model to obtain shipping instructions.

Section 5

Laboratory Procedures

5.1 Introduction

Laboratory analysis must be conducted by a laboratory that is accredited pursuant to the NYSDOH ELAP for the category of parameters analyzed. Samples shall be analyzed using the analytical method included in the most current NYSDEC Analytical Services Protocol (ASP) available on the NYSDEC website. Unless otherwise approved by NYSDEC, laboratory data deliverables must be Category B as defined in the ASP.

The term "data quality" refers to the level of uncertainty associated with a particular data set. The data quality associated with environmental measurement data is a function of the sampling plan rationale and procedures used to collect the samples as well as the analytical methods and instrumentation used in making the measurements. Each component has its own potential sources of error and biases that can affect the overall measurement process.

Sources of error that can be traced to the sampling component of environmental data collection are:

- Poor sampling plan design,
- Inconsistent use of standard operating procedures,
- Sample handling and transportation.

The most common sources of error that can be traced to the analytical component of the total measurement system are calibration and contamination problems. It is recognized that, by far, the largest component of the total uncertainty associated with environmental data collection originates from the sampling process. All sampling programs initiated in support of this project will stress forward planning and be well conceived and reviewed prior to the collection of any samples as a way to minimize this major source of potential error.

Uncertainty cannot be eliminated from environmental measurement data. The amount of uncertainty that can be tolerated depends on the objective of the sampling program and the intended use of the data collected. The purpose of the project's quality assurance program is to assure that the quality of all data collected be of known and ascertainable value.

5.2 Data Quality Criteria

Data quality can be assessed in terms of its precision, accuracy, representativeness, completeness, and comparability. Analytical method detection limits will also be discussed in this section.

5.2.1 Precision

Precision is a measure of the reproducibility of analyses under a given set of conditions. The overall precision of a sampling event is a mixture of sampling and analytical factors. The precision of data collected in support of this project will be assessed on two different levels:

- By calculating the relative percent difference (RPD) of laboratory matrix spike duplicates and/or laboratory replicate samples (a measure of analytical precision).
- By calculating the RPD of field duplicates samples submitted to laboratory "blind" (a measure of the precision of the entire measurement system, including sampling).

Relative percent difference will be calculated according to the following equation:

$$RPD = \frac{|A - B|}{(A + B)/2} \times 100\%$$

Where: A	=	Sample Result
B	=	Replicate Sample Result

5.2.2 Accuracy

Accuracy is a measurement of the amount of bias that exists in a measurement system. This can be thought of as the degree that the reported value agrees with the supposed "true value". The accuracy of data collected in support of this project will be assessed in the following ways:

- By calculating the percent recovery (%R) of laboratory matrix spikes and/or laboratory control standards.
- By documenting the level of contamination that exists (if any) in laboratory method blanks.
- By documenting the level of contamination that exists (if any) in field and/or trip blanks submitted to the laboratory "blind" for analysis.
- Percent recovery will be calculated according to the following equation:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

Where: SSR	=	Spiked Sample Result
SR	=	Sample Result
SA	=	Spike Concentration

5.2.3 Representativeness

Unlike the previous two criteria which can be expressed in quantitative terms, representativeness is a qualitative parameter. However, in terms of overall data quality, representativeness may be the most important parameter of all.

The representativeness criterion is concerned with the degree to which a sample reflects (represents) a characteristic of a population, parameter variations at a specific location, or an environmental condition. Sample representativeness will be addressed in support of this project through a detailed sampling plan design and rationale and through the proper use of the appropriate sampling standard operating procedures, depending on sample matrix and the parameters to be analyzed.

Composite samples will be collected in situations conducive to compositing techniques (particularly samples collected along the vertical extent of a borehole). The use of composite samples tends to maximize the representativeness of a sampling round because more information is provided about a much broader area than a single grab sample. This is especially true in situations where the objective of sampling is to determine where gross contamination exists on site and the location of any "hot spots". In these cases, broad coverage of the area to be sampled is more important than obtaining the lowest possible detection limits.

5.2.4 Completeness

Completeness is a measure of the amount of usable data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Usability will be determined by evaluation of the precision, accuracy, representativeness, and comparability parameters. The data that is validated as correct, or are qualified as estimated or non-detect, are considered usable. Rejected data is not considered usable. A completeness goal of 90% is projected. If this goal is not met, the effect of not meeting this goal will be discussed by the CDM Smith project manager and the NYSDEC site manager. Completeness is calculated using the following equation:

$$Percent\ Completeness = \frac{DO}{DP} \times 100$$

Where: DO = Data obtained and usable
DP = Data planned to be obtained

There also may be incomplete data while still meeting the 90%goal if a critical sample location cannot be sampled.

5.2.5 Comparability

The comparability criterion is a quality characteristic which is an expression of the confidence with which one data set can be compared with another. Comparability issues are of importance at two different levels of a sampling program. The primary comparability issues are concerned with whether the field sampling techniques, analytical procedures, and concentration units of one data set can be compared with another.

The comparability criterion also applies to the environmental conditions/considerations present at the time of the sampling. Temporal and/or seasonal variations may make data collected from the same location at different times of the year incomparable, or comparable in a relative sense only, for example.

Comparability is judged by comparing results to other similar data sets. Consistency in the acquisition, handling, and analysis of samples is necessary for comparing results. Data developed under this investigation will be collected and analyzed using Soil Vapor Intrusion Guidance for soil vapor collection and NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010 to ensure comparability of results with other analyses performed in a similar manner.

5.2.6 Method Detection Limits

Whenever environmental measurement data is to be used in comparison with predetermined "action levels" or other regulatory requirements, the reported method detection limits of the analytical data is of prime importance. Analytical methods specified in support of this project should have a reported detection limit at least 50% below the required action level to assure that measurements made in the vicinity of the action level are of high quality. In circumstances concerning extremely low action levels or regulatory requirements where analytical techniques will have to be pushed to their limits, every effort will be made to select the most appropriate analytical procedures. It is recognized that analytical detection limits are sample specific and are affected by sample volumes as well as the need for sample concentration or dilution. These circumstances will be accounted for in the review and interpretation of the analytical results.

5.3 Quality Control

Two separate levels of quality control exist for all samples collected in support of this project, internal laboratory quality control and program generated quality control.

5.3.1 Internal Laboratory Quality Control

Internal laboratory quality control is a function of the individual laboratory's QA/QC plan. A laboratory's QA/QC plan contains specific criteria governing the manner in which analyses are conducted and provides information on the laboratory's performance and control of the sources of error that exist within the lab. Included in the plan are requirements for the type and frequency of quality control check samples that are to be analyzed on a routine basis.

All laboratory analysis conducted in support of this project must include the following quality control check samples:

- Surrogate spikes (where appropriate)
- Matrix spike/matrix spike duplicate (MS/MSD) or laboratory duplicates and laboratory control samples (where appropriate)
- Method blanks

The laboratory may adhere to the analysis frequency specified in their QA/QC plan for these check samples, provided that the specified frequency is equal-to or greater-than the frequency specified in **Table 5-1** or as modified/specified by the QAPP.

5.3.2 Program Generated Quality Control

Program generated quality control consists of quality control check samples that are submitted to the laboratory for analysis "blind" along with actual environmental samples. These samples provide quality control information for the entire sampling event, from the actual sampling and handling through laboratory analysis. As such, they can provide the best overall estimate of the total uncertainty associated with the sampling round.

Table 5-1
Laboratory Sample Frequency

QC Check Sample	Frequency of Analysis
Method Blanks	One per analytical batch or one per every twenty samples
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per analytical batch or one per every twenty samples
Surrogate Spikes	One per every trace organic analysis

The combination of laboratory duplicates and laboratory control samples may be substituted for MS/MSD analysis for parameters where they are more appropriate.

Program generated quality control samples collected in support of this project are:

- Duplicate samples
- Field and equipment blanks
- Trip blanks

Each report should have a cover page that references the CDM Smith task number.

The cover page also provides an opportunity to describe, in a narrative format, any unusual problems or interferences encountered during analysis. In addition, all results should be reported on a dry weight basis for soils and at dilution-corrected concentrations for all samples.

5.3.3 QC Deliverables Package

The following quality control data is required to be reported. For "priority pollutant" type analysis, the following quality control data is required per sample batch:

- Method Blanks associated with each analytical procedure.
- Surrogate Spike Recoveries for volatile organics, PCBs, semi-volatiles and polynuclear aromatic hydrocarbons.
- MS/MSDs for all priority pollutant parameters. One MS/MSD should be run for every 20 samples.

For non-priority pollutant parameters, the following quality control data is required per sample batch:

- Method Blanks

- Laboratory Duplicates - One duplicate analysis should be performed at a frequency of one per 20 samples.

No specific acceptance criteria for blanks and spike recoveries will be set forth here, however, all laboratories are expected to conform to standard EPA quality control specifications. CDM Smith expects laboratories to reanalyze samples if quality control samples fail to meet EPA specifications.

The quality control data may be presented as a quality control section within the report or it may be integrated with the results.

5.4 Data Quality Requirements

Taking into consideration a project's overall objective and intended use of the data, it should be considered that the analyses be conducted in accordance with SW-846, Test Methods for Evaluating Solid Waste, Third Edition procedures. In cases where additional procedures are required, other EPA approved laboratory methods will be used.

5.5 Data Deliverable

NYSDEC requires the use of electronic submissions to the greatest degree appropriate for the site-specific remedial program. All data generated will be submitted in an electronic data deliverable (EDD) that complies with the NYSDEC Electronic Document Standards (EDWS) or as otherwise directed by NYSDEC.

5.6 Analytical Data Validation

If a work assignment requires the validation of data, validation is performed to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and data use.

Laboratory results shall be supported by sufficient back-up data and QA/QC results to enable the reviewer to conclusively determine the quality of the data. The laboratory will review data prior to its release from the laboratory. Objectives for review are in accordance with the QA/QC objectives stated in each site-specific Work Plan. The laboratory is required to evaluate their ability to meet these objectives. Outlying data will be flagged in accordance with laboratory standard operating procedures, and corrective action will be taken to rectify the problem.

A NYSDEC-approved qualified independent third party data validator will review the data package to determine completeness and compliance in accordance with Standby Contract D009805. A narrative describing how the data did or did not meet the validation criteria is part of the data validation procedure. The validation assessment will describe the overall quality of the data and the data validation report will provide a written statement upon completion of the validation indicating whether or not the data is valid and usable, and will include a percent completeness value of usable data.

5.7 Data Usability Summary Report

A Data Usability Summary Report (DUSR) provides a thorough evaluation of analytical data without the third party data validation.

The primary objective of a DUSR is to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and data use. If a work assignment requires a DUSR, the DUSR will be developed by a NYSDEC approved qualified environmental scientist in accordance with Standby Contract D009805.

Table 3-1
Equipment List

Equipment List \ Field Procedure	Soil Vapor Sampling	Temporary Port Sub-Slab Soil Vapor Sampling	Permanent Port Sub-Slab Soil Vapor Sampling	Indoor (Ambient) Air Sampling	Outdoor (Ambient) Air Sampling	Direct Push Groundwater Sampling	Low Flow Groundwater Sampling	Monitoring Well Purging	Groundwater Sampling by Bailer	Tap Water Sampling	Surface Water Sampling	Sediment/Sludge Sampling	Subsurface Soil Sampling	Surface Soil Sampling	Investigative Derived Waste	Water Level/NAPL Measurement	Rock Coring	Packer Testing	Aquifer Performance Test	Membrane Interface Probe	Fish Sampling	Benthic Macroinvertibrate Sampling
¼-inch flush mount hex socket plug, Teflon coated			x																			
¼-inch OD Teflon tubing	x	x	x				x															
¼-inch outside diameter (OD) stainless steel tubing			x																			
¼-inch Swagelock™ female and male connector			x																			
½- to ¾-inch braided nylon line or Teflon-coated wire rope									x		x	x										
1.4 or 6 Liter summa canisters	x	x	x	x	x																	
1-gallon buckets with foam along the rim	x	x																				
5-gallon bucket							x	x	x	x											x	x
60 cm^3 syringe	x	x	x																			
6-ft Engineers Scale																	x					
Aluminum foil												x									x	
Anchoring cement			x																			
Auger, rotary, air hammer or other drilling method (provided by subcontractor)																	x	x				
Bailer (sampler) and rope or wire line								x	x		x											
Boat (as needed for deep water)												x										
Bricks (or equivalent)	x																					
Camera	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cement (to patch floor)		x																				
Check valve																			x			
Clear waterproof tape												x										
Composite Liquid Waste Sampler (COLIWASA) or sample thief for liquid sampling in a container															x							
Coolers/Sample shipping containers with ice packs						x	x		x	x	x	x	x	x	x			x			x	x
Core Barrel (provided by subcontractor)																	x					
Data logger and laptop																x			x			
Decontamination supplies						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Direct-push drill rig or rotary drill rig (for split-spoon/split barrel or direct push sampling)													x									
Discharge Hosing/piping								x											x			
Electrical conduit putty or modeling clay		x	x																			
Field parameters meters (Temperature, conductivity, pH, dissolved oxygen, Redox, turbidity)							x		x	x	x							x				
Flow meter with totalizer																		x	x			
Generator/electric supply source							x	x											x			
Hammer Drill with 1.25-inch bit		x																				
Hammer Drill with 3/8,1-inch bit			x																			
Hand auger and extension rods (for manual sampling)												x	x									

Table 3-1
Equipment List

Equipment List \ Field Procedure	Soil Vapor Sampling	Temporary Port Sub-Slab Soil Vapor Sampling	Permanent Port Sub-Slab Soil Vapor Sampling	Indoor (Ambient) Air Sampling	Outdoor (Ambient) Air Sampling	Direct Push Groundwater Sampling	Low Flow Groundwater Sampling	Monitoring Well Purging	Groundwater Sampling by Bailer	Tap Water Sampling	Surface Water Sampling	Sediment/Sludge Sampling	Subsurface Soil Sampling	Surface Soil Sampling	Investigative Derived Waste	Water Level/NAPL Measurement	Rock Coring	Packer Testing	Aquifer Performance Test	Membrane Interface Probe	Fish Sampling	Benthic Macroinvertibrate Sampling
Helium, regulator and detector	x	x																				
Indelible black ink pen or marker	x	x	x	x	x	x	x		x	x	x	x	x	x	x		x	x				
Inflatable Packers (provided by subcontractor)																		x				
Kimwipe or paper towels						x	x	x	x		x	x	x	x	x	x					x	x
Labels and shipping products	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x			x	x
Large, wide-mouth breakers for measuring field parameters							x		x	x	x							x				
Lift pipe (provided by subcontractor)																		x				
Logbook	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
low-flow air pump	x	x	x																			
low-flow groundwater pump							x															
Nitrogen																		x				
Personal protective equipment per Health and Safety Plan	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Photoionization detector (PID)	x	x	x			x	x		x	x		x	x	x	x			x				
Plastic Zip-top bag									x	x		x	x	x							x	x
Polyethylene or plastic sheeting						x	x	x	x		x	x	x	x	x			x		x	x	x
Ponar sampler/ Eckman grab												x										
Pond sampler											x											
Pressure Gauges																		x				
Sample containers and preservatives (supplied by laboratory)						x	x		x	x	x	x	x	x	x			x				
Sampling port/valve																		x	x			
Scale																					x	x
Slide Hammer with extension rods (for manual sampling)													x									
Stainless steel push tubes (as needed)												x										
Stainless steel trowels, spoons, pan, tray, or bowls												x	x	x	x							
Stop watch										x									x			
Submersible pump								x										x	x			
Surveyor's stand (or equivalent to place canister on)				x																		
Tap and deionized water						x			x		x	x	x	x	x	x	x	x				
Tape Measure (100+ ft)	x	x	x	x	x	x	x				x	x	x	x				x	x		x	x
Locating device (GPS)	x	x	x	x	x	x	x		x		x	x	x	x			x	x		x		
Tedlar™ sample bags	x	x	x																			
Teflon thread tape			x																			
T-handle (extension rod) and hand auger													x									
three-way valve	x	x	x																			
trowel or putty knife			x																			
Tubing cutter	x	x	x				x	x														
Water level indicator						x	x	x	x							x		x	x			
Water spray bottle						x	x				x	x	x	x	x							
Water storage container (if necessary)					x	x	x											x	x			
Wrenches and pliers	x	x	x	x	x		x	x	x				x									

Appendix A
Field Form

CDM Smith

PHOTOGRAPH TRACKING LOG

SITE NAME: __________________________________

CAMERA # ____

Photograph #	Description	Date/Time	Photographer

REV 5/01

LOW FLOW SAMPLING SHEETS

SITE NAME: ______________________________

DATE:	WELL #:
SAMPLE TIME:	DEPTH OF PUMP:
WEATHER CONDITIONS:	SAMPLERS:

TIME	VOLUME PURGED (GALS)	DEPTH TO WATER (FT TIC)	FLOW RATE (ml/min)	DRAWDOWN (FEET)	TEMP ^{0}C (+/- 10%)	ph (+/- 0.1 SU)	REDOX POTENTIAL mV (+/- 10 mv)	SPECIFIC COND. mS/cm (+/- 3%)	DISSOLVED OXYGEN mg/L (+/- 10%)	TURBIDITY NTUs (+/- 10%)

The well is considered stabilized and ready for sampling when the indicator parameters have stabilized for three consecutive readings by the measurements indicated in parenthesis.

SAMPLE SCREENING TRACKING LOG

SITE NAME: ______________________________

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	MATRIX	DUP (Y/N)	COMMENTS

SYNOPTIC WATER LEVEL MEASUREMENTS

SITE NAME: ___________________________________

DATE: _______________________

Time	Well	Depth to Water	Total Depth	Product/ Thickness	HNu Headspace Readings	Notes/Well Condition

All readings are from Top of Inner Casing (TIC)

DRUM TRACKING LOG

SITE NAME: ______________________________

Drum #	Boring/MW#	Date Drilled/ Sampled	Related Sample #	Description of Drum Contents	Signature

SAMPLE TRACKING LOG

SITE NAME/SAMPLE EVENT:____

LDL VOC LAB: ______________________________ INORGANIC CLP LAB: ________________________

CLP CASE NO:____________________________ ORGANIC CLP LAB:__________________________ SUBCONTRACT LAB: ________________________

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	MATRIX	DEPTH (feet)	ORGANIC CLP NO.	INORGANIC CLP NO.	SUBCONTRACT ANALYSIS	QA/QC

ANALYSIS SUMMARY: ____

____

DRILLING SUMMARY SHEET

SITE NAME HERE

Date:	
Geologist:	
Driller:	
Borehole Locations:	
Drums Generated (ID#s):	

1.0 GENERAL CHARGES			**HAS RIG**	**TRIPOD**
1a.	Mobilization and Demobilization	Each		
1b.	Construct Decontamination Pad	Each		
1c.	Steam Cleaning (1 hour/boring maximum)	Hours		
1d.	Drums	Drums		
1e.	Drumming Residuals/Transportation	Drums		
1f.	Standby Time	Hours		
1g.	Baker Tank Rental (20,000 gallons each)	Each		
2.0 BOREHOLE DRILLING				
2a.	4 ¼ inch ID – HSA	Feet		
2b.	Split Spoon Sampling	Spoons		
2c.	Shelby Tubes	Tubes		
2d.	Geoprobe Boreholes	Feet		
2e.	Macro Core and Large Bore Sampling	Feet		
2f.	Soil Boring with Tripod	Feet		
2g.	Borehole Grouting	Feet		
3.0 OVERBURDEN MONITORING WELL INSTALLATION				
3a.	Soil Borings with 6 ¼ inch ID HAS (8 inch borehole)	Feet		
3b.	Split Spoon Sampling	Spoons		
3c.	4-inch Type 304 Stainless Steel Casing	Feet		
3d.	4-inch Type 304 Stainless Steel Screen	Feet		
3e.	Well Completion Materials (Gravel pack, bentonite, grouting installed)	Feet		
3f.	5 foot Carbon Steel Protective Casing (installed), including Well Lock and Key, Concrete Collar, etc.	Each		
3g.	Flush Mount including Well Lock and Key, Concrete Collar, etc.	Each		
3h.	Well Development (3 hours/well)	Wells		
4.0 OVERBURDEN MONITORING WELL INSTALLATION				
4a.	Surcharge for Level "C"	Per Hour		

Page of

Boring Name:

Client:
Project Location:

Project Name:

Project Number:

Drilling Contractor:
Drilling Method:
Sample Method:
Drilling Date:
North:
East:

Surface Elevation (ft amsl):
Total Depth:
Depth to Initial Water Level (ft bgs):
Field Screening Instrument:
Logged by:

Depth (ft. bgs)	Sample Number	Blows per 6 inches	Sample Interval (ft)	Recovery (ft)	OVM Reading (ppm)	Graphic Log	Material Description

Remarks:

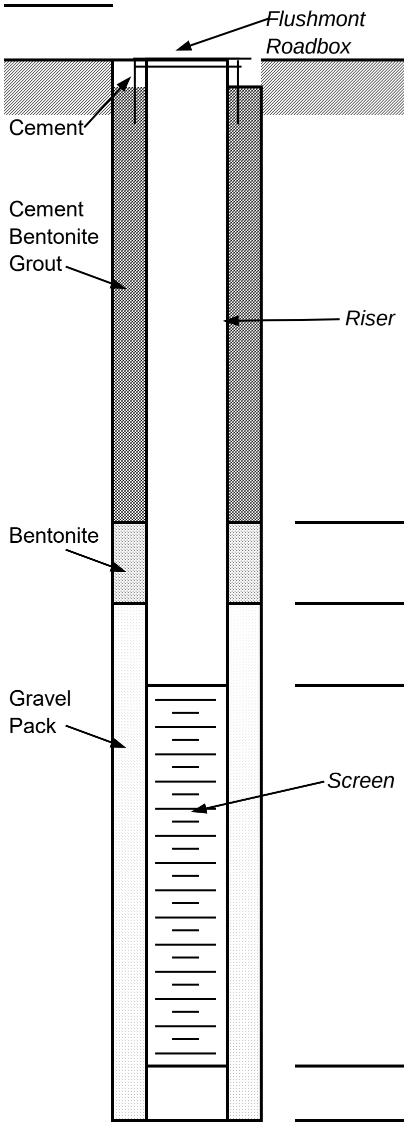
Boring Completion Depth ft bgs __________

WELL CONSTRUCTION SUMMARY

Project: ____________ Location: ____________ Well No.: ____________

Permit No.: ____________

TOC elev.: ________



Type: ____________

DRILLING SUMMARY

Drilling Company: ____________ Drillers: ____________

Drill Rig/Model: ____________

Borehole Diameters: ____________ Drilling Fluid: ____________

Bits/Depths: ____________

Total Depth: ________ Depth To Water: ____________

Supervisor Geologist: ____________

WELL DESIGN

Casing Material: ____________ Diameter: ____________

Screen Material: ____________ Diameter: ____________

Slot Size: ____________ Setting: ____________

Filter Material: ____________ Setting: ____________

Seals Material: ____________ Setting: ____________

Grout: ____________ Setting: ____________

Surface Casing Material: ____________ Setting: ____________

TIME LOG

	Started	Completed
Drilling:		
Installation:		
Development:		

WELL DEVELOPMENT

Method: ____________

Static Depth to Water: ____________

Pumping Depth To Water: ____________

Pumping Rate: ________ Spec. Capacity: ________

Volume Pumped: ________

Appendix B - Field Activities Plan

FIELD ACTIVITIES PLAN

New York State Department of Environmental Conservation

Standby Engineering Services
Contract D009805

Prepared for:
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, NY 12233-7017

Prepared by:
Camp Dresser McKee & Smith
11 British American Boulevard
Suite 200
Latham, NY 12110

August 2024

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Section 1

Introduction

This generic Field Activities Plan (FAP) has been prepared by Camp Dresser McKee & Smith (CDM Smith) for the New York State Department of Environmental Conservation (NYSDEC) to document quality assurance/quality control (QA/QC) under the NYSDEC Standby Contract for Engineering Services D009805. Site-specific procedures will be included in the Field Activities Plan as an attachment to the site-specific Work Plan for each work assignment, as needed. General information and procedures applicable to the field activities and analytical program are provided in the Quality Assurance Project Plan (QAPP) prepared by CDM Smith for NYSDEC.

1.1 Purpose

The principal purpose of this document is to specify QA/QC procedures for the collection, analysis, and evaluation of data that will be legally and scientifically defensible.

1.2 Objectives

The FAP provides general information and procedures applicable to the field activities and analytical program detailed in each site-specific Work Plan provided by NYSDEC for each work assignment. This information includes definitions and generic goals for data quality and required types and quantities of QA/QC samples. The procedures address field documentation; sample handling, chain of custody, and shipping; instrument calibration and maintenance; auditing; data deliverable and reduction, validation, and reporting; corrective action requirements; and QA reporting specific to the analyses performed by the laboratories subcontracted by CDM Smith.

Section 2
Anticipated Field Activities

CDM Smith's point of contact for any field investigation activities is the field team leader and the onsite NYSDEC representative or PM. Any minor changes in sampling activities that are within the proposed scope of the project will be documented each day in the field logbook and signed by both representatives. Any modifications that are inconsistent with the approved work plan are to be approved by NYSDEC PM prior to implementation.

2.1 Soil Vapor Sampling

Soil vapor sampling will be conducted in accordance with the New York State Department of Health (NYSDOH) "*Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006"* including the May 2017 updates to Soil Vapor/Indoor Air Decision Matrices, and the NYSDEC "*Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation, dated May 2010".*

2.1.1 Soil Vapor Probe Installation

A soil vapor probe installation at all locations will be performed using a Geoprobe device. Each soil vapor point will be installed using a 6-inch stainless steel woven screen drive point. The probe will be driven to the desired depths with the maximum depth located approximately two feet above the water table.

2.1.2 Tracer Testing

Tracer tests will be conducted at fifty percent of soil vapor locations to verify the integrity of the soil vapor probe seal. Helium should be injected through the bottom of the device to enrich the atmosphere to approximately 80 percent Helium. If the concentration of tracer gas drawn into the sample probe is read to be below 10 percent, the seal is sufficient.

2.1.3 Soil Vapor Sampling Procedures for Laboratory Analysis

Once the soil gas probe is installed and a tracer test is conducted, soil gas samples for laboratory analysis will be collected using a certified clean Summa canister with a two-hour regulator. One to three implant volumes (i.e., the volume of the sample probe and tubing) should be purged before collecting the soil vapor samples. Purge flow rates should not exceed 0.2 liters per minute. Each Summa canister vacuum reading should be approximately 25-30 inches of mercury (Hg) at the start of the sampling. If not, a different canister should be used due to improper evacuation. It is critical to ensure that moisture does not enter the Summa canister since this could compromise the analytical results. Field personnel will label, pack and ship the samples to an NYSDOH Environmental Laboratory Approval Program (ELAP) approved laboratory at the completion of the sampling. The serial numbers for the Summa canisters and the regulators as well as the initial and ending pressures of the canisters will be recorded on the chain of custody (COC) and in the logbook. The field sampling team will maintain a sample log sheet summarizing the following: Sample identification, date and time of sample collection, sampling depth, Serial numbers for Summa canisters and regulators, sampling methods and devices, and vacuum of Summa canisters before and after sample collection.

2.2 Indoor Air Monitoring

The NYSDOH *Indoor Air Quality Questionnaire and Building Inventory* shall be completed for each structure where indoor air testing is being conducted. The following should be documented to ultimately aid in the interpretation of the sampling results:

- 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).
- 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.
- The use of heating or air conditioning systems during sampling.
- 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.
- 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.
- Weather conditions (e.g., precipitation and indoor and outdoor temperature) and ventilation conditions (e.g., heating system active and windows closed) reported.
- Any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via photoionization detector [PID], 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), and photographs to accompany floor plan sketches.

The field sampling team should maintain a sample log sheet summarizing the following: sample identification, date and time of sample collection, sampling location and approximate height, identity of samplers, sampling methods and devices, and vacuum of canisters before and after samples collected.

2.2.1 Indoor (Ambient) Air Sampling

All indoor air samples will be collected with a 6 liter laboratory certified Summa canister regulated for a 24 hour sample collection. Sample collection will be similar to outdoor ambient air sample collection. The Summa canister will be placed in an appropriate location as to collect a representative sample from the breathing zone at 4 to 6 feet above the floor. Personnel should avoid lingering in the immediate area of the sampling device while samples are being collected. A 24-hour regulator shall be used for residential spaces, while an 8-hour regulator shall be specified for commercial spaces.

2.2.2 Sub-Slab Soil Vapor Sampling Procedures

Sub-slab soil gas samples for laboratory analysis will be collected according to the following procedures:

- Prior to installation of the sub-slab vapor point, the building floor should be inspected and any penetrations (cracks, floor drains, utility, sumps, etc.) should be recorded. Sub-slab points should be installed at locations where the potential for ambient air infiltration via floor penetrations is minimal.

- After the slab has been inspected and the location of any subsurface utilities determined, the ambient air surrounding the proposed sampling location will be screened with a PID.

- A hammer drill, equipped with a ½-inch to ¾-inch drill bit, will be used to advance a hole to a depth of approximately 6 inches beneath the bottom of the slab. Using a larger approximately 1.25-inch diameter drill bit (about the size of a rubber stopper) drill a hole approximately 1.5 inches into the slab. When drilling is complete, clean around drilled area.

- Insert tubing constructed with 3/8-inch outer diameter poly, ¼-inch inner diameter Teflon® tubing through the hole in the rubber stopper and into the hole in the slab making sure the tubing does not extend further than 2 inches into the sub-slab material.

- The annular space between the borehole and the sample tubing will be filled and sealed with electrical conduit putty (or volatile organic compound [VOC] free equivalent) at the surface. Conduct tracer testing in accordance with the procedures specified in site specific plan.

- The samples will be collected using a 6-liter laboratory-certified clean Summa canister with a 24-hour flow regulator and an initial vacuum of 28 inches Hg ± 2 inches. Record the initial pressure in the Summa canister to be used for the sample prior to connecting the tubing. If an initial vacuum reading of less than 25 inches of Hg is observed, use a different canister as this indicates the canister was not properly evacuated.

- The end of the tubing will be connected directly to the Summa canister's regulator valve. Flexible silicone tubing will be used as a tubing adapter only.

- When the vacuum gauge reads 5 inches of Hg or less, close the valve. Sampling is complete. A vacuum of 5 inches Hg ± 1 inch must be present when sample collection is terminated to prevent contamination during transit. Record the final pressure reading in the Summa canister.

- CDM Smith personnel will label, pack and ship the samples to an NYSDOH ELAP approved laboratory. The serial numbers for the Summa canisters and the regulators as well as the initial and ending pressures of the canisters will be recorded on the COC and in the field logbook. Custody seals will be placed on all packages containing laboratory samples during shipment.

- A 24-hour regulator shall be used for residential spaces, while an 8-hour regulator shall be specified for commercial spaces.

2.3 Outdoor (Ambient) Air Monitoring

All outdoor air samples will be collected with a laboratory certified clean Summa canister regulated for a 24 hour sample collection using a 6 liter Summa canister. The Summa canister will be placed in such a location as to collect a representative sample from the breathing zone at 4 to 6 feet above the ground.

Personnel will avoid lingering in the immediate area of the sampling device while samples are being collected. Ambient air samples will be collected in a location far away from any boring or dust generating activities.

The following actions will be taken to document conditions during ambient air sampling:

- Outdoor plot sketches will be drawn that include the building site, area streets, ambient air sample locations, the location of potential interferences, compass orientation, and paved areas.
- Weather conditions (e.g. precipitation, temperature, wind direction and barometric pressure)
- Any pertinent observations, such as odors, reading from field instruments, and significant activities in the vicinity (e.g. operation of heavy equipment) will be recorded.

The field sampling team will maintain a sample log sheet summarizing the following: Sample identification, date and time of sample collection, sampling height, identity of samplers, sampling methods and devices, volume of air sampled, and vacuum of canisters before and after samples collected.

2.4 Monitoring Well Installation

This section provides procedures for well design and well construction to aid in the development of drilling subcontracts. Drilling operation and well development guidelines are presented to aid the reader in the oversight of the installation of monitoring wells.

The principal reason that monitoring wells are constructed is to collect groundwater samples that, upon analysis, can be used to delineate a contaminant plume and track movement of specific chemical or biological constituents. A secondary consideration is the determination of the physical characteristics of the groundwater flow system to establish flow direction, transmissivity, quantity, etc. The spatial and vertical locations of monitoring wells are important. Of equal importance are the design and construction of monitoring wells that will provide easily obtainable samples and yield reliable, defensible, and meaningful information. In general, monitoring well design and construction follows production well design and construction techniques. However, emphasis is placed on the effect these practices may have on the chemistry of the water samples being collected rather than on maximizing well efficiency.

From this emphasis, it follows that an understanding of the chemistry of the suspected pollutants and of the geologic setting in which the monitoring wells are constructed plays a major role in determining the drilling technique and materials used.

2.4.1 Types of Monitoring Wells

Two different types of monitoring wells will be installed depending upon site conditions and the project work plan. Permanent monitoring wells will be proposed at locations in which long term monitoring is required, whereas temporary monitoring wells will be used in locations for short term monitoring. Well depth will be dependent upon monitoring objectives, site specific conditions, contaminant behavior, and site geology.

2.4.2 Well Siting

Specific well siting requires personnel to review and be familiar with pertinent proposal sections, specifications, and subcontractor's contracts, any regulations governing how, where or when the well is drilled and, with data (supplied by the Client, or any other data available) used for program planning. Once a well site is identified on a topographic map or other project base map, the landowner must be contacted to establish whether drilling will interfere with the established land use. Unless the property is owned by the client, the landowner is always contacted before entering the property, even if he is leasing back the property from the client. The well site should also be reasonably level and absent of large boulders or other hazardous obstructions.

A check should be performed to insure the absence of buried high-pressure gas, oil or water lines. If any lines are present relocate the well site a safe distance away from them. Be sure to check with the subcontractor to insure his/her agreement. The absence of overhead power transmission lines should also be checked. If any overhead power lines are present, relocate the well site a safe distance away from them. Be sure to check with the subcontractor to insure his/her agreement.

Lastly, consult the landowner about water source and access, and then notify the driller of these decisions and explain to the driller the need for care and accurate retrieval of drill cuttings and, if necessary, placement and accounting of materials during well completion. If necessary, request access agreement to the well site.

2.4.3 Well Design and Construction

Permanent and temporary monitoring wells differ in the materials in which they are placed and also the methods in which they are constructed. Temporary monitoring wells are typically installed using direct-push techniques. Permanent monitoring wells are typically placed in either bedrock or overburden soils and usually require a hollow-stem auger or rock coring/air rotary drill to be used.

2.4.3.1 Temporary Direct Push Well Installation

Wells will be constructed of a pre-packed 2.5 inch OD (1 inch ID) slotted polyvinylchloride (PVC) well screen (pre-packed with sand and stainless steel mesh) and 1 inch ID, schedule 40 PVC riser casings (a 1-inch ID PVC well screen may also be utilized). The pre-packed well screens are manufactured prior to mobilization. Install a sand filter around the well screen to directly above the screen. Grain size of the sand will be appropriate for the slot size of the screen (normally 0.01-inch). Retract the probe rods to a point above the screen. Install a 2 foot Bentonite pellet seal using "00" gravel or bankrun sand. Backfill the remainder of the hole with bentonite-cement grout until it flows at the surface. Install protective flush-mount or stick-up casing around new well as appropriate.

2.4.3.2 Permanent Overburden Well Installation

Overburden wells are typically installed by a hollow-stem auger. They range from a 2-inch diameter well using a 4-1/4 inch (ID) hollow-stem auger to a 4-inch diameter well using a 6-1/4 (ID) hollow stem auger. Boreholes typically extend at least 5 feet into the ground, but this is depending upon the site-specific plan. The slot sized well screen will be of schedule 40 PVC flush-joint casing up to the ground surface. The space between the boring wall and the PVC will be filled with size Morie Sand or its equivalent. The sand will extend at least 2 feet above the screen to be followed by at least two-foot Bentonite pellet seal. The remaining fill will be a mixture of cement/Bentonite grout filling. The monitoring wells will be completed at the ground surface and if they extend beyond the surface will need to be encased in a steel casing. All permanent wells need a secure cap and locking cover. Alternative methods will be specified in the site-specific plan.

2.4.3.3 Permanent Bedrock Well Installation

Bedrock wells can be installed by either hollow-stem auger or rock coring/air rotary drill. Borings are typically drilled with a 6-1/4 inch inside diameter bit. Once bedrock in encountered a "rock socket" (typically 6-inch) is installed into the rock. It is typically assumed that cores samples are not to be kept, but this could differ depending upon the site-specific plan. The requirements for backfilling materials and procedures are the same as that for overburden wells and can be referenced above.

2.5 Monitoring Well Development

All completed wells, whether production or monitoring, must be developed in order to facilitate unobstructed and continuous groundwater flow into the well. Well development is the process of cleaning the fines from the face of the borehole and the formation near the well screen. During any drilling process the side of the borehole becomes smeared with drilling mud, clays or other fines. This plugging action substantially reduces the permeability and retards the movement of water into the well screen. If these fines are not removed, especially in formations having low permeability, it then becomes difficult and time consuming to remove sufficient water from the well before obtaining a fresh groundwater sample because the water cannot flow easily into the well.

The development process is best accomplished for monitoring wells by causing the natural formation water inside the well screen to move vigorously in and out through the screen in order to agitate the clay and silt and move these fines into the screen. The use of water other than the natural formation water is not permitted. Well development methods may include using a surge block, using a bailer, or by using a surge and pumping technique.

2.6 Monitoring Well Purging and Sampling

Well purging can be performed on a volume basis or on a field parameter stabilization basis, also known as low flow. In both cases, field parameters are recorded; however, for the former case purging is concluded after a target number of well volumes (typically 3 to 5) regardless of whether parameters have stabilized. In the latter case, purging continues until field parameters stabilize within 10 percent.

2.6.1 Volumetric Method of Well Purging

The following steps should be followed when purging a well by the volumetric method:

- Monitor the air space at the wellhead, using a PID or equivalent, as soon as well cover is removed according to health and safety requirements.
- Determine the depth to static water level and depth to bottom of well casing. Calculate the volume of water within the well bore based on the well volumes in **Table 2-1** and record all data and calculations in the field logbook.

Table 2-1
Well Volumes

Well Diameter (inches)	Gallons (per foot)
2	0.16
4	0.65
6	1.5
8	2.6
10	4.1
12	5.9

- Set up field parameter probes at the discharge orifice or dedicated probe port of the pump assembly or within the flow-through chamber.
- Prepare the pump and tubing, or bailer, and lower it into the casing.

- Remove the number of well volumes specified in the site-specific plans. Generally, three to five well volumes will be required. Field parameters should be measured and recorded, if required by site-specific plans. In low recharge aquifers, the well commonly will be pumped or bailed to dryness before three well volumes of water are removed. If this is the case, there is no need to continue with purging operations. Record pertinent data in the field logbook and collect the samples once the well recharges.

- Remove the pump assembly or bailer from the well, decontaminate it (if required), and clean up the site. Lock the well cover before leaving. Containerize and/or dispose of development water as required by the site-specific plan.

2.6.2 Low-Flow Groundwater Purge and Sampling

Low-flow purge and sampling is appropriate at locations where disturbance of the media around the well screen needs to be minimized. A common concern is turbidity in the monitoring wells and the consequent undesirable effects on metals sampling results.

The low-flow purge and sample method creates less disturbance and agitation in the well, and therefore excess turbidity is not generated during the purging and sampling process. The result is a more rapid stabilization of turbidity and other parameters (pH, temperature, oxidation reduction potential [ORP], specific conductivity, and dissolved oxygen), and a sample more representative of conditions in the formation is collected.

The low flow purge and sample method consists of using a submersible or bladder pump to purge the well at a very low flow rate (0.5 to 1.5 liter/minute). The pump intake is set approximately in the middle of the well screen, with a stagnant water column over the top of the pump. The well is purged at the low rate until the field parameters (temperature, pH, ORP, specific conductivity, turbidity, and dissolved oxygen) have stabilized. The sample is then collected directly from the pump discharge at a low flow rate.

2.6.2.1 Low Flow Purging Procedures

- Check and record the condition of the well for any damage or evidence of tampering. Remove the well cap. Measure well headspace with a PID and record the reading in the field logbook. For wells installed on a landfill, also measure the headspace with a combustible gas indicator.

- Measure and record the depth to water with an electronic water level device and record the measurement in the field logbook. Do not measure the depth to the bottom of the well at this time (to avoid disturbing any sediment that may have accumulated). Obtain depth to bottom information from installation information in the field logbook or drilling logs. Calculate volume of the water column by depth of water column times the cross-sectional area of the well.

- Lower pump to desired sampling depth. During purging, monitor the water level and field parameters (temperature, pH, turbidity, ORP, specific conductance and dissolved oxygen) approximately every 3 to 5 minutes or using a flow through cell such as a YSI. Continue monitoring until the water level stabilizes and field parameters have stabilized to within 10 percent (plus or minus 5 percent) over a minimum of three readings. Turbidity and dissolved oxygen are typically the last parameters to stabilize. Once turbidity readings get below 10 nephelometric turbidity units (NTUs), then the stabilization range can be amended to 20 percent (plus or minus 10 percent) over a minimum of three readings.

- If a flow through cell is not used, readings should be taken in a clean container and the monitoring instrument allowed to stabilize before collection of the next sample. The Horiba instrument takes the readings consecutively and therefore the process to record all the measurements may take longer than five minutes. If so, measurements should be taken as often as practicable.

- Once the water level and field parameters have stabilized, collect the samples from the pump.

2.7 Groundwater Sampling by Bailer

Groundwater is typically sampled by bailer after purging 3 to 5 well volumes using the volumetric method above. After the well is purged, allow water level to recover to a depth which will allow submergence of the bailer without contacting the well bottom. Ideally, the water level should recharge to 75 percent of the static level. Samples shall be collected within 3 hours of purging if recharge is sufficient. Wells with a low recharge rate must be collected within 24 hours of purging. Lower and retrieve the bailer slowly to minimize disturbance.

2.8 Surface Water Sampling

Four surface water sampling scenarios are provided below. These include 1) shallow surface water samples for VOC analysis (preserved and unpreserved), 2) shallow surface water samples for non-VOC or inorganic compound analysis (preserved and unpreserved), 3) deep surface water samples using a weighted bottle sampler and 4) deep surface water samples using a peristaltic pump.

When preparing for surface water sampling, personnel should follow all procedures established within the Health and Safety Plan and should also identify the sampling locations as directed from the work plan. The sampling site should be prepared by laying out clean plastic sheeting on the ground or other flat surface to place all equipment upon. All field measurements should take place prior to sampling and include physical, chemical, and biological characteristics of the water. All samples should be collected from areas of least to greatest contamination, when known, and from downstream to upstream. The sampler should always be facing upstream when sampling and documentation of the sampling events should be kept in the field notebook.

2.8.1 Collecting Shallow Surface Water Samples

When collecting shallow surface water samples, the location must be approached from downstream without entering the sample area. VOC vials should be slowly submerged in an area of gently flowing water and care should be taken to not disturb the bottom sediments. If wading or entering the area with a gas-powered vessel is necessary, always do so from downstream, make sure that all engines are turned off and do not physically enter the actual sample area.

When collecting samples for VOC analysis, avoid collecting from a surface water point where water is cascading and aerating. Cap the VOC vial while it is under water. After the vial is capped, check the vial to see if there are any air bubbles trapped in it. If air bubbles are present discard the sample.

2.8.2 Collecting Deep Surface Water Samples at Specified Depth Using a Weighted Bottle Sampler

To use a weighted bottle sampler, lower the weighted bottle sampler to the depth specified in the site-specific plan. Remove the stopper by pulling on the sampler line; allow the sampler to fill with water. Release the sampler line to reseat the stopper and retrieve the sampler to the surface.

2.8.3 Collecting Deep Surface Water Sample Collection Using a Peristaltic Pump

When collecting deep surface water samples using a peristaltic pump, select the appropriate length of Teflon®-lined intake tubing, in order to reach the specified sampling depth. When sampling for per- and polyfluoroalkyl substances (PFAS),high density polyethylene (HDPE) tubing shall be used and any Teflon®-containing materials must be avoided. Attach the intake sampling tube to the intake pump tube. Lower the intake tube into the surface water at the specified sampling location to the specified depth; make sure the end of the intake tube does not touch underlying sediments.

Start the pump and allow at least three tubing volumes of liquid to flow through and rinse the system before collecting any samples. Do not immediately dispense the purged liquid back to the surface water body. Instead, collect the purged liquid and return it to the source after sample collection is complete

2.9 Direct Push Groundwater Sampling

2.9.1 Macro Core Sampling

Direct push methods will be used to collect 48 or 60 inch macro-core samples continuously at each of the groundwater sample locations. The samples will be used by the CDM Smith engineer, geologist or field scientist to determine the depth to groundwater at each location. Once saturated soil is verified, a screen point groundwater sampler will be set approximately 5 feet into the water table.

2.9.2 Purge and Sampling

Standard purge techniques will be utilized to purge and sample groundwater. Standard purge and sampling techniques consist of using a check valve and tubing to purge the well at a low flow rate. The check valve intake is set approximately in the middle of the screen. The well is purged at the low rate until the water flows clear or the turbidity is reduced to 50 nephelometric turbidity units (NTUs) or less, or to a level deemed acceptable to the field team leader. The sample is then collected directly from the tubing or bailer.

2.10 Well Abandonment

Once it is deemed that a temporary or permanent monitoring well is no longer needed, the well will be abandoned by a New York State certified well driller as follows:

- The well will be sounded (its depth measured with a weighted line or appropriate method) immediately before it is destroyed to make sure that it contains no obstructions that could interfere with filling and sealing. If an obstruction is observed the well may need to be over drilled to the wells original depth before abandoned.
- Where possible, remove all material within the original borehole – including the well casing, filter pack and annular seal. If the casing, filter pack and annular seal materials cannot be removed, they may be left in place.
- The casing left in place may require perforation or puncturing to allow proper placement of sealing materials. Where the casing is left in the hole, the casing may be cut at the surface.
- Fill well screen with sand per NYSDEC specifications.
- The monitoring well should be filled to the surface with cement grout, or within 20 feet of the surface with Bentonite grout. After the placement of the Bentonite grout (if used), the remaining

portion of the well then should be sealed with a Portland Type I, II or Type I/II cement with 2 percent to 5 percent Bentonite.

2.11 Sediment/Sludge Sampling

When preparing for sampling sediment/sludge, personnel should follow all procedures established within the Health and Safety Plan and should also identify the sampling locations as directed from the work plan. The sampling site should be prepared by laying out clean plastic sheeting on the ground or other flat surface to place all equipment upon. All field measurements should take place prior to sampling and include physical, chemical, and biological characteristics of the water. All samples should be collected from areas of least to greatest contamination, when known, and from downstream to upstream. The sampler should always be facing upstream when sampling and documentation of the sampling events should be kept in the field logbook. When conducting sampling for PFAS analysis, no Teflon®-containing materials or equipment should be used..

2.11.1 Sediment/Sludge Sample Collection from Shallow Waters

Use a decontaminated stainless steel or Teflon, long-handled scoop, corer, push tube, or dredge to collect the entire sample in one grab. If wading is necessary, approach the sample location from downstream. Do not enter the actual sample area. Retrieve the sampling device and slowly decant off any liquid phase.

2.11.2 Subsurface Sediment/Sludge Sample Collection Using a Corer or Auger from Shallow Waters

At the specified sampling location, force or drive the corer to the specified depth. Twist and withdraw the corer in a smooth motion. Retrieve the sampling device, remove the corer nosepiece (if possible), and extrude the sample into the specified sampling container(s). Use a clean stainless steel or Teflon spoon or spatula to completely fill the container(s), ensuring no headspace.

2.11.3 Sediment/Sludge Sample Collection Using a Dredge from Deep Waters

Attach a clean piece of 12 to 19 mm (½ to ¾ inch) braided nylon line or Teflon-coated wire rope to the top of the sampler. The line must be of sufficient length to reach sediment or sludge and have enough slack to release the mechanism. Mark the distance to the bottom on the line. At the specified sampling location, open the sampler jaws and slowly lower the sampler until contact with the bottom (sediments/sludge) is felt. Slowly raise the sampler and once the sampler is above the water surface, place the sampler in a stainless steel or Teflon lined tray or pan and open the sampler.

2.11.4 Restrictions/Limitations

Core sampling devices may not be usable if cobbles exist in the sediment/sludge. Bumping of core sampling devices and Ponar dredge samplers may result in the loss of some of the sample.

For VOC analysis or for analysis of any other compound(s) that may be degraded by aeration, grab sampling is necessary to minimize sample disturbance and, hence, analyte loss. The representativeness of this sample, however, is difficult to determine because the collected sample represents a single point, is not homogenized, and has been disturbed.

2.12 Subsurface Soil Sampling

Methods of subsurface soil sampling to be used include manual (hand) auger sampling, split-spoon/split barrel sampling, direct-push, and sonic soil sampling. These methods will be used to collect subsurface samples from boreholes and will help to classify overburden soils quickly and cost effectively. These methods also facilitate the installation of temporary monitoring wells, permanent monitoring wells, piezometers, and soil vapor points. Procedures for these four drilling procedures can be found below.

In general, a few steps must always be followed when collecting subsurface soil samples. First, VOC samples or samples that may be degraded by aeration shall be collected first and with the least disturbance possible. Second, sampling information shall be recorded in the field logbook and on any associated forms. Third, a description of the lithology, including color, grains size, moisture, odor and other observations should be recorded. Additionally, when conducting sampling for PFAS analysis, no Teflon®-containing materials or equipment should be used.

2.12.1 Manual (Hand) Auger Sampling

When collecting hand-auger samples auger to the depth required for sampling. Place cuttings on plastic sheeting or as specified in the site-specific plans. If possible, lay out the cuttings in stratigraphic order. Throughout the sampling, make detailed notes concerning the geologic features of the soil or sediments in the field logbook. Cease augering when the top of the specified sampling depth has been reached. If required, remove the auger from the hole and decontaminate the auger or use a separate decontaminated auger, then obtain the sample. Scan sample with PID, as appropriate. Collect VOCs quickly to minimize loss of volatiles. When all sampling is complete, dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans.

2.12.2 Split-Spoon/Split Barrel Sampling

When collecting split-spoon samples the drilling contractor will set up the hollow-stem auger with the cutting head to the drill rig in order to begin drilling and will drill as specified within the site-specific plan. The drilling contractor will also be responsible for following the American Standard of Testing and Materials (ASTM) Method D-1586 when setting up the hammer to drive the split spoon and also for recording the number of blows till the full length of the spoon has been driven or upon refusal. Refusal can be defined by ASTM D1586-99 § 7.2.1 and 7.2.2 as greater than50 blows per 6 inch advance or a total of 100 blows. With the drive shoe and head assembly off, open (split) the split-spoon, being careful not to disturb the sample. Scan sample with PID, as appropriate. Collect VOCs quickly to minimize loss of volatiles.

2.12.3 Direct-Push Procedures

When collecting direct-push samples the drilling contractor should drive samples from the surface to the desired depth, using either 4 foot or 5 foot long direct push samplers, or 2 foot split-spoons. A discrete interval sampling (sampler end is plugged while driving to top of desired sample interval to exclude soil from non-desired depths) should be used when appropriate (for example, deeper than 8 feet or below the water table). At the top of sampling interval, release plug (if used) and drive sampler across desired sample interval. Once sample is retrieved, classify sample based on the Unified Soil Classification System (USCS). Record the following information in the soil boring log and field logbook when describing the sample: soil quality conditions, classification, sampling interval, PID reading, and any visual or olfactory observations. Samples can be secured for laboratory analysis based on visual signs of contamination, exhibiting the highest response to field screening device, existing in an interval above the water table interface, or as directed by NYSDEC project or field manager. At the conclusion of the boring, grout the borehole and decontaminate equipment.

Subsurface soil samples may be collected using a hand auger at depths of up to 10 feet (typical). In such cases, CDM Smith typically performs the boring and collects the samples for analysis. For deeper depths, a drilling subcontractor is typically used to perform a boring and collect subsurface soil samples by split spoon or Shelby tube via rotary drilling methods, or by direct push methods. In such cases, the driller provides the soil samples to CDM Smith, and CDM Smith then collects the laboratory samples.

2.12.4 Sonic Drilling Samples

When collecting sonic drilling samples, the drilling contractor should drive samples from the surface to the desired depth, using either 5 foot or 10 foot long barrow samplers. Once sample is retrieved, classify sample based on the USCS. Record the following information in the soil boring log and field logbook when describing the sample: soil quality conditions, classification, sampling interval, PID reading, and any visual or olfactory observations.. Samples can be secured for laboratory analysis based on visual signs of contamination, exhibiting the highest response to field screening device, existing in an interval above the water table interface, or as directed by NYSDEC project or field manager. At the conclusion of the boring, grout the borehole and decontaminate equipment.

2.13 Surface Soil Sampling

When preparing for sample collection, locate sampling location(s) in accordance with project documents (e.g., work plan) and document pertinent information in the appropriate field logbook. When possible, reference locations back to existing site features such as buildings, roads, intersections, etc. The processes for verifying depth of sampling must be specified in the site-specific plans. Surface soil samples should be collected from the least contaminated to the most contaminated areas, if known. When taking the sample place clean plastic sheeting on a flat, level surface near the sampling area, if possible, and place equipment to be used on the plastic; place the insulated cooler(s) on separate plastic sheeting. A clean, decontaminated trowel, scoop, or spoon will be used for each sample collected. Other equipment may be used (e.g., shovels) if constructed of stainless steel. Document the sampling events, recording the information in the designated field logbook. Document any and all deviations from SOPs in the field logbook and include rationale for changes. When collecting samples for PFAS analysis, no Teflon®-containing materials or equipment should be used.

2.14 Water Level/NAPL Measurement

Water levels can be measured by several instruments. The two most common are covered here – electric water level meter (measures depth to water only) and the interface probe (measures depth to water and depth to non-aqueous phase liquid (NAPL)).

2.14.1 Procedures for Use of Water Level Meter

Before using a water level meter, standing upwind of the well, open the well head and monitor vapors with a PID as dictated by the site-specific Health and Safety Plan (HASP). Check that the water level meter is functioning correctly (test button, or immerse probe in tap water to test). Next, lower the probe slowly into well until contact with water surface is indicated (tone and/or light). Continue to slowly raise and re-lower probe until a precise, repeatable depth to water can be measured.

Record the depth to water from the measuring point of known elevation, usually marked at the top of the casing. If no mark is present, measure from the highest point of the casing or as otherwise instructed in the site-specific work plan.

2.14.2 Procedures for Use of Interface Probe

The interface meter is used to measure the depth to water and the depth to NAPL (light and/or dense). As with the water level meter, standing upwind of the well, open the well head and monitor vapors with a PID as dictated by the site-specific HASP. Check that the interface level meter is functioning correctly using the test button or immerse the probe in tap water and NAPL to test. Next, lower the probe slowly into the well until contact with water or NAPL surface is indicated. Water is typically indicated by a beeping tone; NAPL is typically indicated by a steady tone; check manufacturer's specifications. Continue to slowly raise and re-lower probe until a precise, repeatable depth to water/NAPL can be measured. Record the depth to water/NAPL from the measuring point of known elevation, usually marked at the top of the casing. If no mark is present, measure from the highest point of the casing or as otherwise instructed in the site specific work plan.

When measuring the interface depth between light non-aqueous phase liquid (LNAPL) and water, the non-aqueous phase is floating on top of the water column, and the probe must be lowered through the NAPL before encountering water. In this case, shake the probe after water is encountered to help dislodge any NAPL droplets stuck to the probe. Then raise the probe slowly until it re-enters the NAPL. Perform this procedure until a repeatable result is obtained. The interface depth should be recorded in the up direction, never the down direction. When the probe is moving down, past the LNAPL, it may still be coated with product and can therefore yield misleading results. Therefore, it must be shaken in the water and raised to the interface for an accurate result. Record depth from measuring point, as noted above.

When measuring the interface depth between dense non-aqueous phase liquid (DNAPL) and water, the non-aqueous phase is at the bottom of the well, below the water column. Lower the probe until NAPL is encountered. Then raise the probe, shake it in the water to dislodge any NAPL droplets, and lower it again. Perform this procedure until a repeatable result is obtained. The interface depth should be recorded in the down direction, never in the up direction. When the probe is moving up from the DNAPL it may still be coated with product and can therefore yield misleading results. Therefore, it must be shaken in the water and lowered to the interface for an accurate result. Record the depth from the measuring point.

2.15 Tap Water Sampling

Tap water sampling may be performed in residential, commercial or industrial areas for several reasons. The most common tap water samples are used to obtain groundwater samples from private wells. Prior to sampling tap water, permission must be obtained to access the property from the resident or owner. The location of the tap should be determined based on its proximity to the water source. It is preferable that the tap water sampling be conducted at a tap located prior to any holding or pressure tanks, filters, water softeners, or other treatment devices that may be present. If possible, obtain well construction details, holding tank volumes etc. to evaluate standing volume of water in the system. If the sample must be collected at a point in the water line beyond a pressurization or holding tank, a sufficient volume of water should be purged to provide a complete exchange of fresh water into the tank and at the location where the sample is collected. If the sample is collected from a tap or spigot located just before a storage tank, spigots located inside the building or structure should be turned on to prevent any backflow from the storage tank to the sample tap or spigot. It is generally advisable to open as many taps as possible during the purge, to ensure a rapid and complete exchange of water in the tanks. Samples collected to determine if system related variables (e.g., transmission pipes, water coolers/heaters, holding/pressurization tanks, etc.) are contributing to the quality of potable water should be collected after a specific time interval (e.g., weekend, holiday, etc.). Sample collection should consist of an initial flush, a sample after several minutes, and another sample after the system has been purged.

Devices such as hoses, filters, or aerators attached to the tap may harbor a bacterial population and therefore should be removed prior to sampling. Sample containers should not be rinsed before use when sampling for bacterial content, and precautions should be taken to avoid splashing drops of water from the ground or sink into either the bottle or cap. Samples of the raw water supply and the treated water after chlorination should be collected when sampling at a water treatment plant and in the logbook, the location and description of the general condition of the tap selected to be sampled should be recorded. The rationale used in selecting the tap sampling location, including any discussions with the property owner, should also be recorded. Provide a sketch of the water supply/distribution system noting the location of any filters or holding tanks and the water supply source (i.e., an onsite groundwater well or surface water intake or a water service line from a public water main). If an onsite water supply is present, observe and record the surrounding site features that may provide potential sources of contamination to the water supply. It's important to don the appropriate personal protective clothing as dictated by the site-specific HASP. Gloves should be changed between sampling locations to avoid possible cross-contamination of the tap water samples.

Prior to sample collection, the supply system should be purged by turning the cold-water tap on. The following general guidelines should be followed to determine when the system is adequately purged (refer to the site-specific sampling plans for any other requirements):

- Onsite Water Supply; A minimum of three standing volumes of water (i.e., the static volume of water in the well and holding tank, if present) should be purged. Obtain water temperature, conductivity, and pH measurements after each volume of water is purged. If the standing volume of water in the supply system is unknown, the tap should be allowed to run for a minimum of 15 minutes and temperature, conductivity, and pH measurements, or other parameters as specified by the project plan, should be collected at approximately 3- to 5-minute intervals. (In general, well construction details and holding tank volumes should be obtained prior to conducting the sampling event to estimate the standing volume of the water supply system.) The system is considered adequately purged when the temperature, conductivity, and pH stabilize within 10 percent for three consecutive readings. If these parameters do not stabilize within 15 minutes, then purging should be discontinued and tap water samples may be collected.

- Large Distribution Systems; Because it is impractical to purge the entire volume of standing water in a large distribution network, a tap should be run for a minimum of 5 minutes, which should be adequate to purge the water service line. Obtain temperature, conductivity, and pH measurements at approximately 1-minute intervals. The system is considered adequately purged when the temperature, conductivity, and pH readings, or other parameters as specified by the project plan, stabilize within 10 percent for three consecutive readings. If these parameters do not stabilize within 5 minutes, then purging should be discontinued and tap water samples may be collected. During purging, a 5 gallon bucket and stopwatch may be used to estimate the flow rate if required by the site specific plans. Dispose of the purged water according to the site specific plans. Record the temperature/conductivity/pH readings, or other parameters as specified by the project plan, the volume of water purged, the flow rate if measured, and the method of disposal in the field logbook.

After purging the supply system, collect the samples directly from the tap (i.e., if a hose was used for purging, the hose should be disconnected prior to sampling). Any fittings on the end of the faucet that might introduce air into the sample (i.e., a fine mesh screen that is commonly screwed onto the faucet) should be removed prior to sample collection also. A smooth-flowing water stream at moderate pressure with no splashing should be obtained.

2.16 Rock Coring

The rock core will be collected by advancing the borehole to the desired depth using auger, rotary, air hammer or other drilling method, as appropriate and collecting the core (using specified core barrel) in accordance with ASTM D2113-06, as appropriate for site conditions. Be sure to record the penetration rate, any fluid loss and depth of loss, rock type, fractures, and other pertinent information. The cores should be placed in sturdy, wooden, core boxes that are clearly labeled with the borehole number and depth. Breaks in the sample should also be marked with 3 parallel lines across the break. Each core sample should be photographed in its box clearly displaying the holes number and depth. Lastly, the Rock Quality Designation for each core run should be determined and should be followed as below.

- Determine Rock Quality Designation (RQD) for each core run:

$$RQD = \frac{\text{the total length of core pieces greater than four inches long}}{\text{total core run}}$$

It should be noted that the core lengths should be measured along the center line of the core. Also, do not count core pieces that are not "hard and sound" as part of the RQD; however, record such lengths separately. Lastly, core breaks known to be induced by drilling or core handling should be fitted together and counted as one piece when determining RQD.

2.17 Packer Testing

Packer testing is performed to obtain groundwater samples from discrete intervals within a larger open borehole in bedrock. A dual straddle packer system or single packer system can be used, as appropriate. The single packer is often used when collecting a groundwater sample from near the bottom of the borehole. Inflatable packers, with a submersible pump between the packers (or below the single packer) are typically used. Geophysical logging can be used prior to packer testing to design the packer interval. If packer testing occurs concurrent with drilling, then a single packer is typically used at progressively deeper depths.

2.18 Aquifer Performance Test

Aquifer performance tests are typically performed to characterize the hydraulic properties of wells and aquifers. Properties evaluated include specific capacity, hydraulic conductivity, transmissivity and storativity.

2.18.1 Continuous Background Monitoring

Baseline groundwater level measurement data will be used to evaluate the effects of outside influences (i.e., influences other than the proposed pump test withdrawal) on groundwater levels. These influences will then be considered when analyzing the pump test data. Typically groundwater level data will be recorded with an electronic data logger at a selected well approximately every 30 minutes. Precipitation and barometric pressure data is also obtained in order to analyze outside effects other than that of the pump test on the aquifer.

2.18.2 Step Drawdown Test

The step drawdown test (or step test) is required to determine the specific capacity and short term yield of the recovery well and select the pumping rate for the long-term pump test. During the test, continuous groundwater levels at the pumping well and select observation points will be recorded logarithmically. An example of a logarithmic schedule is provided in **Table 2-2** below.

Table 2-2
Step Drawdown Test Logarithmic Schedule

Log Cycle	Elapsed Time	Sample Interval	Points/Cycle
1	0-20 seconds	0.2 second	101
2	20-60 seconds	1 second	40
3	1-10 minutes	10 seconds	54
4	10-100 minutes	2 minutes	45
5	100-480 minutes	10 minutes	38

A variable rate submersible pump capable of operating across various flow ranges should be used to complete testing. A vertical check valve will be placed on the discharge line immediately above the pump. A 1-inch diameter polyvinylchloride line will be placed in the well, with the open, bottom end extending to within one foot of the pump. This 1 inch line will be used as the stilling pipe for the water level transducer.

2.18.3 Long-Term Constant Rate Test

The long-term constant rate test (72-hour pumping test) will be performed at the pumping well on the day after completion of the step test, assuming groundwater levels have recovered to 90 percent of baseline values. The 72-hour pump test will not commence until this condition is met or a minimum of 72 hours have elapsed since the termination of the step testing. The step test results will be reviewed in advance and used to select the pumping rate for this test, which will equate to approximately 50 to 75 percent of the calculated short-term, maximum well yield. During this test, continuous groundwater levels at the pumping well and select observation points will be recorded logarithmically. An example of a logarithmic logging schedule is provided in **Table 2-3** below.

Table 2-3
Long Term Constant Rate Test Logarithmic Schedule

Log Cycle	Elapsed Time	Sample Interval	Points/Cycle
1	0-20 seconds	0.2 second	101
2	20-60 seconds	1 second	40
3	1-10 minutes	10 seconds	54
4	10-100 minutes	2 minutes	45
5	100-480 minutes	10 minutes	38

2.18.4 Recovery Water Level Measurement

Initiate a new log cycle for the transducers immediately upon termination of the constant-rate pumping test. Continuous groundwater levels at the pumping well and select observation points will be recorded logarithmically. Leave the transducers in place to record continuous groundwater level data until the groundwater level at the pumping well has recovered to 90 percent of its baseline value or 72 hours (minimum) have elapsed since termination of pump testing.

2.18.5 Discharge Water Management

The water pumped from the well shall be discharged and managed following the plan specific to the project and in accordance with DER-10 and all applicable local, state and federal regulations.

2.19 Membrane Interface Probe (MIP)

In order to provide a screening-level characterization of VOC contamination in subsurface soil in both the vadose and saturated zones, when practical, CDM Smith will utilize a MIP to obtain qualitative, depth-continuous, relative instrument response data for VOCs and electrical conductivity data in the subsurface soil. The MIP data will be used to establish an instrument response gradient in subsurface soils to identify "hot spots" for sampling during the soil boring investigation. The MIP utilizes a truck-mounted PID, flame-ionization detector (FID), and an electron-capture devise (ECD). The 1.5 inch diameter MIP will be pushed into the subsurface at a penetration rate of approximately 1 foot per minute. The tip of the probe contains a thermister, which provides a heat source to volatilize VOCs. The gases that are produced pass into the probe through a permeable membrane and enter a sampling loop. The gases are then transported to the surface and pass through the PID, FID, and ECD. The MIP will produce a response to all compounds that volatilize sufficiently and diffuse through the MIP probe membrane, are carried to the detector in the carrier gas, and produce a response on one or more of the detectors (PID, FID, and ECD).

The total response for each detector is related to the total contaminant concentration and the relative response of the detector to the compounds in the carrier gas stream. Therefore, the MIP is considered to produce qualitative data.

2.19.1 MIP Procedure

Prior to initiating any field activities, the field team will review and discuss, in detail, the site-specific HASP and any appropriate background documentation. All monitoring and protective equipment will be thoroughly checked at this time. All underground and overhead utilities and structures which may interfere with the progress of the work will be located prior to the commencement of subsurface drilling activities.

2.20 Fish Sampling

Fish samples will be collected from an adequate number of locations in order to characterize and address project objectives, or as directed by the NYSDEC. Samples will be collected using site-specific common fisheries techniques (e.g., seine net, electroshocking, etc.). During each investigation, species representative of the site or individual location (i.e., dominant taxa, high percentage of total biomass, etc.) will be targeted for analysis. The age and/or trophic level of species and other pertinent sampling design information will be decided after consultation with the NYSDEC. Upon capture, sampling crews will taxonomically identify fish retained for analysis, photograph, and record the weight and total length of representative individuals. In order to satisfy analytical requirements, it may be necessary in specific cases (e.g., minnow species) to composite samples consisting of an individual species. When required, the total number of individuals and total weight of the composite will be noted. After processing, individual samples will be wrapped in aluminum foil, placed in re-sealable plastic bags and placed on wet or dry ice. Samples will be shipped via overnight delivery to the subcontracted analytical laboratory for the analyses specified in the site-specific work plan.

2. 21 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate (benthos) samples will be collected from an adequate number of locations in order to characterize and address project objectives, or as directed by the NYSDEC. Samples will be collected using site-specific sampling techniques (e.g., kick net, surber sampler, etc.). During each investigation, species representative of the site or individual location (i.e., dominant taxa, high percentage of total biomass, etc.) will be targeted for analysis. Pertinent sampling design information (e.g., sample size, etc.) will be decided after consultation with the NYSDEC.

As samples are collected they will be placed into a clean sample vessel (e.g., stainless steel bucket, high density polyethylene bucket, etc.) for sorting. Representative species retained for analysis will be taxonomically identified to order. Due to analytical requirements, all samples will consist of a given number of individuals composited together until the proper sample mass is achieved. After processing, individual samples will be placed into the appropriate sample container, placed in re-sealable plastic bags and placed on wet ice or dry ice. Samples will be shipped via overnight delivery to the subcontracted analytical laboratory for the analyses specified in the site-specific work plan.

2.22 Test Pits

All excavation activities will be performed in accordance with the Dig Safely New York *Excavator Manual: A User's Guide to Safe Excavation Practices in New York State.* The location of the test pits will be specified within the site specific plan and will be based off of site conditions and historic site usage. The test pit will predominantly serve as a way to collect soil "grab" samples and to characterize site conditions. All work done in and around the test pit must be compliant with the project HASP.

2.22.1 Procedure

When beginning a test pit, all excavated soil should be stored on an impermeable barrier between the ground surface and should be located at an appropriate distance from excavation to insure slope stability. Before acquiring the soil sample, all visual characterization and PID readings should be recorded in the field logbook. All samples will be forwarded to an approved laboratory and will be labeled, handled, and shipped according to procedures located in the Quality Assurance Project Plan (QAPP).

When samples have been lifted and the site has been observed, test pits should be refilled with the excavated soil. If contamination is severe, fill material will have to be disposed of in proper ways and should not be replaced in the test pit.

2.22.2 Analytical Program

CDM Smith expects to collect one sample from each test pit. However, field observations may dictate that additional samples be collected. Samples may be obtained from the test pit side walls or bases and will be collected from the bucket of the excavator. All samples shall be field screened, photographed and recorded.

Appendix A

Drilling Summary Sheet

DRILLING SUMMARY SHEET

SITE NAME HERE

Date:	
Geologist:	
Driller:	
Borehole Locations:	
Drums Generated (ID#s):	

1.0 GENERAL CHARGES			**HAS RIG**	**TRIPOD**
1a.	Mobilization and Demobilization	Each		
1b.	Construct Decontamination Pad	Each		
1c.	Steam Cleaning (1 hour/boring maximum)	Hours		
1d.	Drums	Drums		
1e.	Drumming Residuals/Transportation	Drums		
1f.	Standby Time	Hours		
1g.	Baker Tank Rental (20,000 gallons each)	Each		
2.0 BOREHOLE DRILLING				
2a.	4 ¼ inch ID – HSA	Feet		
2b.	Split Spoon Sampling	Spoons		
2c.	Shelby Tubes	Tubes		
2d.	Geoprobe Boreholes	Feet		
2e.	Macro Core and Large Bore Sampling	Feet		
2f.	Soil Boring with Tripod	Feet		
2g.	Borehole Grouting	Feet		
3.0 OVERBURDEN MONITORING WELL INSTALLATION				
3a.	Soil Borings with 6 ¼ inch ID HAS (8 inch borehole)	Feet		
3b.	Split Spoon Sampling	Spoons		
3c.	4-inch Type 304 Stainless Steel Casing	Feet		
3d.	4-inch Type 304 Stainless Steel Screen	Feet		
3e.	Well Completion Materials (Gravel pack, bentonite, grouting installed)	Feet		
3f.	5 foot Carbon Steel Protective Casing (installed), including Well Lock and Key, Concrete Collar, etc.	Each		
3g.	Flush Mount including Well Lock and Key, Concrete Collar, etc.	Each		
3h.	Well Development (3 hours/well)	Wells		
4.0 OVERBURDEN MONITORING WELL INSTALLATION				
4a.	Surcharge for Level “C”	Per Hour		

Drum Tracking Log

DRUM TRACKING LOG

SITE NAME: ______________________________________

Drum #	Boring/MW#	Date Drilled/ Sampled	Related Sample #	Description of Drum Contents	Signature

Low Flow Sampling Sheets

LOW FLOW SAMPLING SHEETS

SITE NAME: ______________________________

DATE:	WELL #:
SAMPLE TIME:	DEPTH OF PUMP:
WEATHER CONDITIONS:	SAMPLERS:

TIME	VOLUME PURGED (GALS)	DEPTH TO WATER (FT TIC)	FLOW RATE (ml/min)	DRAWDOWN (FEET)	TEMP ^{0}C (+/- 10%)	ph (+/- 0.1 SU)	REDOX POTENTIAL mV (+/- 10 mv)	SPECIFIC COND. mS/cm (+/- 3%)	DISSOLVED OXYGEN mg/L (+/- 10%)	TURBIDITY NTUs (+/- 10%)

The well is considered stabilized and ready for sampling when the indicator parameters have stabilized for three consecutive readings by the measurements indicated in parenthesis.

Photo Tracking

PHOTOGRAPH TRACKING LOG

SITE NAME: ________________________________

CAMERA # ____

Photograph #	Description	Date/Time	Photographer

Sample Screening Tracking Log

SAMPLE SCREENING TRACKING LOG

SITE NAME: ______________________________________

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	MATRIX	DUP (Y/N)	COMMENTS

Sample Tracking Log

SAMPLE TRACKING LOG

SITE NAME/SAMPLE EVENT: ______________________________

LDL VOC LAB: ______________________ **INORGANIC CLP LAB:** ______________________

CLP CASE NO: ______________________ **ORGANIC CLP LAB:** ______________________ **SUBCONTRACT LAB:** ______________________

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	MATRIX	DEPTH (feet)	ORGANIC CLP NO.	INORGANIC CLP NO.	SUBCONTRACT ANALYSIS	QA/QC

ANALYSIS SUMMARY: ____

____

Synoptic Water Level Measurements

SYNOPTIC WATER LEVEL MEASUREMENTS

SITE NAME: ____________________________________

DATE: ________________________

Time	Well	Depth to Water	Total Depth	Product/ Thickness	HNu Headspace Readings	Notes/Well Condition

All readings are from Top of Inner Casing (TIC)

Well Logs

CDM

Consulting, Engineering, Construction & Operations

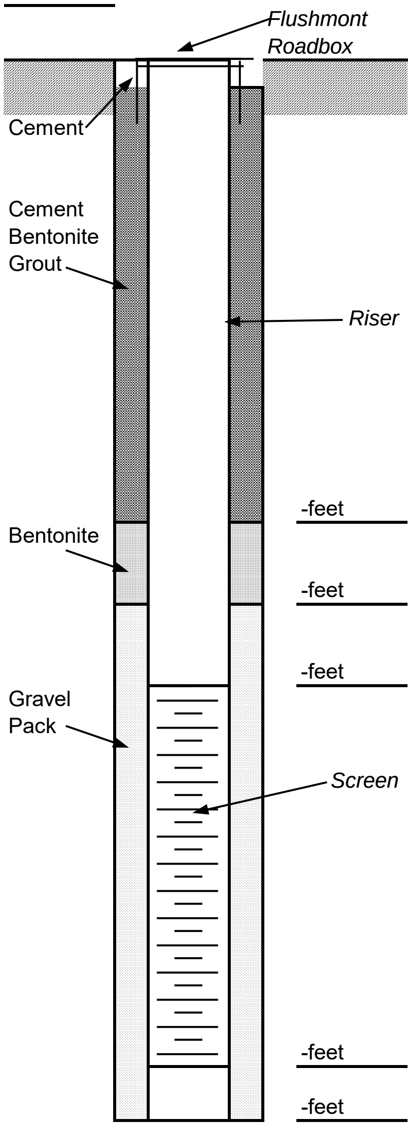
WELL CONSTRUCTION SUMMARY

Project: ____________________ Location: ____________________ Well No.: ____________

Permit No.: ____________

TOC elev.: ________

Type: ____________



DRILLING SUMMARY

Drilling Company: ____________ Drillers: ____________

Drill Rig/Model: ____________

Borehole Diameters: ____________ Drilling Fluid: ____________

Bits/Depths: ____________

Total Depth: ________ Depth To Water: ____________

Supervisor Geologist: ____________

WELL DESIGN

Casing Material: ____________ Diameter: ____________

Screen Material: ____________ Diameter: ____________

Slot Size: ____________ Setting: ____________

Filter Material: ____________ Setting: ____________

Seals Material: ____________ Setting: ____________

Grout: ____________ Setting: ____________

Surface Casing Material: ____________ Setting: ____________

TIME LOG

	Started	Completed
Drilling:		
Installation:		
Development:		

WELL DEVELOPMENT

Method: ____________

Static Depth to Water: ____________

Pumping Depth To Water: ____________

Pumping Rate: ________ Spec. Capacity: ________

Volume Pumped: ________

*Appendix C - Site-Specific Health and Safety Plan Addendum

*Will be completed prior to field activities commencing and submitted under this cover as a revision.

Appendix C-1 - NYSDEC Standby Engineering Services Contract D009805 Health and Safety Manual

HEALTH & SAFETY MANUAL

New York State Department of Environmental Conservation

Standby Engineering Services
Contract D009805

Prepared for:
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Division of Environmental Remediation
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Section 1

Project Overview

1.1 Health and Safety Philosophy and Principles

Camp Dresser McKee & Smith (CDM Smith Smith) affirms the following philosophy and principles as the basis of our company's health and safety (H&S) program.

1.1.1 Philosophy

The CDM Smith H&S Program is guided by the belief that our people are our greatest asset and that health and safety must receive top priority and support from every employee. Prevention of occupationally related injuries and illnesses is an integral part of the firm's goals for quality service to clients, growth, and profit.

CDM Smith will maintain an H&S program designed to minimize the number of injuries and illnesses, with an ultimate goal of zero accidents and injuries. CDM Smith's program will be equal or superior to the standard practices of our industry. The firm will provide the appropriate supervision, training, and protective equipment to keep its employees safe and healthful.

Finally, management and staff share responsibility for health and safety and all levels are accountable for specific health and safety activities. Full participation by and cooperation with all CDM Smith employees are crucial to the overall success of the program.

1.1.2 Principles

- Occupationally caused injuries and illnesses are preventable.
- Preventing occupationally caused injuries and illnesses is one of our highest responsibilities.
- CDM Smith is committed to providing safe working conditions in the office and in the field.
- Employees have a right to information and training.
- Working safely is a condition of employment and is a shared responsibility between management and staff.
- Neither CDM Smith nor its projects can succeed unless injuries and exposures are mitigated, managed, and prevented.

1.2 Introduction

Safety is the responsibility of every CDM Smith employee. Ultimately, however, the successful implementation of the H&S program depends upon the integrated activities of managers, H&S staff, and employees. Specific responsibilities are outlined in Section 2.

Through oversight and coordination of all H&S functions and issues at all CDM Smith offices, CDM Smith achieves compliance with all applicable H&S regulations and client requirements. In the United States and its territories, these regulations and requirements include the following:

- 29 CFR 1910, OSHA Safety and Health Standard for General Industry
- 29 CFR 1904, OSHA Recording and Reporting Occupational Injuries and Illnesses
- 29 CFR 1926, OSHA Safety and Health Standards for the Construction Industry
- EPA Order 1440.2, EPA Health and Safety Requirements
- EM 385-1-1, U. S. Army Corps of Engineers, Safety and Health Requirements Manual
- Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH Publication Number 85-115
- Title 8 of the California Code of Regulations, General Industry Safety Orders, specifically 8 CCR § 3203, Injury and Illness Prevention Program (California operations only)
- Title 8 of the California Code of Regulations, Construction Safety Orders, specifically 8 CCR § 1509, Injury and Illness Prevention Program (California operations only)
- State and local regulations pertaining to health and safety

Outside the United States, CDM Smith offices and operations are expected to comply with local country regulations. International offices and operations may need to develop their own H&S management systems taking into account local regulations, work practices, and customs.

1.3 Health and Safety Guidance

A copy of this H&S manual is available to all CDM Smith personnel. These guidelines represent practical experience, technical advice, and administrative practices developed from many sources. The unique features of each operation, location and project may require some refinement or modification of the procedures in this manual. Modifications made to the procedures outlined in this manual shall be made with the review and approval of a Health and Safety Manager (HSM) and must be consistent with the CDM Smith Smith H&S philosophy and principles.

CDM Smith will develop site-specific health and safety plans (HASPs) where appropriate to reflect client, contract, or site-specific requirements. Copies of the site-specific HASP will be maintained at the project location and will be available to CDM Smith employees. A CDM Smith HASP form is provided in **Appendix A**.

1.4 Scope and Considerations

A primary consideration for all of CDM Smith operations is the health and safety of its personnel. The protection of the general public and the environment is also an important consideration in developing and implementing the CDM Smith H&S Program. The application of standardized health and safety procedures by trained personnel reduces the possibility of injury or exposure. To be effective, CDM Smith H&S procedures must be:

- Based on available and current information, operational principles, and technical guidance
- Field tested, reviewed, and revised, when appropriate, by an HSM and/or designated safety personnel
- Adjustable to site- or task-specific situations and conditions
- Understandable, feasible, and appropriate for site conditions
- Available to site personnel who have been briefed on their use
- Performed, implemented, and used by individuals appropriately trained

The prevention of occupational injuries and illness is of such consequence that it will be given precedence over project operations at all times. To the greatest degree possible, CDM Smith management will provide all mechanical and physical facilities required for personal H&S in keeping with the required standards, the most current professional practices, and applicable regulations.

CDM Smith requires manager and employee cooperation in all health and safety matters. Only through such a cooperative effort can a safety program in the best interest of all be established and maintained.

1.5 Elements and Objectives

CDM Smith's objective is an H&S program that will reduce the number of accidents, injuries, exposures, and illnesses to an absolute minimum. Our goal is zero accidents, exposures, and injuries.

Specific elements that form the foundation of CDM Smith's H&S Program include the following:

Employee Health Surveillance. This includes the administration of baseline and annual/interim physical examinations for employees involved in hazardous waste work and project- and material-specific biological monitoring.

H&S Education and Training Program. This is a continuous program designed to promote hazard recognition and accident/illness prevention as well as to familiarize each employee with pertinent EPA, OSHA, and Department of Transportation (DOT) regulations. In addition, this program is designed to address potential specific hazards of tasks that employees may be assigned to perform. The program is not limited to project personnel. All personnel receive periodic materials related to proper lifting techniques, office ergonomics, slips, trips, falls, personal safety, etc.

Employee Exposure Assessment to Potential Chemical and Physical Hazards. This includes a review of tasks, both administrative and project-related, to ascertain hazard potentials to those individuals assigned to perform those tasks and to take appropriate actions designed to minimize those hazard potentials. Project-related hazard potentials are typically addressed in a project-specific HASP that is designed to address those particular hazards associated with site-specific project work. These plans describe hazard potentials, prescribe specific procedures and personal protective equipment (PPE) designed to minimize these potentials, and determine types of specific monitoring that may be required to ascertain the effectiveness of these efforts in minimizing these hazards.

- Ensure that employees assigned to specific tasks are mentally and physically able to perform those tasks.
- Ensure that individuals required to wear PPE in the performance of specific tasks are able to wear such prescribed equipment and that they have been trained in the selection, use, and maintenance of such equipment.
- Provide a mechanism by which employees assigned to various tasks have been trained in the proper performance of these tasks.
- Generate task-, or site-specific HASPs by, or under the direction of, the HSM, a health and safety coordinator (HSC), or a site health and safety coordinator (SHSC). Chemical and physical hazard potentials associated with specific project operations are considered in advance of performance of those operations.
- Provide a mechanism for monitoring specific hazard potentials and the effectiveness of procedures and PPE in minimizing those potentials.

1.6 Implementation

Development, administration, and maintenance of the H&S program are the responsibility of the Corporate Health and Safety Officer and designated HSMs. Implementation of the CDM Smith H&S Program within each office and on projects is a coordinated effort between senior management and health and safety staff. It is accomplished through the identification and designation of HSCs and SHSCs by program managers and project managers, with the concurrence of the appropriate HSM. Those designated individuals implement the requirements of the program in each CDM Smith office and at each individual CDM Smith project site.

Section 2

Organization and Personnel

2.1 Health and Safety Organization

Responsibility for H&S is shared by all levels of the organization. To administer the H&S program effectively, a network of CDM Smith H&S professionals has been established. These individuals are integrated into the operational activities performed by CDM Smith offices and operations.

2.2 Health and Safety Roles and Responsibilities

Successful implementation of the H&S program requires dedication and participation from all members of the CDM Smith organization. In addition to H&S staff, the Office of the Chairman, unit presidents, managers of client service, corporate managers, client officers, project managers, resource managers, direct managers, employees, and subcontractors all have roles in maintaining a healthy and safe workplace.

2.2.1 Corporate Health and Safety Officer

The Corporate H&S Officer (CHSO) is a senior officer of the firm who directs the development, implementation, and maintenance of H&S programs for all company offices and operations. Specifically, the CHSO:

- Develops and monitors H&S budgets and expenditures
- Maintains adequate professional staff to develop, implement, and maintain effective H&S programs
- Communicates H&S program issues to the Office of the Chairman and the Management Committee
- Coordinates with the Office of General Counsel, Human Resources, and other corporate departments on H&S issues
- Provides support and oversight of activities of H&S staff

2.2.2 Senior Management

"Senior management includes the Office of the Chairman, unit presidents, regional managers and managers of client service, client officers, corporate managers, and equivalent positions. As managers with key leadership responsibilities, personnel in these positions greatly influence the H&S program. Responsibilities related to H&S include.

- Being an enthusiastic and visible supporter of the H&S program
- Discussing H&S issues in company meetings
- Monitoring the H&S performance of activities and personnel within their area of responsibility
- Dedicating adequate resources to effectively implement the H&S program on activities within their area of responsibility
- Promoting open communication, cooperation, and trust among CDM Smith, its employees, subcontractors, and clients

2.2.3 Group Leaders and Direct Managers

Group leaders and direct managers are responsible for considering the H&S of employees that directly report to them. They support the H&S program by:

- Recognizing projects that may include special hazards such as hazardous waste operations, radiation, confined space entry (CSE), exposure to lead or other hazards, and ensuring that the employees assigned to these projects have the appropriate H&S training and qualifications.
- Identifying employees that may need specialized safety training based on anticipated project assignments that may involve special hazards.
- Encouraging employees to maintain H&S qualifications by holding personnel accountable for keeping their H&S training and medical status current and identifying employees requiring exit physical examinations upon termination of employment.
- Promptly reporting to H&S managers when employees become injured or ill on the job. This should be done within 24 hours of an injury unless there are extenuating circumstances.
- Helping to identify work options for employees whose injuries or conditions limit or restrict the work they can do.
- Assisting employees in finding H&S information within CDM Smith via H&S coordinators, managers, and the H&S intranet site.
- Overseeing employee work areas within the office to provide a work environment free from recognized hazard.

2.2.4 Project Managers

Project managers play a key role in the H&S performance of projects and activities they direct or oversee. Project managers demonstrate the importance of H&S by making it a routine topic of conversation and considering H&S issues in project plans and meetings. Project managers support the H&S program by:

- Monitoring the implementation of procedures and guidelines outlined in CDM Smith H&S programs and project HASPs on projects under their direction
- Participating in and promoting H&S planning for projects and activities under their direction
- Coordinating subcontractor or partner H&S responsibilities with the HSM and Office of General Counsel as described in Section 2.2.9
- Committing adequate resources so work may be conducted in accordance with the CDM Smith H&S program
- Monitoring employee and subcontractor performance relative to project health, safety, and regulatory requirements
- Maintaining open communication with employees to encourage participation and feedback
- Implementing corrective actions on recommendations identified by inspections, observations, employee concerns, and incident investigations
- Recognizing H&S issues related to projects and seeking assistance and guidance from H&S coordinators or H&S managers as necessary

2.2.5 Health and Safety Managers

HSMs are the lead technical and administrative specialists in the area of H&S and support the CHSO, directing the H&S programs throughout CDM Smith. Their responsibilities include designing and implementing H&S activities that recognize the diversity of projects and clients associated with each unit. The HSMs:

- Provide advice and support to management on H&S needs and issues
- Prepare or review HASPs and project-specific H&S procedures
- Conduct or oversee H&S training programs, perform H&S audits and accident/incident investigations
- Measure H&S performance and provide feedback and recommendations to the appropriate managers and CHSO
- Review the H&S program periodically and amend it accordingly
- Assist project staff in developing and implementing site safety programs
- Review proposals, estimates, and work plans to ensure H&S issues are properly addressed
- Act as lead representative in dealing with Occupational Safety and Health Administration (OSHA) and other government agencies on matters relating to H&S
- Oversee medical surveillance and H&S training programs

- Oversee and monitor activities of H&S coordinators
- Ensure that individuals who have H&S responsibilities have the necessary resources and support to discharge those responsibilities effectively
- Support marketing and business development activities
- Oversee and perform H&S-related consulting services

2.2.6 Health and Safety Coordinators

HSCs report to their direct managers and receive technical direction on H&S-related matters from an HSM. Both the direct manager and the HSM monitor the performance of their H&S responsibilities. The HSCs:

- Assist in the preparation and approval of site-specific HASPS, CSE permits, and other permits when necessary and appropriate
- Assist the HSM with the investigation and reporting of any incident involving any CDM Smith employee or subcontractor employee that results in injury, illness, or property damage
- Facilitate and coordinate physical exams, biological monitoring, and H&S training under the direction of the HSM, when necessary
- Perform respirator fit tests as necessary for project employees
- Monitor the office work environment for hazards
- Assist project managers in evaluating project hazards and precautions, seeking input from the HSM as necessary
- Distribute information on H&S-related matters as it becomes available from the HSM
- Display assertive leadership and a positive attitude in all activities associated with office and project H&S issues

2.2.7 Project/Site Health and Safety Coordinators

For larger projects with more complex H&S issues and activities, a project/site HSC may be designated by the project manager with the concurrence with the HSC or HSM. For smaller projects with limited risk and H&S activities, the SHSC may be the project manager, a field engineer, field technician, or site superintendent.

SHSCs are responsible for implementing the H&S program on specific projects and report directly to the project manager, while receiving technical guidance and direction on H&S matters from HSCs or HSMs.

It is important that SHSCs understand their roles related to subcontractor safety oversight. SHSCs monitor and oversee subcontractor H&S performance against project HASPs and communicate findings to the project manager. The SHSC will provide available information related to site H&S to subcontractors on a timely basis.

Responsibilities include the following:

- Implement and maintain the provisions of project HASPs
- Communicate any identified H&S hazard concerns to employees and subcontractors
- Conduct project H&S orientations
- Coordinate site activities with the project manager to ensure that all tasks are reviewed with regard to potential H&S hazards
- Coordinate with the client or site owner to ensure client or owner H&S issues are addressed
- Perform project H&S inspections
- Perform or coordinate any required air monitoring, medical surveillance, or H&S training as described in the site H&S plan
- Implement proper, positive, and immediate corrective actions on recommendations identified by inspections, observations, employee concerns, and incident investigations
- Monitor subcontractor H&S performance
- Assist and/or conduct accident/incident investigations
- Stop or suspend work where conditions warrant
- Maintain project records documenting the implementation of HASPs including:
    - Attendance at H&S orientations
    - Documentation of inspections and corrective actions implemented
    - Air monitoring records including calibration data and results
- Upgrade or downgrade levels of PPE as described in HASPs
- Seek advice and guidance from the HSC or HSM as needed
- Notify the HSC and HSM as soon as possible of any injuries or incidents that require treatment beyond first aid or offsite assistance
- Coordinate any changes to the project H&S plan with the HSC or HSM
- Promote a positive attitude with regard to all H&S issues related to specific project activities

2.2.8 All Employees

Every employee must participate in successfully implementing the guidelines and procedures discussed in this H&S manual. All employees share the following responsibilities in implementing the H&S program effectively:

- Learn and recognize hazards associated with assigned tasks
- Follow the guidelines presented in this H&S manual, project HASPs, procedures outlined in safety meetings and training courses, and the instructions of their direct manager and project managers
- Report unsafe conditions or practices and offer suggestions to maintain safe working conditions; correct unsafe conditions where possible
- Report all injuries, illnesses, and accidents to their direct manager, resource manager, or project manager immediately
- Advise the site HSC regarding the use of any medication or other condition that may affect the safe performance of their job responsibilities

2.2.9 Subcontractors

Generally, subcontractors are hired for their specialized expertise and are expected to be knowledgeable on H&S aspects of their activities. Subcontractors are expected to have an H&S program and to adhere to applicable federal, state, and local safety regulations, as well as all H&S contractual requirements pertaining to their work. CDM Smith may request project HASPs, safe operating procedures, and/or safety manuals from subcontractors for review before allowing subcontractors to work on CDM Smith projects.

Subcontractors hired by CDM Smith are responsible for the safety and health performance of all lower-tier subcontractors.

On some projects, subcontractors may be similarly affected by general site conditions and procedures, such as emergency response, air monitoring, and site PPE and may be included in the CDM Smith project HASP and be trained accordingly. On others, given a specific scope of work, it may be more appropriate to require a separate HASP from the subcontractor. During project planning, client officers, project managers, or others involved in project planning shall seek input from the HSM and Office of General Counsel regarding the appropriate approach to subcontractor safety planning.

Specific subcontractor responsibilities related to H&S may include:

- Attending pre-job planning meetings
- Participating in activity hazard analyses
- Reviewing and concurring with project HASPs
- Preparing independent HASPs

- Demonstrating the training and qualification of its employees
- Providing advice to CDM Smith on H&S issues related to their area of expertise
- Attending project or site H&S committee meetings
- Designating a qualified onsite H&S representative
- Participating in accident/incident investigations
- Providing CDM Smith with periodic H&S performance information such as:
  - Copies of OSHA 300 logs or first aid logs
  - Hours worked
  - Inspection reports
  - Other H&S documentation requested by CDM Smith

Section 3

Injury and Illness Protection

The overall objective of the CDM Smith H&S Program is to reduce the number of illnesses and injuries to an absolute minimum, with the ultimate goal of zero accidents and injuries. CDM Smith's corporate strategy to achieve this goal include the following:

- **Identification and employment of quality employees**. In addition to a detailed interviewing session, previous employment record checks, investigation into education and training, and personal reference checks are all tools used to evaluate potential employability.

- **Quality, consistent, and ongoing health and safety training programs.** CDM Smith's training programs are designed to exceed those required in OSHA standards 29 CFR 1910, 29 CFR 1926, Title 8 CCR§1509, and Title 8 CCR§3203.

- **Identification and appraisal of accident and loss-producing conditions and practices.** This consists of a detailed hazard analysis of materials, materials handling operations, and materials handling systems, including advanced and detailed studies of all hazard potentials where possible.

- **Development of accident prevention and loss control methods, procedures, and programs.** Using knowledge in accident causation and control, CDM Smith aims to eliminate factors that cause accidents. This is accomplished through the establishment of methods, development of procedures, and the education of managers.

- **Communication of accident and loss control intervention to all layers of management.** This element is accomplished with an accident information management system. With formatted information provided on the accident report form, a signature is required by the project manager and the appropriate office manager before being sent to corporate headquarters. The system allows for the generation of required documents (i.e., OSHA 300 logs), as well as tracking and sorting by accident type, cause, etc. This information is summarized and distributed to all management personnel.

- **Assigning accountability and responsibility to all employees for implementation and maintenance of methods, procedures, and practices involved with the H&S program.** Each office has a designated HSC that oversees the implementation of all program elements on a day-to-day basis and motivates employees to have proper attitudes towards health and safety.

- **Measurement and evaluation of the effectiveness of the accident and loss control system.** Annual summaries of frequency, type, and cost of accidents are used to evaluate the H&S program's effectiveness. Quarterly summaries allow for trend and statistical analysis.

3.1 Site-Specific Health and Safety Plans

On a project-specific level, CDM Smith evaluates hazards associated with the project and, when warranted, develops and implements site-specific HASPs. The development of these plans begins before mobilization with a detailed review of all information currently available on the project. Operations to be performed, health and safety hazard potentials, and potential exposure to hazardous materials are all reviewed for incorporation in an HASP. Functions that may be performed by the HSC and/or the HSM at this time include the following:

- An assessment of potential physical and operational hazards including equipment operation, exposures to temperature extremes, hearing protection, etc. An assessment of materials present and calculation of potential airborne concentrations that can reasonably be anticipated during all operations.
- A review, with CDM Smith occupational physician, of the materials expected to be presented at the job site, anticipated exposure concentrations, and the physical requirements of the work to be performed so that an appropriate project-specific health surveillance program can be designed.
- An assignment of levels of protection for operations with exposure potential, based on information provided and anticipated.
- A review of the site characteristics so that an appropriate ambient air and employee exposure air monitoring program can be developed.
- Additional details on the content and scope of site HASPs are provided in Section 7.

3.2 Accident Reporting

The CDM Smith Injury/Illness Report Form will serve as the basis for the written reporting of accidents. This includes any injury that requires offsite medical treatment or onsite first aid.

The employee, the employee's direct manager, group leader, or resource manager should report the accident to either the HSM or Corporate Human Resources as soon as practical. Priority shall be given to securing necessary medical services and employee care before initiating the report and investigation. The HSM or Human Resources representative will provide a copy of the CDM Smith Injury/Illness Report Form for completion. Copies of this form are also available through the HSC or the office service coordinators. The completed form is to be faxed to the appropriate HSM and the Human Resources manager. Unless there are extenuating circumstances, the completed form should be faxed within 2 working days of the incident.

Required completion of a client injury or incident report form may not be substituted for the CDM Smith form (i.e., both forms are to be completed).

The injury/illness report form is to be completed for all accidents, including CDM Smith employees and subcontractor's employees. In the event of an accident to a subcontractor employee, the form and investigation should be prepared and performed by the subcontractor.

3.3 Accident Investigations

3.3.1 When Accident Investigations are Conducted

While all accidents should be reported using the CDM Smith Injury/Illness Report Form (See Section 3.2), some accidents may be of such a severity or have the potential to cause severe consequences, that a formal accident investigation is warranted. The need to conduct a formal accident investigation will be determined by the CHSO or the appropriate HSM. A project manager, client officer, corporate manager, resource manager, manager of client service, unit president, or equivalent position may also request a formal accident investigation. Investigations will be conducted by the appropriate HSM or someone designated by them.

3.3.2 Purpose and Guidelines of Investigations

The purpose of the investigation is to objectively determine factors that contributed to or caused the incident to identify corrective actions to be taken to prevent re-occurrence. It is not intended to find fault with individuals or companies. Guidelines for conducting investigations are provided below:

- Initiate the investigation as soon as possible. While the first priority should be to ensure injured employees receive proper first aid and medical care, the passage of time delays corrective actions and allows facts to become distorted, forgotten, or lost.
- Where possible, the accident scene should remain undisturbed until the investigation is conducted. Some changes and alterations may need to be done to prevent further injury or damage.
- If possible, take photographs of the scene. Take pictures from multiple angles and the surrounding area.
- Prepare sketches/diagrams.
- Accurately measure distances, weights, and other factors associated with the accident.
- Identify and interview witnesses independently as soon as possible after the accident.
- Interview the injured employee/individual as soon as their condition allows. In many instances, the injured may be the only witness.
- The following information should be considered when interviewing witnesses and collecting observations:
  - Weather conditions at time of accident
  - Adjacent distractions
  - Employee attitudes
  - Training records
  - Pre-job planning efforts

- Fatigue

3.3.3 Investigations by Other Agencies

Investigations by non-CDM Smith personnel (federal, state, city, client, insurance) who are legally empowered to investigate accidents shall be allowed. CDM Smith employees should contact the Office of General Council immediately upon receiving information that non-CDM Smith personnel plan to or are conducting an investigation that relates to an accident or incident involving CDM Smith. The Office of General Council will provide an appropriate response. When possible, non-CDM Smith investigators should be accompanied by a CDM Smith employee.

3.4 Exposure Incidents to Hazardous Materials

If the injury/illness resulted from exposure to a hazardous material, the HSM is to be notified immediately so that discussions with the occupational physician can occur to determine if additional biological monitoring should be prescribed. As soon as practical following the initial medical treatment, the injured employee is to be scheduled into the clinic that administers the annual examinations for the injured employee's office. This is necessary to ensure that the employee receives quality medical treatment during any type of recovery period. This does not apply to a subcontractor employee. If the incident involves a subcontractor employee, the subcontractor shall be notified in writing by the HSM of any knowledge CDM Smith has available regarding the nature and extent of exposure.

3.5 Follow Up

Accident reporting procedures that are client-specific and applicable are also to be enacted at this time. The HSM and the HSC should follow up with the project manager to ensure that corrective action, if identified in the injury/illness report form, has been implemented.

Section 4

Health and Safety Education Training

4.1 General

Ensuring that CDM Smith employees have the appropriate skills, attitude, and knowledge to perform tasks assigned to them safely is a key accident prevention tool. The main goals of the CDM Smith H&S training are:

- Train employees to be able to identify hazards correctly
- Give employees the technical understanding and skills to work in a safe manner
- Promote safety awareness so that employees develop a safe work attitude
- Meet regulatory requirements

4.2 Responsibilities

Resource Managers and Direct Managers – Ensure employees are adequately trained to perform assigned job responsibilities safely.

Health and Safety Managers (HSM) – Develop, present, and administer high-quality H&S training programs that adequately train employees to perform assigned responsibilities safely and meet all regulatory requirements.

Health and Safety Coordinators (HSC) – Prepare and coordinate delivery of office- and project-specific information and training for employees on an as needed basis. Also, assist group leaders, project managers, and resource managers in the tracking of training requirements needed for various types of work.

Employees – Attend and participate in the H&S training programs and maintain their training credentials to perform their jobs safely and meet H&S training regulatory requirements.

4.3 General Health and Safety Training

4.3.1 Employee Health and Safety Orientation

New employees are greatly influenced by initial impressions. Initial instructions and personal contacts contribute significantly to employee attitudes. Consequently, all new employees shall receive a presentation of the CDM Smith new employee H&S orientation available through CDM Smith's online ContinUum platform.

The H&S orientation shall occur during the employee's initial orientation to CDM Smith. The orientation covers the following topics:

- CDM Smith's H&S philosophy and principals

- H&S objectives
- Key personnel - roles and responsibilities
- CDM Smith H&S performance
- Office-specific and site-specific H&S information including:
  - Emergency notification and evacuation procedures
  - First aid assistance
  - HSC and HSM
  - Introduction to hazard communication
  - Basic awareness training on office hazards, ergonomics, and/or other site- specific hazards

Because of constantly changing environments, operations, and conditions, all rehired employees shall also be scheduled for the orientation.

4.3.2 OSHA 10-Hour Construction Safety Training

CDM Smith employees who are assigned to work primarily in the field on active construction sites should complete the OSHA 10-hour construction safety curriculum. This nationally recognized curriculum is required to cover the following topics:

- Introduction to OSHA
- General duty clause of OSHA
- Recordkeeping
- Electrical safety
- Fall protection

Depending on the needs and makeup of the class, additional topics are selected from the following:

- Personal protective and lifesaving equipment
- Materials handling, storage, use, and disposal
- Tools – hand and power
- Scaffolds
- Cranes, derricks, hoists, elevators, and conveyors
- Excavations

- Stairways and ladders
- Motorized vehicles and mechanized equipment
- Concrete and masonry construction
- CSE awareness
- Other topics relevant to the class

4.3.3 Hazard-Specific and Task-Specific Training

Certain hazards or tasks have specific training requirements that must be met to ensure employee H&S and are required by OSHA standards. The following are examples of such hazards or activities that require special training:

- CSE
- Working on scaffolds/fall protection
- Potential exposure to:
  - Asbestos
  - Lead
  - Cadmium
  - Bloodborne pathogens (see Section 14)
  - OSHA listed carcinogens
  - Ionizing radiation
- Work at locations subject to the OSHA Process Safety Management Standard (Section 10)
- Work subject to the control of hazardous energy (i.e., lockout/tagout)
- Work in laboratories, as defined by OSHA

Direct and resource managers must ensure that employees have adequate training to perform all assigned tasks and job responsibilities safely. HSMs and HSCs are available and should be consulted to make arrangements for employee H&S training for specific tasks and projects.

Hazard-specific or task-specific training will be provided by HSMs or HSCs via in-house courses, or arrangements can be made for training through qualified vendors. Contact your HSM to make arrangements for an instructor-led hazard or task-specific training session. Some hazard-specific training classes are available online through Continuum. To review the Continuum H&S course catalog, log into the CDM Smith InSite page.

4.3.4 Management Health and Safety Training

A basic orientation on CDM Smith's H&S program and its impact on business performance is available to project managers, regional and area managers, managers of client service, client officers, corporate managers, and other personnel in management or leadership positions. The course is provided by HSMs and covers the following topics:

- H&S culture
- Cost of accidents
- Accident effect on insurance costs
- Effect of H&S performance on business
- Roles and responsibilities of managers
- CDM Smith H&S performance history
- Subcontractor H&S management
- H&S leadership

Presentation of this course may be arranged by contacting the appropriate HSM.

4.3.5 First Aid and CPR Training

CDM Smith periodically sponsors first aid and cardiopulmonary resuscitation (CPR) training for employees and authorized guests. Training is conducted by qualified vendors, such as the Red Cross. As an alternative, CDM Smith will pay for course fees associated with any employee who completes Red Cross first aid or CPR classes (or equivalent course approved by the HSM). Any employee who would like to attend first aid or CPR training should contact their HSM or HSC to arrange for payment of the class fees.

4.3.6 Field Project Orientation and Tailgate Talks

All field projects should hold an initial field orientation to review specific work tasks, hazards involved, and hazard controls established including procedures, PPE, and instrumentation. The orientation may be conducted as a part of the project kickoff meeting. Any employee assigned to work on the project after the kickoff meeting should receive the orientation from the project manager or project SHSC. The level of detail and duration of a project safety orientation will vary with the complexity and hazards associated with the project.

Daily tailgate talks should be held during the project to review hazards associated with upcoming activities and precautions to be taken, as well as review lessons learned during the project and any changes made to project procedures. Meetings should be conducted by the field project manager or designated SHSC. Attendance and meeting content should be documented in a field notebook or other means.

4.3.7 Ongoing Health and Safety Communication

The CHSO shall publish periodic notices and articles to keep employees informed of both occupational and nonoccupational H&S issues via the CDM Smith Intranet, e-mail dispatches, and other CDM Smith publications.

Where specific needs arise or opportunities become available, the CHSO may periodically sponsor H&S training sessions and seminars for employees to be presented by outside speakers, HSMs, HSCs, or other interested employees.

4.4 Training for Hazardous Waste Operations

Personnel who perform hazardous waste work as defined by 29 CFR1910.120, the OSHA Hazardous Waste Operations and Emergency Response Standard, shall participate in CDM Smith hazardous waste H&S training that includes:

- 40 hours of initial H&S training
- 8 hours of annual refresher training
- 8 additional hours of training for hazardous waste supervisors and managers

4.4.1 Initial 40-Hour Hazardous Waste Health and Safety Training

CDM Smith provides initial 40-hour hazardous waste H&S training via vendors who have been prequalified by the HSM. Minimum training content must include basic information relevant to hazardous waste operations required by 29 CFR 1910.120, including CSE awareness and hands-on training with air purifying and supplied-air respiratory protective equipment. To obtain training, the resource or direct manager should notify the HSC or designated H&S administrative support person via e-mail, memo, or other documented means that an employee is hired or to be assigned hazardous waste work. The HSC or administrative support person will arrange training with a qualified vendor at a time and location acceptable to the employee.

4.4.2 8-Hour Hazardous Waste Supervisory Training

Personnel who act in a management capacity on hazardous waste projects receive an additional 8 hours of training on supervisory and management issues related to hazardous waste project management. Topics presented include:

- CDM Smith H&S requirements for hazardous waste operations
- Project/site HASPs
- Accident/incident reporting and investigation
- Spill prevention and containment
- H&S roles and responsibilities
- Hazard recognition
- Medical surveillance

- Health hazard monitoring
- Transportation of hazardous materials
- Management of investigation-derived waste

Employees who are approved to take the hazardous waste supervisory course must complete the 40-Hour Hazardous Waste H&S course, complete 3 days of on-the-job training on field hazardous waste projects working with a qualified manager and be nominated by their direct or resource manager. The course is given periodically based on need for the course. Hazardous waste supervisory classes are presented by the HSM. A vendor-presented hazardous waste supervisory course may be substituted, provided the course is approved by the appropriate HSM and the student receives a briefing from the HSM on CDM Smith management roles and responsibilities and CDM Smith hazardous waste H&S procedures. In cases where CDM Smith hires an employee with documented hazardous waste supervisory training from another employer, such training shall be considered the same as vendor-supplied supervisor training, and the employee shall not be certified as a CDM Smith hazardous waste site manager until briefed on CDM Smith management responsibilities and procedures.

4.4.3 8-Hour Hazardous Waste Refresher Training

Personnel actively involved in CDM Smith hazardous waste projects or anticipated to be involved in hazardous waste projects in the future shall participate in 8-hour hazardous waste refresher training. To remain eligible for field hazardous waste work, employees must attend an 8-hour refresher training class within 13 months (12 months + 1-month grace period) of the last day of their initial 40-hour training or their last 8-hour refresher training. If the 8-hour refresher training is not completed within the 13-month period, the employee is not eligible to participate in field hazardous waste operations until the 8-hour refresher training is completed and the employee has met all other field H&S requirements (i.e., medical surveillance and fit testing, if necessary).

The 8-hour refresher training requirement may be completed by any of the following:

- Attend an 8-hour refresher class led by a CDM Smith instructor.
- Attend an 8-hour refresher class approved by the HSM and provided by a vendor, client, or subcontractor.
- Complete a computer-based 8-hour refresher curriculum approved by the HSM. An online 8-hour refresher course is available through ContinUum.

HSMs may approve alternate ways of completing this requirement that meet the requirements of Paragraph (e)(8) of 29 CFR 1910.120, the OSHA standard for hazardous waste operations.

4.5 Subcontractors

Subcontractors are responsible for providing H&S training for their employees. Any specific H&S training required for a subcontractor's work should be specified in the scope of work and contract documents. Examples would include 40-hour hazardous waste training, CSE training, forklift training, scaffold erection, asbestos training, excavation – competent person, etc. Verification of any required training should be submitted by the subcontractor before being given a notice to proceed.

In some circumstances, subcontractors may participate in CDM Smith H&S training. Site- and project-specific H&S orientations normally include subcontractors when CDM Smith and subcontractor personnel are required to know and understand project hazards and procedures. In such cases, subcontractors must sign declarations indicating the training provided is adequate for their employees. Any training required to address additional activities, which may expose subcontractor employees to additional hazards, is the responsibility of the subcontractor.

4.6 Recordkeeping

4.6.1 Corporate Health and Safety Training Database

CDM Smith maintains a database to track employee H&S training. Attendance at all CDM Smith H&S classes is documented on an attendance sheet. Instructors of CDM Smith H&S training classes should forward a copy of the attendance sheet to the H&S database administrator and the ContinUum Registrar and keep copies for their records and any records required by the office, unit, or project. When an HSC arranges for training for CDM Smith employees, arrangements shall be made to have training certificates sent to the HSC. The HSC shall forward copies of the certificates to the H&S database administrator and ContinUum registrar and distribute original certificates to the employees. New employees who have previously had H&S training required to perform specific job functions should forward copies of relevant certificates or other documentation of training to the H&S database administrator. Documentation is subject to approval of the HSM and must be provided for the new employee to receive credit for the training. The database administrator shall publish reports as requested by the HSM, RMs, and others as necessary.

4.6.2 Site and Project Orientations

Records of project-specific and site-specific training and tailgate talks shall be maintained by the site project manager or designated SHSC with the project files. A copy of attendance records of any H&S training provided on a project site that meets CDM Smith program H&S training requirements shall be forwarded to the H&S database administrator and the ContinUum registrar for entry into the H&S training database.

Section 5

Medical Surveillance and Evaluations

5.1 Purpose and Scope

CDM Smith administers an occupational medical surveillance program for the following activities:

- Hazardous waste operations
- Activities that require the use of respiratory protection beyond the use of “loose fitting dust masks”
- Project-specific activities or job assignments that may expose employees to hazards where medical surveillance is required by regulation or it has been determined by the project manager, resource manager, and/or HSM that a project-specific medical evaluation program or biological monitoring is warranted
- As requested by a client

The occupational medical surveillance program is designed and overseen by a board- certified occupational physician. The medical surveillance program is intended primarily to monitor an employee’s fitness for duty and is not intended for the diagnosis or treatment of injury or illness. The functions of the medical surveillance program include:

- Establishing a baseline medical condition before project or job assignment
- Monitoring the employee’s physical ability to perform assigned job functions
- Identifying the presence or absence of conditions that could be aggravated by the type of work assigned
- Monitoring health trends during hazardous waste and other designated project assignments
- Establishing a medical condition at time of termination or post assignment

In addition, medical exams or evaluations of employees may be provided in the following circumstances:

- Employment-related injuries or illnesses
- Exposures to toxic or hazardous substances
- Medical clearance to return to work

5.2 Responsibilities

Direct Managers and Resource Managers – Direct managers and resource managers ensure employees participate in the medical surveillance program when required by project assignment and notify the HSM of employee termination or reassignment requiring an exit physical examination.

Health and Safety Managers – HSMs select and monitor performance of medical contractor and oversee CDM Smith administration of the program.

Health and Safety Coordinators – HSCs or their designees coordinate medical appointments and maintain employee medical clearance forms for their office(s).

Medical Consultant – The medical surveillance consultant identifies qualified clinics, medical facilities, and maintains employee medical records. The medical consultant provides the services of a board-certified occupational physician to advise on recommended medical protocols, provide medical opinions regarding employee fitness for duty, and provide medical advice as requested.

Employees – Employees selected for activities that include participation in a medical surveillance program are responsible for participating in the program by attending assigned appointments and maintaining their medical qualifications.

5.3 Hazardous Waste Medical Surveillance

5.3.1 Pre-Assignment Medical Examination

All employees assigned to work on hazardous waste projects will be given a pre- assignment physical examination before performance of fieldwork. To initiate a pre- assignment hazardous waste physical examination, the group leader, direct manager, or resource manager shall notify the H&S database administrator via e-mail, memo, or other documented means that an employee is hired or to be assigned hazardous waste work. The H&S database coordinator will provide all necessary forms and instructions so that the exam can be scheduled by the employee at a qualified medical facility identified by the medical consultant at a time and location acceptable to the employee. Typical content of the exam is given in **Table 5–1**. The medical consultant will determine the specific content of the examination with concurrence with the HSM.

5.3.2 Periodic Hazardous Waste Medical Exam

Employees enrolled in the hazardous waste medical surveillance program must have a periodic exam every 10 to 24 months following the employee's baseline exam. The medical consultant will determine the frequency of examination after he/she reviews the employee's completed periodic medical questionnaire. Typical contents of the periodic exam are given in Table 5-1. Additional exam elements listed at the bottom of Table 5-1 may be included by the HSM or as deemed medically indicated by the examining physician based on the employee's work history.

On or before the first anniversary of any physical exam, the employee will be asked to consult the help of a medical professional to determine if the employee needs a physical exam or may be granted a 12-month extension before the next physical. If a determination is made by the occupational physician, based on the employee's work history, a full exam is not needed after 12 months. However, if the employee is expected to use a negative pressure respirator, they will need to have a medical release to wear a respirator as described in Section 11, Respiratory Protection.

In addition to the basic periodic physical exam, employees may receive additional medical examinations as follows:

- Following a known acute exposure to a toxic or hazardous material
- At the discretion of the HSM or medical consultant
- When an employee experiences signs or symptoms of exposure to a toxic or hazardous material and requests an exam

5.3.3 Hazardous Waste Exit Exam

When the direct or resource manager or Human Resources manager learns that an employee in the hazardous waste medical surveillance program is permanently reassigned to nonhazardous waste work or terminates employment, they shall notify the HSM. The HSM will coordinate to ensure an exit examination is scheduled. The employee will be scheduled to take an exit physical exam unless the employee has completed the exam waiver form and the following criteria have been met:

- The employee has had a periodic physical exam within the previous 6 months.
- The employee has not participated in work that could produce potential exposure to toxic or hazardous materials.
- The employee has had no signs or symptoms of exposure since the employee’s last physical examination.

or

- The employee refuses to participate in an exit examination. If the employee refused to participate in an exit physical examination, appropriate documentation should be generated for that employee’s personnel record by the employee's group leader, resource manager, HSM or HSC.

The typical content of the exit exam is listed in Table 5-1.

Table 5-1 Contents of Hazardous Waste Medical Examination

Baseline Examination	Periodic Examination	Exit Examination
General Medical Questionnaire	Medical and Exposure History since last exam	General Medical Questionnaire
Physical Exam	Physical Exam	Physical Exam
Visual Acuity	Visual Acuity	Visual Acuity
Audiometry	Audiometry	Audiometry
Pulmonary Function Test	Pulmonary Function Test	Pulmonary Function Test
Blood Chemistry and Urinalysis	Blood Chemistry and Urinalysis	Blood Chemistry and Urinalysis
Chest X – Ray		Chest X – Ray

Additional Exam Elements - Performed if requested by HSM or Medically Indicated			
Respirator Fit Test	PCB	Audiometry	Chest X-ray
RBC Cholinesterase	Blood Lead/ZPP	Methemoglobin	EKG
Serum Cholinesterase	Urine Heavy Metal	Tetanus/Diphtheria Vac	Cardiac Stress Test

5.4 Respirator Medical Qualification

Employees who are required to wear respiratory protection, other than loose fitting disposable dust mask type respirators, and are not enrolled in the hazardous waste medical surveillance program, must have a medical evaluation performed to determine if they are medically qualified to wear a respirator. The evaluation should be performed by the medical consultant before the employee is fit tested or required to wear the respirator for personal protection. A full description of the medical evaluation procedure and administrative requirements is provided in Section 11, Respiratory Protection.

5.5 Medical Release Forms

Upon completion of a medical exam or evaluation, results shall be reviewed by the medical consultant's occupational physician and a medical release letter shall be sent to the H&S database administrator indicating the medical status of the employee. The medical consultant shall also provide a copy of the results of the exam to the employee.

5.6 Project-Specific Medical Evaluation and Biological Monitoring

Employees may be assigned to projects that require specific physical requirements, physical skills, or have the potential to create an exposure to a toxic or hazardous substance sufficient to warrant biological monitoring. Examples of such projects may include projects with significant lifting; exposure to extreme heat; physical exertion; or exposure to lead, asbestos, mercury, or material at a level where biological monitoring is required by regulation or is warranted based on the evaluation of the hazard by the HSM. If a medical evaluation or biological monitoring is required for a specific project, substance, or hazard, the details of the medical evaluation or biological monitoring program for the project will be developed by the HSM in consultation with the medical consultant and outlined in the project-specific HASP.

5.7 Employment-Related Injury or Illness Medical Evaluations

In a non-emergency situation, employees who are injured or contract an illness that may be related to their employment at CDM Smith should notify their direct manager or resource manager and contact their HSM or HSC in accordance with procedures outlined in Section 3.2 or found on the H&S home page. If necessary, an appointment will be arranged at a medical facility identified by the medical consultant at a time and location convenient to the employee.

The HSM or HSC must be notified by the employee, their group leader, direct manager, or resource manager before seeking non-emergency medical services for employment-related injuries or illnesses.

5.8 Return to Work Examinations

An employee desiring to return to work following a leave of absence due to injury or illness, or return to full work status from a restricted work period, must obtain a medical release to work, signed by a licensed physician, stating that the employee is capable of performing assigned duties with or without restrictions and with or without reasonable accommodation. The content of the examination may be determined by the medical consultant and may be performed at a facility selected by the medical consultant at a time and location acceptable to the employee. A medical work status form should be provided to the HSM and Human Resources benefits manager.

5.9 Access to Medical Records and Exposure Data

Employee medical records, including results of medical tests and X–Rays, shall be retained by the medical consultant and kept confidential in accordance with OSHA medical recordkeeping requirements, 29 CFR 1910.1020. Medical records and information obtained in the course of the administration of the CDM Smith medical surveillance program shall be kept confidential and released only under the following conditions:

- An employee, former employee, or their designated representative may obtain a copy of his/her personal records by submitting a written request for the information to the HSM. The written request must include the employee's name, the address to send the records to, and a phone number to call to verify the identity of the requestor.

- CDM Smith's workers' compensation insurance carrier may request information related to alleged occupational illnesses or injuries with the written permission of the employee.

- The CHSO or HSM may obtain medical information without personal identifiers by submitting a written request to the medical consultant.

- Recognized government research and regulatory agencies may obtain medical information without personal identifiers by submitting a written request to the CHSO. The request shall identify the nature and purpose of the information requested.

Air monitoring data and exposure records for specific projects are kept with project H&S records. Employees may obtain access to data related to their exposure or generic data associated with potential exposure of employees in their job classification or performing similar duties by submitting a written request to their appropriate HSM.

Section 6

Hazardous Waste Field Qualifications

6.1 Purpose and Scope

To be qualified to participate in hazardous waste operations, an employee must have current:

- Medical clearance from the CDM Smith medical consultant
- Training clearance
- Site-specific/activity clearance for project-specific work (e.g., CSE, lead, or asbestos awareness, radiation worker training, etc.)

Requirements for training and medical clearances are described in Sections 4 and 5.

6.2 Responsibilities

Group Leaders, Direct Managers, and Resource Managers – Group leaders, direct managers, and resource managers are responsible for ensuring employees have adequate training and are medically qualified to perform job assignments in accordance with this section. Group leaders, direct managers, and resource managers must consider employee hazardous waste qualification level and status when assigning project tasks and making project assignments.

Health & Safety Managers – HSMs are responsible for the development and administration of training, medical and record-keeping programs, which assist employees and managers in meeting the requirements of this section.

Employees – Employees are responsible for maintaining their personal hazardous waste operations qualifications and not accepting assignments for which they are not qualified.

6.3 Hazardous Waste Qualification Levels

Field hazardous waste qualification levels are described below:

HAZWASTE Site Worker - Personnel may perform Level B, Level C, or Level D field activities under the direction of a qualified site manager. Qualification at this level requires:

- Completion of OSHA 40-hour hazardous waste H&S training
- Completion of initial hazardous waste medical exam
- Participation in 8-hour annual refresher training program
- Participation in CDM Smith Medical Surveillance Program

For Level B or C work, meet the requirements to wear an air purifying respirator described in Section 11.

HAZWASTE Site Supervisor - Personnel may participate in all the field activities of HAZWASTE site worker personnel and supervise field activities that require Level B, C, or D PPE. Qualification at this level includes all the requirements for HAZWASTE site worker plus:

- Three days hazardous waste field experience
- 8 Hour hazardous waste supervisor class
- Concurrence by the HSM that the individual has a good safety attitude and is capable of leading field activities at the level assigned

For Level B and C work, project personnel should participate in project-specific refresher training on the use of Level B and C equipment, dress-out, and decontamination procedures.

Level A - If specific project hazards require CDM Smith personnel to directly participate in Level A PPE, project staffing shall be made with the concurrence of the HSM.

6.4 Hazardous Waste Qualification Designation

Database Record

An employee's hazardous waste qualification records are maintained in the H&S database. A change in an employee's status can be made based on documentation provided by the employee or their direct or resource manager and reviewed by the HSM or his/her designee.

Section 7

Health and Safety Planning

7.1 Purpose and Scope

H&S planning is essential to minimize hazards and ensure project success. All projects that expose CDM Smith employees to hazards outside the office environment should have an appropriate level of H&S planning. The level of effort required is dependent on the complexity of the project, client requirements, and regulatory concerns. CDM Smith HASPs are intended for the exclusive use of CDM Smith personnel and its direct subcontractors when they are performing similar work activities that are covered in the HASP. Before the use of a CDM Smith HASP by a CDM Smith subcontractor, the subcontractor will provide an acknowledgement that the HASP has been provided and understood by all involved subcontractor employees.

7.2 Responsibilities

Client Officers – Client officers are responsible for considering H&S concerns at the proposal stage and project kick-off by working closely with the appropriate HSM and project managers to apply adequate resources to safely conduct work in accordance with CDM Smith H&S programs, client requirements, and government regulations.

Project Managers – Project managers are responsible for ensuring adequate H&S planning is conducted in accordance with this procedure for projects they manage. The actual planning effort may be delegated to qualified project personnel, HSCs, or HSMs. The project manager should work with the client to identify client H&S requirements and address those requirements in the project HASPs.

Health and Safety Managers – HSMs are responsible for assisting client officers and project managers in the identification of potential physical and chemical hazards and determining the level of resources required to minimize those hazards. HSMs or their designees are responsible for reviewing HASPs prepared by projects.

7.3 Go – Stop Evaluation Phase

During the go-stop evaluation of a potential project, the client officer should consider any hazardous conditions, H&S risks, and potential precautions required. The direct costs estimated for the project should reflect any protective equipment, instrumentation, HASP preparation, H&S oversight, or other activities needed to conduct the project safely. Where needed, the HSM and Office of General Counsel should be consulted to assist in assessing risks and level of effort required to safely perform the work.

7.4 Project Management Plan

The Health and Safety Evaluation Section of the Project Initiation Form (PIF) should be completed for each project. If any questions in the H&S section of the PIF have been answered “yes,” the project manager should forward the PIF to the HSM or someone they designate as the H&S Approver for the project.

7.5 General Health and Safety Plan

The general HASP may be used for projects involving field work that present specific hazards to CDM Smith personnel that require a level of planning beyond a simple PIF but not as detailed as hazardous waste work or CSE. Examples of such projects may include extended inspection work at active construction sites, work over or near water, work involving significant physical activity, work with fall exposures greater than 6 feet, or other hazards. If the H&S Section of the PIF indicates the project requires a general HASP, the plan should be generated and reviewed with project staff before performing fieldwork. The form provides an area to identify key project personnel, activity hazard analyses (AHAs) (Section 7.9), and basic emergency information that should be considered for any field project. The form can be found on CDM Smith's InSite page at https://cdmsmithonline.sharepoint.com/sites/HS/Pages/Home.aspx.

The form may be completed by the project manager or their designee and reviewed by the project manager, HSC, or HSM or another employee designated by the HSM.

7.6 Hazardous Waste Operations Health and Safety Plans

A hazardous waste site-specific HASP shall be prepared for field projects whenever:

- Required by OSHA Standard 29 CFR 1910.120
- Required by client contract requirements
- Determined by the HSM and project manager

The complexity of each plan will vary as to the types of operations to be conducted and the chemical and physical hazard potential associated with each project. For most site investigation projects, the Hazardous Waste Site HASP Form may be completed and used as the project or site-specific HASP. For projects involving remedial construction or other activities, it may be necessary to supplement the HASP form with AHAs for specific activities. AHAs are discussed in Section 7.8. The Hazardous Waste HASP form and AHA form can be found on the H&S home page at https://cdmsmithonline.sharepoint.com/sites/HS/Pages/Home.aspx.

7.6.1 Hazardous Waste Health and Safety Plan Elements

Before completing the HASP, the preparer should obtain as much background information as possible about the site and planned operations. Much of the information required to fill out the HASP form will be available from previous studies, the project work plan, and other project documents.

The HASP form is broken up into key elements. Each element of the form should be addressed as follows:

- Plan Heading – Identify project name, location, client contact, etc. as indicated on form.
- Objectives of Field Work – Provide a basic statement of the objectives of the fieldwork.

- Type of Site – Identify key characteristics of the site. Are there ongoing operations present? Can the general public readily access the site? Is the site secure? Is the site a landfill, an industrial site, former or active military site?
- Site Description and Features – Provide a brief description of the site including features that may affect site H&S such as presence of power lines, underground utilities, steep slopes, wetlands, known poisonous plants, accessibility, drums, or tanks. Identify the type of surrounding area.
- History – Summarize site history with focus on activities or conditions that could affect site H&S. Include history of spills, releases, or previous investigations.
- Waste Types and Characteristics – Identify known or reasonably suspected characteristics of waste types anticipated at the site.
- Hazards of Concern – Based on work activities and surroundings, identify hazards likely to be present at the site.
- Work Zones – Describe how work zone will be established and identified at the site.
- Past and Present Disposal Methods and Practices – If applicable, describe how the facility disposed of its wastes. Were materials disposed of onsite or offsite? How were they transported? Was there a separate process waste system? Was the waste in liquid, solid, or sludge form? Was it drummed? Are there known waste lagoons or pits?
- Hazardous Material Summary – Use this section to identify the types of waste known or suspected to be present at the site.
- Summary Table – For specific contaminants, list the following data when it is available:
  - Highest concentration found from previous sample efforts and the medium it was found (soil, water)
  - The lower of the OSHA permissible exposure limit (PEL) or the American Council of Governmental Industrial Hygienists – threshold limit values (ACGIH) – (TLV)
  - The National Institute for Occupational Safety and Health (NIOSH) value listed for immediately dangerous to life or health (IDLH)
  - Immediately noticeable warning concentrations. (i.e., odor threshold, irritation threshold, visible cloud, etc.)
  - Summarize health effects of overexposure
  - The photoionization potential (when applicable)
- Task Descriptions/Specific Technique/Site Location Hazard Analysis – In this section project activities should be broken down into discrete tasks and the most significant hazards associated with each task identified. Typical hazards may include:

- Significant exposure to groundwater contaminants
- Excavation hazards
- Uneven terrain
- No significant exposure to site contaminants
- Work near overhead wires
- High traffic area
- High heat stress potential

After all tasks have been reviewed, the overall hazard rating for the project should be filled in along with a statement indicating why the site was rated the way it was.

Finally, if there is a need for any specialized training, such as:

- Asbestos awareness
- Fall protection
- Supplied air respiratory protection review
- Or, specialized medical surveillance due to exposure to site contaminants, such as blood lead, serum polychlorinated biphenyls, or other contaminant-specific surveillance

These items should be identified at the bottom of the page.

- Personal Protective Equipment – For each task listed on the previous page, identify the level of protection and specific PPE and other safety equipment to be used. The same level of PPE may be identified for multiple tasks.
- Monitoring Equipment – In this section, identify the monitoring instrumentation to be used and actions that will be taken based on the response of specific instrumentation.
- Decontamination and Disposal – Describe decontamination procedures to be used for personnel, sampling equipment, and heavy equipment at the site. Also, describe means and methods planned to contain wastes generated and how they will be disposed.
- Emergency Contacts – List appropriate telephone contacts and identify evacuation routes and rally locations. List local hospital or medical facility and provide directions and attach a map to the facility.

7.6.2 Acknowledgment of Acceptance of Health and Safety Plan

All CDM Smith site personnel must understand the requirements of the HASP and agree to its provisions. The site manager shall distribute the HASP to CDM Smith personnel as they are assigned to the project. Field team members must sign the acknowledgement at the end of the HASP before beginning fieldwork. Subcontractors to CDM Smith must also acknowledge and accept the provisions of the site HASP, when they are performing similar activities, or they have agreed to work under their own HASP, and it has been reviewed and accepted by CDM Smith.

7.6.3 Modifications to an Existing Health and Safety Plan

Minor administrative changes to an existing HASP may be made in the field with notification made to the HSM. This can be done through a formal memo, e-mail, or telephone conversation. Minor changes include changes in personnel, dates and time of work, extending existing tasks, or repeating existing tasks at the same site. Significant changes that may affect the risk analysis of the plan must be reviewed with the HSM before implementation. Such changes include upgrading or downgrading levels of PPE not identified on the initial plan, increasing or reducing air monitoring frequencies, discovery of additional contaminants not previously identified, or additional tasks involving intrusive work.

7.7 Submittal and Approval of Health and Safety Plans

HASPs should be developed in concert with the general work plan. The plans may be prepared by a qualified individual designated by the project manager and then reviewed by both the project manager and the HSM or his/her designee. Fieldwork should not begin until the HSM or their designee has reviewed and signed the HASP.

7.8 Activity Hazard Analysis

7.8.1 Description of Activity Hazard Analysis

A hazardous waste site-specific HASP shall be prepared for field projects whenever:

- Required by OSHA Standard 29 CFR 1910.120
- Required by client contract requirements
- Determined by the HSM and project manager that an HASP be prepared for the project

The complexity of each plan will vary as to the types of operations to be conducted and the chemical and physical hazard potential associated with each site. For most site investigation projects, the Hazardous Waste Site HASP Form may be completed and used as the project or site-specific HASP. For projects involving remedial construction or other activities, it may be necessary to supplement the HASP form with AHAs for specific activities. AHAs are discussed in Section 7.9. The HASP form can be found on the H&S home page at https://cdmsmithonline.sharepoint.com/sites/HS/Pages/Home.aspx.

7.8.2 How to Complete the Activity Hazard Analysis Form

To complete the AHA form:

- Fill in the project summary information at the top of the form.
- Describe the basic activity that will be analyzed. Provide sufficient detail so that someone familiar with the activity will understand what is planned.

- Identify all hazards associated with the activity. The list below provides a list of possible hazards that may be encountered.
- Describe precautions to be taken for each hazard identified. Try to use engineering methods and or administrative and work practices to plan a way to avoid the hazard before prescribing the use of PPE. In many cases it is advisable to include the use of PPE as well, in case engineering or other controls fail.
- Identify any specialized training or equipment needed to perform the activity safely.
- The complete AHA should be reviewed by an HSC or HSM.

7.8.3 List of Possible Hazards

A list of possible hazards to consider is provided below. It is intended as a reminder of possible hazards that may be encountered and is not intended to be a complete list of all possible hazards.

Table 7-1 Possible Hazards for AHAs

Partial List of Hazards to Consider for AHAs	
Exposure to hazardous chemicals	Exposure to ionizing radiation
Falls from height	Slippery walking and work surfaces
Over-water hazards	Excavation and trenching hazards
Noise	Poisonous plants, insects, animals
Exposure to biological waste or organisms	Working with sharp tools
Working with hand tools	Fire and explosion hazards
Working around heavy equipment	Vehicular traffic
Moving machinery including gears, belts, etc.	Hot or cold environments
Work in confined spaces	Heavy and or frequent lifting/carrying
Electrical hazards	Exposure to biological waste, molds, pathogens
Unexploded ordnance	Hazards from lasers
Compressed gases, pressure	Welding or thermal cutting hazards

7.9 Application and Use of Health and Safety Plans

7.9.1 Application of Health and Safety Plans to Project Work

When CDM Smith issues a HASP for a project, CDM Smith employees are expected to work in conformance with the plan. The project manager or field team leader is expected to monitor employee performance with respect to H&S activities and to the extent possible, verify that:

- Project team members are aware of and understand the contents of the project HASP
- PPE is used as described in the HASP
- Any procedures called for or described in the HASP are followed
- If the HASP also covers subcontractors, that subcontractors also verify that their personnel follow the procedures described in the HASP

7.9.2 Use of CDM Smith Health and Safety Plans by Other Organizations

CDM Smith HASPs are developed to protect CDM Smith employees and, at times, it's direct subcontractors. When a HASP is shared with a subcontractor, allow enough lead time for the subcontractor to review the HASP so it may meet its responsibilities under the plan.

Clients or regulators may request a copy of CDM Smith's HASP for their records. They may review the HASP and provide comments. CDM Smith will address all client comments; however, any revision of the HASP is subject to the review procedures described in Section 7.6.3. Ultimately the H&S of CDM Smith employees is the responsibility of CDM Smith, and we will accommodate client requests relative to H&S as long as CDM Smith is confident the H&S of its personnel are not compromised.

If a copy of a CDM Smith HASP is provided to a client or regulator, it should be provided under a cover letter explaining that the CDM Smith HASP is for the exclusive use of CDM Smith and its direct subcontractors and does not apply to any other work or employer.

Section 8

Hazardous Communication

8.1 Purpose and Scope

This program has been prepared to meet the requirements of the OSHA Standard 1910.1200, Hazard Communication. It includes guidelines on the identification of hazardous chemicals, the preparation and proper use of labels, administration of safety data sheets (SDS), and employee training on chemical hazards and applies to CDM Smith work locations.

8.2 Responsibilities

Direct Managers and Resource Managers – Direct managers and resource managers are responsible for ensuring that employees working under their direction receive adequate information on the chemicals and hazardous materials they may use and be exposed to during the course of their employment. Direct managers and resource managers are responsible for ensuring the hazard communication program is implemented for the offices and projects under their direction.

H&S Coordinators and Site H&S Coordinators – Maintain chemical inventory and SDSs for their assigned work location. They also coordinate SDS requests from employees and seek guidance from the division HSM when needed.

Health and Safety Managers – Oversee implementation of the hazard communication program for their assigned units and provide guidance to HSCs and SHSCs working under their direction.

Employees – Active participation in the hazard communication training program. This program is part of the blended learning activity associated with the new employee orientation available through Continuum. Employees are also responsible for asking for information on the chemicals and hazardous materials they may need to use.

8.3 Chemical Inventory

Each CDM Smith work location should maintain a chemical/hazardous material inventory for chemicals and hazardous materials used at the location. Lists of typical materials associated with maintenance, water, wastewater, environmental field activities, and offices are provided in Section 8.8.

8.4 Container Labeling

Whenever possible, order chemicals and materials in container sizes convenient for immediate use to allow use of the manufacturer's label as the primary means of identifying the material and precautions recommended. Labels must remain legible and should not be marked or taped over. If the original label becomes illegible for any reason, the container must be relabeled, or the container and its contents must be properly disposed.

If materials must be transferred to a container other than the original, the receiving container must be labeled to identify the contents. No unmarked containers of any size should be left unattended.

8.5 Safety Data Sheets

An SDS is a summary of safety, health, and environmental information associated with a specific chemical or product. Each manufacturer or distributor is required to provide an SDS for materials they manufacture or distribute.

Each CDM Smith work location should maintain a central file of SDSs for materials used at the location. As SDSs are received, they should be forwarded to the HSC, SHSC, office services coordinator, or other designated individual for inclusion in the SDS file. This file provides the primary source of SDSs for chemicals and materials used at the location since it includes those SDSs from the manufacturer or distributor. The SDS file should be periodically reviewed by the HSC or individual designated to maintain it to ensure SDSs are present and outdated SDSs are removed and updated. Additional sources of SDSs can be found at various websites. A few of these sites are available on the CDM Smith H&S homepage at https://cdmsmithonline.sharepoint.com/sites/HS/Pages/Home.aspx.

For any material they use or are potentially exposed to, employees may request a copy of an SDS from their direct manager, project manager, HSC, SHSC, HSM, or they may directly access the databases referred to above. Indeed, employees are encouraged to seek out and review SDSs before using chemicals or hazardous materials. Employees should contact the appropriate HSM or HSC with any questions regarding the hazards, storage, disposal, or shipping of chemicals or potentially hazardous materials.

8.6 Hazard Communication Training

Each new employee will have a basic introduction on hazard communication provided during the new employee orientation. The introduction includes:

- An overview of the OSHA hazard communication standard
- Discussion on the location and availability of the CDM Smith hazard communication program
- Instructions on how to access SDSs
- An explanation of how to read chemical labels and SDSs

Hazard-specific training is provided to those employees who may use or be exposed to chemicals or hazardous materials before such use or exposure. Training is conducted during the course of specialized training such as 40-hour OSHA hazardous waste site H&S training, groundwater sampling, and fieldwork pre-job briefings. This training includes:

- A review of chemicals and materials present or anticipated to be present
- Methods and techniques to detect the presence or release of a material in the work area

- Discussion on how to minimize or prevent exposure
- An explanation of the proper use of personal protective equipment

8.7 Multi-Employer Worksites

8.7.1 CDM Smith as Prime Contractor

On project sites and work locations where CDM Smith functions as a prime contractor, CDM Smith requires all subcontractors to submit to CDM Smith copies of SDSs for materials and chemicals the subcontractor plans to bring or use onsite. These SDSs are available to all CDM Smith personnel and other subcontractors working on the site or work location.

Subcontractor and owner personnel should be informed of the availability of SDSs and granted access to any SDSs for chemicals or materials used or brought to the work location by CDM Smith.

8.7.2 CDM Smith as Subcontractor or Owner's Engineer

On project sites and work locations where CDM Smith does not function as a prime contractor and is not in control of the site, CDM Smith employees and subcontractors may request information on chemicals or hazardous materials related to potential exposure to other employer's work activities. These activities may include processes controlled by a facility owner or other contractors working at the site. CDM Smith employees or subcontractors should request SDS information through the CDM Smith SHSC, site manager, HSC, or appropriate HSM, who shall contact the appropriate organization and make the SDS request. If the request is denied, the HSM should be contacted for guidance.

8.8 Typical Chemical Inventories

8.8.1 Maintenance

Aluminum carbide	Gasoline	Paint thinner
Aromatic solvent (toluene)	Grease	Polyurethane
Cement mix	Hydraulic fluid	Sand
Concrete sealer	Kerosene	Spill absorbent
Detergents	Machine oil (WD-40)	
Degreaser (1,1,1-TCE)	Motor oil	
Diesel fuel		

8.8.2 Water Facilities

Acetic acid	Ferric sulfate	Potassium permanganate
Aluminum chloride	Ferrous chloride	Salt (sodium chloride)
Aluminum sulfate	Ferrous sulfate	Silica gel
Ammonia	Fluorosilic acid	Soda ash (sodium carbonate)
Calcium carbonate	Hydrochloric acid	Sodium aluminate
Calcium hydroxide	Hydrogen peroxide	Sodium bicarbonate
Calcium hypochlorite	Hydrofluoric acid	Sodium bisulfite

Calcium oxide
Carbon monoxide
Cement
Charcoal Ozone
Copper sulfate
Copperas
Diatomaceous earth
Dimethyl sulfide
Ferric chloride
Hydrogen sulfide
Lime
Magnesium oxide
Sodium hypochlorite
Polymers – anionic
Polymers – cationic
Polymers – nonionic
Potassium ferrocyanide
Sodium fluoride
Sodium hexametaphosphate
Sodium hydroxide
Sodium silicofluoride
Sulfur dioxide
Zinc chloride
Zinc orthophosphate

8.8.3 Environmental Field Work

Acetone
Alconox
Ascorbic acid
Bentonite
Buffer solutions
Compressed air
Electrode solutions
Hexanes
Hydrochloric acid
Isopropyl alcohol
Methane Soil
Methanol
Methyl ethyl ketone
Nitric acid
Skin cream
Sodium thiosulfate

8.8.4 Office Chemicals

Ammonium hydroxide
Process Developer, indirect electrostatic process drum
Process Photoreceptor
Toner, direct electrostatic
Toner, indirect electrostatic

Section 9

Personal Protective Equipment

The activities performed by CDM Smith frequently require the use of clothing and equipment that shields and/or isolates employees from chemical and physical hazards that may be encountered.

In order to prescribe personal protective equipment requirements effectively, the nature and extent of potential chemical and physical hazards associated with various activities need to be assessed. Prior to mobilization, CDM Smith performs a detailed review of the project site. This includes a review of the site history, types and quantities of materials handled at the site, types of operations performed at the project site, and types of activities to be performed during the course of the project.

From this review, personal protective equipment is selected based on the reasonable anticipation of exposure to the chemical and physical hazard exposure potential.

9.1 Use of Personal Protective Equipment

Employees are responsible for using PPE identified in H&S plans, as directed by project managers, where recognizable hazards exist, to meet client requirements and in accordance with the guidelines described in this section. Employees are also responsible for inspecting PPE assigned to them and having worn out or defective equipment replaced.

Use of personal protective equipment is required by OSHA regulations contained in 29 CFR 1910 and 29 CFR 1926, and is reinforced by EPA regulations in 40 CFR Part 300. These regulations include all individuals who may perform work at hazardous, or potentially hazardous, waste sites, when applicable. Types of protection, relevant to OSHA regulation, and the source of the regulation appear in Table 9-1.

Personal protective equipment in use shall be inspected daily and maintained in serviceable condition. Items of personal issue shall be cleaned and sanitized as appropriate prior to being reissued to another employee. Defective or damaged personal protective equipment shall be taken out of service immediately.

9.2 Basic Personal Protective Equipment

9.2.1 Eye Protection

Eye protection should be worn on all active construction sites, field hazardous waste sites and whenever there is a potential hazard of foreign substances or harmful energy affecting the eye. Employees should wear safety glasses during field activities unless it can be demonstrated that there are no potential hazards to the eye.

For most dusts and particulates, safety glasses with side shields meeting the requirements of Z87.1 are adequate. For potential splash hazards of liquids, a face shield or splash hood should be used in conjunction with regular safety glasses. In some exposures to mist or heavy dust, goggles may provide the best form of eye protection. If lasers are used, specialized eye protection using specific lenses for the wavelength and energy emitted by a specific laser may be required.

Based on current information related to the use of contact lenses in the industrial work environment, contact lenses may be used in most situations. Eye protection such as safety glasses, face shields or goggles appropriate for the hazards present should be used as well. If a specific situation or condition arises where the use of contact lenses presents an additional hazard, the hazard should be identified in the H&S plan or activity hazard analysis and the use of contact lenses may be prohibited on a project or activity specific basis.

9.2.2 Hard Hats

Hard hats meeting the requirements of ANSI Z89.1 should be worn:

- On all active construction sites and field hazardous waste operations,
- Working near exposed electrical conductors.
- Whenever there are potential hazards associated with falling or moving objects.
- Whenever there are overhead objects such as piping, structural elements or other stationary elements that create a bump hazard.
- Whenever required by a client or owner.

Hard hats should be worn with the brim facing forwards unless there is a specific safety related reason to turn the hat backwards. In such instances the webbing in the hat shall be repositioned in the hat so that the back of the webbing is at the back of the head.

9.2.3 Foot Protection

Personnel should wear protective footwear when working on active construction sites, field hazardous waste sites and while performing work activities where there is a danger of foot injuries due to falling or rolling objects, objects piercing the sole, and where employees' feet are exposed to electrical hazards. Safety footwear shall meet the requirements of ANSI Z41.1 and cover the ankle. Any footwear worn for field work must have a good sturdy tread appropriate for outdoor use and a defined heel.

9.2.4 Hand Protection

Various types of gloves are available for protection against cuts, scrapes, bruises, etc. that may occur during the physical handling of material, equipment tools etc. Cotton, leather, Kevlar®, and steel mesh gloves are available and should be made available to personnel and used depending on the work activity and potential hazards. If needed, leather or mesh work gloves can be worn over chemical protective gloves.

9.2.5 High-Visibility Clothing

High-visibility vests or jackets are required whenever personnel work in or around vehicular traffic. High-visibility clothing should meet the level of visibility required for the work conditions in ANSI / ISEA 107 (1999). Employees should also wear high- visibility clothing on active construction or industrial sites where there is frequent movement of trucks, excavation or other heavy equipment. See Section 16.22 Traffic and Work Zone Safety.

9.2.6 Chemical Protective Clothing

Personnel should wear protective clothing in circumstances where there is the potential for hazardous dusts, toxic or contaminated material, mists, or liquids to come into contact with the employee's skin or personal clothing. Protective clothing may include disposable or reusable coveralls, polymer coated coveralls, or splash suits. When there is a significant potential for direct contact of liquids or mists, polymer coated coveralls or splash suits are indicated. Selection consideration should be given to such factors as size, durability, chemical compatibility, and heat stress potential. Project managers are particularly reminded to consider the correct size of protective garment for very large and small workers.

Chemical Protective Footwear – Chemical protective footwear should be worn when there is the potential for boots to come into direct contact or be splashed with hazardous materials or waste. When direct contact hazards exist, chemical resistant boots or boot covers may be worn.

Chemical Protective Gloves – For those activities where there is a potential for direct contact with hazardous or toxic materials, or contaminated soil or groundwater, employees should wear chemical protective gloves. The selection of glove should be based on the activity and the material of potential contact. A wide variety of gloves are available, and consideration should be given to dexterity, durability, and material compatibility.

9.2.7 Respirators

Please refer to Section 11.

9.2.8 Hearing Protection

Employees shall use hearing protection when noise levels exceed the allowable limit. A Hearing Conservation Program (Section 14) shall be implemented if the allowable limits are exceeded.

9.2.9 Specialized Protective Equipment

Specialized protective equipment is available for a wide variety of activities and include:

- Fall protection harnesses and lanyards
- Chaps for work in rough brush
- Shin guards for chain saws
- Face shields
- Spark resistant tools
- Cooling vests

9.2.10 Personal Work Clothing

Employees are expected to supply personal clothing appropriate for their work assignments, including long pants, a shirt with sleeves, and basic outerwear appropriate for normal protection against weather conditions. The equipment centers can supply clothing for extreme cold or wet weather employees. These include rain suits, insulated coveralls, cold weather work gloves, hard hat liners etc. Employees may request this equipment directly from the equipment centers.

9.3 Availability of PPE

CDM Smith field equipment centers maintain an inventory of basic PPE including hard hats, safety glasses, hearing protection, harnesses, traffic vests, etc. The specific make and model of equipment is reviewed periodically by the H&S managers to ensure equipment issued to CDM Smith personnel is of adequate quality. Projects and employees may obtain basic PPE by requesting equipment from the field equipment centers by telephone or email.

PPE required for use on CDM Smith work activities is provided to CDM Smith employees at no expense to the employee. Individual PPE that is assigned to a specific employee for use on multiple projects should be charged to the employee's division safety equipment overhead number. PPE assigned to an individual would typically include items such as hard hat, safety glasses, hi-visibility vests etc. CDM Smith may also issue a respirator to individuals who will frequently use respiratory protection. The employee's Group Leader or Direct Manager, in consultation with the H&S Manager assigned to support the employee's division, shall make the final determination regarding what PPE will be assigned to the employee based on the employee's expected role.. Employees who are expected to work on projects where the use of respiratory protection is anticipated or required must fulfill the training and medical approval requirements for respirators as described in Section 11, Respiratory Protection of this manual.

PPE that is used to support activities for specific projects should be charged to those projects. Typical project specific PPE would include consumables such as gloves, disposable Tyvek® suits, respirator cartridges, etc. Non - disposable PPE, used on a specific project can be obtained from the equipment centers for short or moderate durations on a rental basis. In some cases, it may be more cost effective for projects to have the equipment centers purchase the equipment for the project. Non-disposable PPE may include respirators, air-supplied respiratory protective systems, or specialized chemical protective clothing. The specific PPE ensemble for a specific project will be identified in the project specific H&S plan and approved by the service group H&S manager responsible for that project.

9.4 Levels of Protection

Each type of protective equipment has been designed specifically to protect against a reasonably anticipated chemical and physical hazard. In order to standardize personal protective equipment ensembles, "levels of protection" have been defined to address those chemical and physical hazards which may be present at hazardous waste sites. The levels of protection are defined accordingly:

Level A	This level is worn when the highest level of respiratory, skin, and eye protection is anticipated as being required.

Level B	This level is worn when the highest level of respiratory protection is anticipated as being required, with a lesser level of skin protection being necessary.
Level C	This level is worn when criteria for air-purifying respirators are determined to be necessary and a lesser level of skin protection needed.
Level D, Modified	This level is worn when activities do not pose a problem from a respiratory protection point of view but may present a skin problem and where cross contamination via shoes needs to be considered.
Level D	This level is worn when activities and areas do not present a respiratory or skin hazard.

Detailed equipment, use, and limitations associated with each level of protection appear in Table 9-2.

Table 9-1

OSHA Standards for the Use of Personal Protective Equipment

Type of Protection	Regulation	Source
General	29 CFR 1910.132 29 CFR 1910.1000-1045	41 CFR Part 50-204.7 General Requirements for Personal Protective Equipment OSHA Rulemaking
Eye and Face	29 CFR 1910.133(a)	ANSI Z87.1-[1] Eye and Face Protection
Noise Exposure	29 CFR 1910.95	41 CFR 50-204.10 and OSHA Rulemaking
Respiratory	29 CFR 1910.134	ANSI Z88.2-[1] Standard Practice for Respiratory Protection
Head	29 CFR 1910.135	ANSI Z41.1-[1] Safety Requirements for Industrial Head Protection
Foot	29 CFR 1910.136	ANSI Z41.1-[1] Men's Safety Toe Footwear

Electrical Protective Devices	29 CFR1910.335(a)(2)	NFPA 70E: Standard for Electrical Safety in the Workplace
High-Visibility Safety	29 CFR 1926.651(d)	ANSI / ISEA 107 National Standard for High-Visibility Safety Apparel

Table 9-2

Levels of Protection

Level	Equipment	Protection Provided	Should be Used When:	Limiting Criteria
A	**Recommended**: ▪ Pressure-demand, full facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA ▪ Full-encapsulating, chemical-resistant suit ▪ Inner chemical-resistant gloves ▪ Chemical-resistant safety boots/shoes ▪ Two-way radio communications **Optional:** ▪ Cooling Unit ▪ Coveralls ▪ Long cotton underwear ▪ Hard hat ▪ Disposable gloves and boot covers	The highest available level of respiratory, skin, and eye protection	▪ The chemical substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either: - Measured (or potential for) high concentration of atmospheric vapors, gases, or particulates - Site operations and work functions involving a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through intact skin ▪ Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible ▪ Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection is determined	Fully encapsulating suit material must be impermeable to the substances involved

Table 9-2

Levels of Protection

Level	Equipment	Protection Provided	Should be Used When:	Limiting Criteria
B	**Recommended:** ▪ Pressure-demand, full-facepiece SCBA or pressure-demand supplied air respirator with escape SCBA ▪ Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one-piece chemical splash suit; disposable chemical resistant one-piece suit) ▪ Inner and outer chemical-resistant gloves ▪ Chemical-resistant safety boots/shoes ▪ Hard hat ▪ Two-way radio communications **Optional**: ▪ Coveralls ▪ Disposable boot covers ▪ Face shield ▪ Long cotton underwear	The same level of respiratory protection but less skin protection than Level A. It is the minimum level recommended for initial site entries until the hazards have been further identified.	▪ reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin	Used only when the vapor of gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin Use only when it is highly unlikely that the work being done will generate either high concentrations of vapors, gases, or particulates or splashes of material that will affect exposed skin

Table 9-2

Levels of Protection

Level	Equipment	Protection Provided	Should be Used When:	Limiting Criteria
C	**Recommended** ▪ Full-facepiece, air-purifying, cartridge-equipped respirator ▪ Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one-piece chemical splash suit; disposable chemical-resistant one-piece suit ▪ Inner and outer chemical-resistant gloves ▪ Chemical-resistant safety boots/shoes	The same level of skin protection as Level B, but a lower level of respiratory protection.	▪ The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin ▪ The types of air contaminants have been identified, concentrations measured, and a cartridge is available that can remove the contaminant ▪ All criteria for the use of air-purifying	
D MODIFIED	**Recommended:** ▪ Chemical-resistant outer gloves ▪ Disposable shoe covers ▪ Work clothes ▪ Safety boots/shoes ▪ Safety glasses or chemical splash goggles ▪ Hard hat ▪	No respiratory protection. Minimum skin protection.	▪ The atmosphere contains no known hazard ▪ Work functions may involve skin contact with hazardous chemicals	

Section 10

Project Safety Management

This section provides guidance to protect the safety and health of all CDM Smith employees working on projects where there is the potential exposure to highly hazardous chemicals and where the release of such chemicals would result in toxic, fire, or explosion hazards.

This section applies to all CDM Smith employees and subcontractors who provide services to facilities that are covered by the OSHA Process Safety Management (PSM) Standard (29 CFR 1910.119) or the EPA Risk Management Rules (40 CFR Part 68).

These facilities involve the following characteristics:

- A chemical present at or above the specified threshold quantities listed in Appendix A of the OSHA PSM Standard. (Note: The presence of a threshold quantity of a highly hazardous chemical in a process is to be at one point in time, not aggregate over a period of time.)
- A process that involves a flammable liquid or gas onsite, in one location, in a quantity of 10,000 pounds (4,535.9 kilograms) or more, except for:
  - Hydrocarbon fuels that are used solely for workplace consumption as a fuel (e.g., propane used for comfort heating or gasoline for vehicle refueling), if such fuels are not a part of a process containing another highly hazardous chemical covered by this procedure
  - Flammable liquids that are stored or transferred in atmospheric tanks that are kept below their normal boiling point without benefit of chilling or refrigeration

This section does not apply to retail facilities, oil and gas well drilling or servicing operations, or normally unoccupied remote facilities unless specified by the client.

The purpose of this guidance is to establish procedures for work covered by the OSHA PSM standard that is intended to protect employees, the general public and the environment by preventing or minimizing the consequences of chemical accidents that involve highly hazardous chemicals. (Note: The full text of the OSHA PSM standard can be found at http://www.osha.gov.)

10.1 Responsibilities

Client Officers and Project Managers – Client officers and project managers should seek guidance from the HSM on projects and work activities that may fall under the OSHA PSM standard. Activities must be coordinated with the client to meet the requirements of the PSM standard and protect the health and safety of CDM Smith employees, client personnel, the general public, and the environment.

Resource Managers – Resource managers, in consultation with the HSM or HSC, are expected to monitor their assigned employees' training status and remind employees to keep safety, health and skill related training current and in compliance with CDM Smith requirements and government regulations. Resource managers must consider employee safety and health related training, professional and technical credentials, and skills in making appropriate project assignments to be able to ensure personnel assigned to projects are able to perform their jobs safely.

Health and Safety Managers – HSMs shall provide guidance and support to client officers and project managers on the types of facilities that are likely to fall under the PSM standard and generally support projects and clients in meeting PSM goals and requirements.

Health and Safety Coordinators – HSCs prepare project-specific information and directly coordinate H&S activities in support of projects that fall under the PSM standard.

Employees – Employees are responsible for maintaining their own H&S, professional, and technical training and credentials to be able to perform work in their discipline safely. Employees are required to work in accordance with CDM Smith and client procedures and seek assistance if they have safety and health questions, concerns or identify an unsafe condition.

10.2 Process Safety Management Guidance Procedures

The following is a summary of requirements for facility owners and operators, contractors, and other service providers. Client officers and project managers should familiarize themselves with these requirements and coordinate project activities with appropriate client contacts to meet CDM Smith responsibilities under the PSM standard. If there are questions regarding specific processes or facilities, the appropriate HSM should be consulted.

10.2.1 Facility Owners/Operators

Under the OSHA PSM standard, facility owners and operators that are covered by the standard are charged with specific responsibilities. This summary is provided to help project managers coordinate CDM Smith activities with those of owners and operators of the facilities that we visit. Owners or operators are required to:

- Review existing process design and equipment.
- Compile specific information related to covered processes that will enable the owner/operator to conduct a process hazard analysis.
- Perform process hazard analyses on existing processes using one of several recognized methodologies:
  - What-if
  - Checklist
  - Hazard and operability study (HAZOP)
  - Failure mode and effects analysis (FMEA)

- Fault tree analysis
- Other equivalent methodology

- The process hazard analyses shall address:
  - The hazards of the process
  - Any previous incidents that had a potential for catastrophic consequences
  - Engineering and administrative controls applicable to the hazards
  - Consequences of failure of the controls
  - Facility location issues and human factors
  - A qualitative evaluation of the range of possible safety and health effects
- Review and update process hazard analyses every 5 years.
- Develop and implement written operating procedures for startup, normal operations, temporary operations, normal shutdown, emergency shutdown, and operations and startup after an emergency. Review and certify annually that the operating procedures are accurate.
- Specific procedures should be developed and implemented for lockout/tagout, CSE, opening process lines and equipment, and control over access to the facility by maintenance, contractor, or other support personnel. These procedures should apply to both facility and contractor's personnel.
- Identify operating limits, consequences of deviation, and means to correct and avoid deviations.
- Training must be provided to employees currently involved in process operations and newly assigned employees in an overview of the process, hazards associated with it, proper operating procedures, and emergency operations and procedures. Refresher training for operators must be provided every 3 years, or more frequently if necessary.
- Conduct a pre-startup safety review of new or modified facilities.
- Develop and implement a system of inspection, testing, maintenance, and corrective actions to ensure processes covered under the system maintain mechanical integrity.
- Develop and implement a hot work permit system for hot work (welding, cutting, or other spark- or flame-producing activity) conducted on processes covered under the PSM standard and those in proximity to covered processes.
- Develop and implement written procedures to manage changes in covered processes. The system must address:

- The technical basis for the change
- Impact of the change on H&S
- Modifications to operating procedures
- Time required for the change(s)
- Authorization requirements for the change
- Notification of employees and contractors affected by the change
- Update of operating procedures and documentation to reflect the change

- Investigate any incident that results in, or could have reasonably been expected to result in, a catastrophic release of a highly hazardous chemical and address and resolve findings and recommendations resulting from the investigation.
- Develop and implement an emergency action plan.
- Perform a compliance audit every 3 years to evaluate compliance with the OSHA PSM standard.

10.2.2 Activities Involving CDM Smith or CDM Smith Subcontractor Personnel

The following elements are required for any maintenance, repair, turnaround, major renovation, or specialty work processes covered under the PSM standard or work performed adjacent to covered processes.

10.2.3 Owner/Operator Responsibilities

- When selecting a contractor or service provider, the owner/operator shall obtain and evaluate information related to the contractor's H&S performance and their H&S programs.
- The owner/operator of a facility must provide CDM Smith information related to known or potential fire, explosion, or toxic release hazards related to processes or adjacent areas where CDM Smith personnel or CDM Smith subcontractors are expected to work.
- The owner/operator of a facility must explain to CDM Smith applicable provisions of the facilities emergency action plan (i.e., alarm systems, evacuation routes, required emergency equipment, safe places of refuge, etc.).
- The owner/operator of a facility is required to develop site control procedures and practices to control the entrance, presence, location, and exit of contractor and service personnel such as CDM Smith and its subcontractors.
- The owner/operator is required to monitor and periodically evaluate contractor performance and maintain an injury and illness log related to contractor employees.

10.2.4 CDM Smith Responsibilities as a Contractor and Service Provider

- CDM Smith must be able to ensure that each employee assigned to work on or near adjacent processes covered under the standard is trained in the work practices necessary to safely perform their job. CDM Smith resource managers and individual employees are expected to monitor training requirements for work activities they perform and participate in training programs necessary to perform their job safely and meet regulatory requirements. Examples include CSE training, respiratory protection, and proper use of PPE. Resource managers and project managers should only assign employees to tasks that they are qualified to perform correctly and safely.

- The project manager or SHSC should request from the client/owner/operator of a facility, where CDM Smith anticipates having CDM Smith employees or CDM Smith subcontractors working onsite, information related to potential fire, explosion, toxic release, or other potential hazards that CDM Smith employees or CDM Smith subcontractors may encounter while working at the facility. This information should be reviewed with those employees assigned to work at the facility before they perform work at the site. The project manager should provide employees and CDM Smith subcontractors' instructions in applicable provisions of the facility's emergency action plan, including alarms, evacuation routes, accountability procedures, and safe places of refuge.

- The project manager or field site manager is expected to monitor CDM Smith employees and CDM Smith subcontractors to enforce safety and health requirements of the facility and those of CDM Smith.

- The project manager or designee must advise the client/owner/operator of any unique hazards presented by work performed by CDM Smith or its subcontractors and inform the client/owner/operator of the facility of any hazards observed by CDM Smith personnel.

CDM Smith will cooperate as advised by the Office of General Council with any incident/accident investigation initiated by the client/owner/operator.

Section 11

Respiratory Protection

11.1 Purpose and Scope

CDM Smith will implement feasible engineering and work practice controls to limit employee exposures to hazardous chemicals to less than the lower of either the most recent edition of the TLVs published by the ACGIH or the PELs published by OSHA. In some situations, personal respiratory protection may be required to protect employees when the implementation of other controls is not adequate. These procedures are to be implemented whenever respirators are used by CDM Smith personnel. They are intended to protect the health of CDM Smith employees and comply with 29 CFR 1910.134, OSHA's Respiratory Protection standard. The use of personal respiratory protection should be considered in the following situations:

- Whenever airborne exposures to hazardous chemicals are known to exceed or have a significant possibility of exceeding their respective TLVs or PELs and may not be controlled by other means.
- When the implementation of an engineering control creates a greater hazard, e.g., would expose employees for longer than the task itself or expose employees to greater safety hazards.
- Whenever a respiratory protection may be needed on a precautionary basis until air monitoring data or other objective data is available to assess exposures.
- Whenever an employee desires to use a respirator on a voluntary basis and the use of respiratory protection does not create a significantly greater hazard.
- Guidance should be sought during the project planning phases of work from the appropriate HSM when the use of respiratory protection is considered a possibility. The selection of the type of respirator, cartridges, and cartridge change-out schedules should be included in the HASP and reviewed by the appropriate HSM or designee.

11.2 Responsibilities

Project Managers – Project managers are responsible for having these guidelines implemented on projects they manage where CDM Smith personnel use or are expected to use respirators.

Direct Managers and Resource Managers – Direct managers and resource managers should only assign personnel to projects where it is anticipated that respirators will be worn if they are medically qualified, fit tested, and trained to use respirators or will schedule personnel to complete a medical evaluation, fit tests, and training before respirators are used.

Health and Safety Managers – HSMs are responsible for the development and oversight of the implementation of these guidelines and maintaining employee medical, training and fit test records. HSMs will review HASPs and AHAs to assess if the appropriate level of respiratory protection has been identified.

Health and Safety Coordinators – HSCs shall ensure that any employee that is assigned an activity involving the use of respiratory protection devices have been adequately trained, medically cleared to use such devices, and have been fit tested for the respirator that they have been assigned to use.

Medical Consultant – CDM Smith's medical consultant will evaluate medical questionnaires, perform medical evaluations, and issue medical releases regarding employee medical qualifications to use respiratory protection.

Employees – CDM Smith employees are responsible for using respiratory protection in accordance with these guidelines, the manufacturer's instructions, and training.

Subcontractors – Subcontractors to CDM Smith on projects where the use of respiratory protection is anticipated must provide:

- Their own respiratory protection equipment
- Evidence of a written respiratory protection program that meets the requirements of the OSHA respiratory protection standard (29 CFR 1910.134)
- Documentation to confirm employee respirator training, fit tests, and medical evaluations before the use of respiratory protection under contract to CDM Smith

11.3 Procedure

11.3.1 Hazard Evaluation and Selection of Respirators

All projects are expected to execute the H&S planning process described in Section 7. As part of this process, hazards that require the use of respiratory protection and the specific type and level of respiratory protection required should be identified in the HASP or AHA. During the planning process, consideration should be given to the hazardous materials present, the media they are in, the activities that present exposure, and the potential for exposures to exceed TLVs or PELs. This would include factors such as toxicity, physical state of the contaminant, volatility, concentration, work activities being performed, and the proximity to activities that have the potential to generate airborne respiratory hazards. Information contained in **Table 11-1**, OSHA Assigned Protection Factors and **Table 11-2**; Respiratory Protection Devices is also used during the equipment selection process. The determination to use respiratory protection and the type of respiratory protection needed should be reviewed by the appropriate HSM or their designee.

Table 11-1 Assigned Protection Factors[5]

Type of respirator[1], [2]	Quarter mask	Half mask	Full facepiece	Helmet/ hood	Loose-fitting facepiece
1. Air-Purifying Respirator	5	[3]10	50	....	....
2. Powered Air-Purifying Respirator (PAPR)	....	50	1,000	[4]25/1,000	25
Supplied-Air Respirator (SAR) or Airline Respirator					
Demand mode	....	10	50	....	....
Continuous flow mode	....	50	1,000	[4]25/1,000	25
Pressure-demand or other positive-pressure mode	....	50	1,000	....	....
Self-Contained Breathing Apparatus (SCBA)					
Demand mode	....	10	50	50	....
Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)	....	....	10,000	10,000	....

Notes:

1. Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.
2. The assigned protection factors in Table 1 are only effective when the employer implements a continuing, effective respirator program as required by this section (29 CFR 1910.134), including training, fit testing, maintenance, and use requirements.
3. This APF category includes filtering facepieces, and half masks with elastomeric facepieces.
4. The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators and receive an APF of 25.
5. These APFs do not apply to respirators used solely for escape. For escape respirators used in association with specific substances covered by 29 CFR 1910 subpart Z, employers must refer to the appropriate substance-specific standards in that subpart. Escape respirators for other IDLH atmospheres are specified by 29 CFR 1910.134 (d)(2)(ii).

Table 11-2 Respiratory Protection Devices

General Description	Limitations	CDM Smith Requirements
Air-Purifying Respirators		
Half-mask or full facepiece respirator equipped with air purifying units to remove gases, vapors, and particulate matter from the ambient air before its inhalation. Some air-purifying respirators are power operated and provide respirable air to the facepiece (or hood) under a slight positive pressure.	Do not protect against oxygen deficient (<19.5%) atmospheres or atmospheres that are IDLH. The method of purification is generally chemical- or chemical- group-specific so they cannot be used in atmospheres that contain unknown concentrations of unknown materials. Also, cannot be used in atmospheres containing chemicals that present a health risk below their odor or taste thresholds. The useful life of this type of respirator is limited to the concentrations of contaminants, the breathing demand of the wearer, and the removal capacity of the purification medium.	When Level C respiratory protection devices are specified, they will consist of a full-face respirator with an MSA GMC-H (NIOSH approval number TC-23C-1283) cartridge or equivalent. Alternative respirators and cartridges must be approved by the HSM.
Atmosphere-Supplying Respirators		
A respirable atmosphere is supplied independent of the ambient air surrounding the wearer. These devices provide protection against oxygen deficiency and most toxic atmospheres.	Some limitations of atmosphere-supplying respirators include time limitations of supplied air, bulkiness of equipment, and inherent safety hazards associated with working while dragging an airline or while wearing an air cylinder.	SCBAs will be pressure-demand types of devices and, where appropriate, equipped with an emergency escape bottle.

11.3.2 Procurement and Issue of Respirators

Respirators should be obtained from the CDM Smith equipment centers. The equipment will only be issued to those employees who have received training on the use of respirators, are medically qualified, and have a valid fit test. All respirators, cartridges, and associated equipment will be NIOSH approved.

11.3.3 Training

All employees must receive training on the proper selection, use, maintenance, and limitations of respirators before using respiratory protection. Training includes:

- Basic elements of the CDM Smith respiratory protection requirements described above and the OSHA respiratory protection standard
- When and where respirators are needed
- The capabilities and limitations of respirators
- The importance of proper use, maintenance and fit
- Instruction on how to inspect the respirator

- Instruction with respect to donning and doffing respirators
- Instruction on how to perform positive and negative pressure fit checks
- Proper maintenance and storage procedures

Employees who are expected to use a respirator must have initial respirator training before using a respirator. Employees who may use respirators several times over a period of years must have had initial respirator training or a respirator refresher training class within 13 months of use of a respirator.

Employees who have had the OSHA 40-hour hazardous waste operations H&S training and participate in the annual refresher training receive respirator training as a part of participation in hazardous waste H&S training. Employees who do not participate in hazardous waste H&S training must receive specific training on respiratory protection as described above before using respirators. Training may be provided by qualified vendors, an HSM, or their designees. The employee should be provided an opportunity to practice inspection and donning and doffing respiratory protective equipment in a nonhazardous atmosphere before using the respirator in a potentially hazardous environment.

11.3.4 Medical Approval to Use Respiratory Protection

Employees must undergo a medical evaluation by a physician or other licensed health care provider approved by CDM Smith's medical consultant before wearing a respirator.

The medical approval is for a 12-month period. An additional medical evaluation should be performed if:

- An employee reports signs or symptoms related to their ability to use a respirator
- A physician; an employee's project, direct, or resource manager; the HSM; or HSC recommends the employee be reevaluated

Those employees who actively participate in the hazardous waste medical surveillance program and have received a medical clearance to wear a respirator meet the requirements of the medical approval for respirator use.

The CDM Smith medical consultant will provide CDM Smith and the employee with a written recommendation regarding the employee's capability to wear a respirator.

11.3.5 Respirator Fit Tests

Employees must pass a fit test that meets the requirements of 29CFR1910.134, OSHA's Respiratory Protection Standard, with the make, model, and size of respirator they will use before using the respirator in the field or a potentially hazardous environment. Respirator fit tests may be conducted by qualified vendors, or the appropriate HSM or their designees. Fit tests will not be conducted on employees with facial hair that interferes with the facepiece to face fit.

Before the fit test procedure, the employee will be first shown how to put on a respirator, how it should be positioned on the face, how to set strap tension, and how to determine an acceptable fit.

Then he/she will select the respirator that provides the most acceptable fit from a variety of respirator models and sizes.

If the employee finds the fit of the respirator unacceptable, he/she will select a different respirator. Once a respirator has been selected, a fit test shall be conducted. Fit testing can either be qualitative (QLFT) or quantitative (QNFT) as permitted in the OSHA standard. Fit testing is to be performed in accordance with the mandatory procedures contained in Appendix A to 1910.134: Fit Testing Procedures.

11.3.6 Use of Air Purifying Respirators

Personnel issued respiratory protection should use respirators in accordance with the manufacturer's instructions and the following:

- Beards or other facial hair that prevent an adequate face seal are prohibited.
- Inspect the respirator for defects, wear, or other conditions that may inhibit the effectiveness of the respirator before each use. Inspect overall respirator function; tightness of connections; and condition of straps, tubes, valves, cartridges, connections, etc.
- Perform a positive and negative pressure fit test of negative pressure, air purifying respirators before each use.
- Head coverings (e.g., Tyvek hoods or hard hat liners), if used, must not interfere with the respirator-to-face sealing surface.
- Leave the work area at the first indication of facial irritation, discomfort, increased breathing resistance, contaminant breakthrough, or other indication the respirator is not functioning properly and immediately notify the project manager or site H&S officer.

11.3.7 Cartridge Change-Out Schedules

Cartridges for Gases and Vapors – When air purifying respirators are used for protection against gases and/or vapors, a cartridge change-out schedule should be specified in the HASP or AHAs that specifies the use of air purifying respirators. The cartridge change-out schedule should be developed or reviewed by the appropriate HSM and may be determined using information from the following sources:

- The OSHA Respirator Change Schedule
- Cartridge service life spreadsheet calculators
- Information based on respirator manufacturer service life calculators, if applicable
- End of service life indicators on cartridges certified by NIOSH

At a minimum, cartridges should be changed at the start of each work shift or if an employee experiences contaminant breakthrough.

Cartridges for Particulate Contaminants – Respirator cartridges for particulate contaminants should not be used more than one work shift. Cartridges may need to be changed more or less frequently if users experience changes in breathing resistance.

11.3.8 Supplied-Air and Self-Contained Breathing Apparatus

Breathing air for SARs and SCBAs must meet or exceed the requirements for Grade D breathing air (ANSI G-7.1-1989) including:

- Oxygen content (v/v) of 19.5-23.5 percent
- Hydrocarbon content of less than 5 milligrams/cubic meter
- Carbon monoxide content of 10 parts per million (ppm) or less
- Carbon dioxide content of 1,000 ppm or less
- No noticeable odor
- Moisture content in cylinder shall not exceed a dew point of –50 degrees Fahrenheit (°F) at 1 atmosphere pressure

11.3.9 Inspection and Maintenance Procedures for Self-Contained Breathing Apparatus

- Check the cylinder label for a current hydrostatic test date
- Inspect the cylinder for large dents or gouges
- Inspect the cylinder gauge for damage
- Complete a routine inspection
- Fill out the appropriate records with results and recommendations

Routine Inspection: Perform immediately before donning and after cleaning.

Before proceeding, check that the:

- O-ring is present on the conical high-pressure fitting
- Bypass valve is closed
- Mainline valve is closed
- Regulator outlet is not covered or obstructed

Backpack and harness assembly:

- Visually inspect straps for wear, damage, and completeness
- Check the wear and function of the belt
- Check the backplate and the cylinder holder for damage
- Check that the cylinder is firmly attached to the backplate

Cylinder and high-pressure hose assembly:

- Attach the high-pressure hose connector to the cylinder fitting
- Check that the belt and the high-pressure hose are not tangled
- Open the cylinder valve and listen or feel for any leakage around the packing and the hose connection
- Check the high-pressure hose for damage or leaks

Regulator function:

- Cover the regulator outlet with the palm of your hand
- Open the round golden mainline valve
- Note the stoppage of air flow after the positive pressure has built up
- Compare the pressure reading on the cylinder and regulator gauges; they should be the same
- Close the mainline valve
- Remove hand from the regulator outlet
- Open the magenta bypass valve slowly; note its function
- Close the bypass valve

Warning alarm and regulator integrity:

- Cover the regulator outlet again with the heel of your hand
- Open the mainline valve
- While covering the regulator outlet, close the cylinder valve
- Move your hand from the outlet so the air drains out slowly
- Observe the regulator gauge reading at which the low-pressure alarm sounds; it should start sounding at 550 to 650 pounds per square inch (psi)
- Remove your hand from the regulator outlet
- Close the mainline valve
- Blow air into the regulator for 5 to 10 seconds
- Draw air from the outlet for 5 to 10 seconds

If a positive pressure or vacuum cannot be maintained, there is a leak.

Facepiece and corrugated breathing hose:

- Inspect the head harness and the facepiece for damage, serrations, and deteriorated rubber
- Inspect the lens for damage and proper seal in the facepiece; inspect the exhalation valve for damage and dirt buildup
- With the breathing hose separated from the facepiece, inspect the hose connector for damage and presence of a wagon-wheel washer
- Stretch the breathing hose and carefully inspect it for holes and deterioration
- Attach the breathing hose to the facepiece
- Perform a negative-pressure test with the facepiece donned

Storage:

- Refill the cylinder to 2,216 psi
- Close the cylinder valve
- Tightly connect the high-pressure hose to the cylinder
- Bleed the pressure from the high-pressure hose by opening mainline valve
- Close the mainline valve
- Close the bypass valve
- Fully extend all of the straps
- Store the facepiece in a clean plastic bag for protection

11.3.10 Work Practices for Conditions Immediately Dangerous to Life and Health

Except under emergency conditions, all work under work practices for IDLH conditions must be preplanned. The preplanning of such work shall involve the appropriate HSM or his/her designee. Operations that involve the use of SARs or SCBAs by CDM Smith employees must be directly supervised by a CDM Smith hazardous waste supervisor meeting the qualifications described in Section 6.

In those instances where employees must work under IDLH conditions, the following work practices must be followed:

- The appropriate HSM should be notified at least 3 days in advance of any planned work to be conducted under IDLH conditions.
- If such work is required under emergency conditions, the appropriate HSM shall be notified as soon as possible.

- At least one employee or more, if necessary, shall be located outside the IDLH atmosphere. The number of outside employees shall be determined by the division HSM or their designee based on the number of employees working in the IDLH atmosphere, the complexity of the task, and complexity of a potential rescue.
- The outside employee(s) shall remain in visual, voice, radio, or signal line communication with the employee(s) working within the IDLH condition.
- The outside employee(s) shall be equipped with pressure demand SCBAs and appropriate rescue and retrieval equipment to aid employees working in the IDLH atmosphere.

11.3.11 Procedures for Care and Maintenance of Air Purifying Respirators

Cleaning Procedure for Respirators used Daily or More than Once per Week

At the end of each day, respirators used on a daily basis or respirators expected to be used within the next 30 days shall be cleaned and stored as follows:

- Respirator cartridges shall be removed and discarded in labeled bags or containers for final disposal in accordance with a project's waste management procedures.
- Respirators shall be rinsed thoroughly with potable water to remove visible dirt, dust, sweat, saliva, etc.
- Wipe respirator down thoroughly with disposable disinfectant towelette.
- Dry respirator and place in plastic bag for storage.
- Store in a clean, dry location.

Cleaning Procedure for Respirators for Long-Term Storage or Intermittent Use

Respirators that will not be used within 30 days should be decontaminated at the location of use and returned to the Equipment Center to be cleaned and stored as follows:

- Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard and replace or repair any defective parts.
- Wash components in warm (110°F [43 degrees Celsius (°C)] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.
- Rinse components thoroughly in clean, warm (110°F [43°C] maximum), preferably running water. Drain.
- When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for 2 minutes in one of the following:

- Hypochlorite solution (50 ppm of chlorine) made by adding approximately 1 milliliter of laundry bleach to 1 liter of water at 110°F (43°C)
- Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6 to 8 grams ammonium and/or potassium iodide/100 cc of 45 percent alcohol) to 1 liter of water at 110°F (43°C)
- Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer

- Rinse components thoroughly in clean, warm (110°F [43°C] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.
- Components should be hand-dried with a clean lint-free cloth or allowed to air dry.
- Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.
- Inspect the respirator to ensure that all components have been reassembled properly.
- Respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals. They shall be packed or stored to prevent deformation of the facepiece and exhalation valve.

Upon next use, the employee shall perform a self-fit check to ensure the respirator seals and works properly.

Section 12

Confined Space Entry

12.1 Purpose and Scope

This program establishes requirements for safe entry into, work in, and exit from confined spaces such as wet wells, manholes, tanks and vessels, or pipelines. It is intended to protect the health of CDM Smith employees and to comply with 29 CFR 1910.146, OSHA's Permit-Required Confined Spaces standard. CDM Smith employees or subcontractors may enter a confined space only when these or equivalent CSE procedures are followed.

Confined spaces are dangerous because gases and vapors can accumulate to form oxygen-deficient, explosive, or toxic atmospheres. Entry into the following is considered CSE, unless these procedures provide otherwise:

- Tanks
- Vessels
- Manholes
- Pipelines
- Water transmission lines
- Tunnels
- Stilling wells
- Junction structures
- Valve and metering vaults
- Unventilated dry wells
- Limited access wet wells
- Sewers

Depending on the circumstances, some confined spaces may or may not require a permit. CDM Smith treats trenches, vaults, pits, or diked areas as a permit-required confined space if they pose a potential for trapping a toxic atmosphere. Only designated HSCs or HSMs may determine that work in such a space does not need a permit.

When there is no potential for an atmospheric hazard and the physical hazards can be controlled without entry, employees may consider the space a non-permit required confined space, with a designated HSC or HSM approval. The types of spaces where this might apply include clear wells, sedimentation basins, equalization basins, rapid- mix tanks, flocculation tanks, sand filters, and water plant clarifiers.

12.2 Definitions

Confined Space - A confined space is an enclosed space which:

- Is large enough and configured such that an employee can enter and perform assigned work, and
- Has limited or restricted means of entry or exit, and
- Is not designed for continuous employee occupancy

Permit-Required Confined Space - Confined spaces that have one or more of the following additional characteristics:

- Contains or has a known potential to contain a hazardous atmosphere, or
- Contains a material that can engulf an entrant, or
- Has a configuration that could trap or asphyxiate an entrant, or
- Contains any other recognized serious safety or health hazard

Emergency - Any occurrence (including any failure of hazard control or monitoring equipment) or event(s) internal or external to the confined space that could endanger entrants.

Engulfment - The surrounding and effective capture of a person by a liquid or finely divided solid substance.

Entry - The act by which a person intentionally passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and occurs when any part of the entrant's body breaks the plane of an opening into the space.

Hot Work - Operations that could provide a source of ignition, such as riveting, welding, cutting, burning, or heating.

Immediately Dangerous to Life or Health - Any condition that poses an immediate threat of loss of life, may result in irreversible or immediate severe health effects, may result in eye damage, irritation or other conditions that could impair escape from the confined space.

Inerting - Rendering the atmosphere of a confined space nonflammable, nonexplosive, or otherwise chemically nonreactive by such means as displacing or diluting the original atmosphere with a gas that is nonreactive with that space.

Isolation - The process by which a confined space is completely protected from the release of energy or material. Isolation is usually accomplished by such means as blanking or blinding, removal or misalignment of pipe sections or spool pieces, double block and bleed, or lockout and/or tagout.

Limited or Restricted Means of Entry or Exit - When the entry occurs while crawling, through a manhole, by a ladder, or on a rope. Entries on grade, through doorways, or on stairways that meet OSHA standards are not restricted.

Non-Permit-Required Confined Space – A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

Not Designed for Continuous Employee Occupancy - Spaces that are designed for filling with liquids or solids or contaminated air. Most spaces with continuously operating ventilation and lights are designed for human occupancy**.**

Oxygen-Deficient Atmosphere - An atmosphere containing less than 19.5 percent oxygen by volume.

Oxygen-Enriched Atmosphere - An atmosphere containing more than 22 percent oxygen by volume.

12.3 Responsibilities

12.3.1 Management Responsibilities

Client Officers – Client officers are responsible for allocating adequate resources to implement these procedures on applicable projects and ensuring applicable CDM Smith CSE contract requirements are met with both the client and subcontractors.

Project Managers – Project managers are responsible for initial identification of workspaces as potential confined spaces and contacting an HSC or the appropriate HSM to evaluate the hazards associated the space. In addition, project managers should:

- Obtain any available information regarding permit space hazards and entry operations from the client or operator of the space

- Coordinate entry operations with the client, when both client personnel, and/or client subcontractor personnel and CDM Smith personnel and/or CDM Smith subcontractor personnel will be working in or near permit spaces

- Inform the client or operator of the space about the permit space program that CDM Smith will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operation

- Include CSE contract addenda in contracts for subcontractors to CDM Smith involved in CSE operations

H&S Coordinator – The HSC is an individual, designated by the HSM, who has training and experience in the evaluation of CSE hazards. A designate HSC may provide technical advice to project managers on the hazards of confined spaces and reviews confined space permits for completeness and appropriate controls.

Direct Managers and Resource Managers – Direct managers and resource managers only assign personnel that have successfully completed CSE training and are familiar with CDM Smith CSE procedures to projects involving entry into confined spaces.

Health and Safety Managers – HSMs are responsible for the development and oversight of the implementation of this program and advising project managers on the applicability of this program to projects. HSMs will designate CSE coordinators within their assigned units as needed.

12.3.2 Confined Space Entry Team Responsibilities

Unless it is determined that liquids or gases are neither present nor can enter the space during the work period, entry by team members requires, at a minimum, people who fill three roles:

Entry Attendant(s)   Confined Space Entrant(s)   Entry Supervisor

The roles above can be fulfilled with a minimum of two individuals, with one acting as both entry supervisor and attendant or entrant.

CDM Smith achieves confined space safety principally through a detailed plan of cooperation between team personnel in the roles listed in **Table 12-1.**

Table 12-1 Entry Team Requirements

Position	Role
HSC	A CDM Smith employee trained and authorized by the HSM issue entry permits. HSC are listed on the H&S website
Entry Supervisor	An entry team member trained and authorized to sign and certify that entry permit conditions have been met and authorizes entryinto a confined space
Entrant(s)	Entry team members who are trained to perform actual work in confined spaces
Entry Attendant	A team member outside the confined space who monitors conditions inside and outside of the space
Rescuers	Personnel trained in first aid, CPR, and confined space rescue methods who are available to respond to emergencies in confinedspaces

CDM Smith employees may fill these roles only when their HSM determines that they are qualified to do so. The personnel who fill these roles must have completed appropriate training and passed the examination required by these procedures. Documentation of this training is to be maintained on the H&S database.

The persons who fill the roles described above shall perform the tasks described below:

Confined Space Entry Supervisor – The CSE supervisor is the individual at the entrance of the confined space who has the responsibility to ensure the provisions of the CSE permit are met in the field and ultimately authorizes entry into a confined space. The CSE supervisor is responsible for:

- Learning about the hazards of the space, the materials in it, and how to recognize the signs and symptoms of exposure to any toxic materials in the space

- Ensuring that the pre-entry checklist on the permit is complete and that conditions are acceptable before any employee enters the space
- Verifying that rescue personnel are available, are able to provide assistance if needed, and that communications are established to contact rescue personnel
- Signing the entry permit authorizing entry into the confined space
- Immediately terminating the entry if a nonpermitted condition occurs

The CSE supervisor may also serve as an entrant or an attendant taking on the additional responsibilities described below.

Confined Space Entrants – CSE entrants are responsible for the following:

- Learning about the hazards of the space, the materials in it, and how to recognize the signs and symptoms of exposure to any toxic materials in the space
- Reading and understanding the entry permit for spaces they enter
- Removing jewelry before entering spaces (jewelry can compromise their protective clothing, catch on objects, or cause a spark)
- Leaving cigarettes, lighters, and pagers outside the space
- Avoiding hand-to-mouth contact during entry
- Inspecting his/her own and each other's personal safety gear before and during the CSE
- Wearing or carrying appropriate air monitoring equipment during the entry
- Complying with these procedures and all of the conditions of the permit
- Following the directions of the entry supervisor and the entry attendant
- Leaving the confined space and reporting to the entry attendant immediately upon detecting any nonpermitted condition, an alarm, or any other changed condition
- While working in a subsurface space, avoiding looking up

Confined Space Attendants – Attendants are responsible for the following:

- Learning about the hazards of the space, the materials in it, and the signs and symptoms of exposure to any toxic materials in the space.
- Reading and understanding the entry permit.
- Remaining outside the confined space, immediately available, and in communication with entrants.

- Leaving their assigned spaces only when replaced by equally qualified attendants or to save their own lives. If an attendant must leave and there is no replacement available, the entrants must exit the confined space.
- Staying continuously aware of the location and condition of all authorized entrants within the confined space by voice, radio, visual observation, or other equally effective means.
- Staying continuously aware of conditions in the space.
- Ordering entrants to exit the confined space at the first indication of hazardous condition (such as instrument alarms, visible releases, or unusual behavior by the entrants).
- Summoning immediate emergency assistance, if needed.
- Warning unauthorized persons not to enter--or to exit immediately if they have already entered--and advise the authorized entrants and management of entry by unauthorized persons.
- Providing support to rescue workers if requested.
- Keeping objects away from the access hole where they can be accidentally knocked, pushed, or dragged into the confined space. Lower tools or supplies to workers inside by a hand line.
- When the job is finished and all objects have been removed from the confined space, ensuring the space has been closed.
- Securing the safety line of any safety harnesses to an extraction tripod, **never** to movable equipment or a vehicle. Monitor the safety line at all times, taking up extra slack as needed. Keep the safety line away from traffic and moving parts of any equipment.
- Testing the means of non-entry retrieval. You must use a mechanical hoist, unless manual methods would be more effective.

12.3.3 Rescue Personnel – Responsibilities of rescue personnel include:

- Remaining immediately available to provide rescue assistance throughout the entry.
- Not performing other tasks that would interfere with their ability to provide timely rescue assistance if needed. They may perform other tasks during an entry only if those tasks do not impede response to emergencies.
- Notifying the attendant if they become unavailable to provide rescue services.

CDM Smith employees assigned responsibilities as rescue personnel must be qualified in the use of SCBA, be current in first aid/CPR training, as well as having completed CDM Smith CSE training.

Properly trained and equipped rescue units from client plant teams or local fire departments are the preferred sources of rescue services if they can provide timely response. If the client plant rescue team or local fire departments are untrained, unequipped, or unavailable to provide rescue services, appropriately trained CDM Smith personnel may be assigned this role. The designated rescue service must be listed on the CSE permit and be contacted before the entry to verify they are available for rescue services if needed.

12.3.4 Responsibilities on Multi-Employer Confined Space Entries

Team members who do not work for CDM Smith may fill the onsite roles, if they meet the training requirements and agree to fulfill the responsibilities outlined below. A CDM Smith construction inspector, for example, may enter a space while a general contractor's employee serves as the entry attendant, if the general contractor's employee: (1) has completed training equivalent to that shown in this program, and (2) can fully perform the attendant's role.

Only CSE coordinators or HSMs may evaluate the CSE programs of other organizations.

Although client and subcontractor personnel may participate with CDM Smith personnel in a CSE, this program is for the protection of CDM Smith employees. Clients and subcontractors may use these procedures only if they accept all liability for their use. Subcontractors to CDM Smith that are required to enter confined spaces in the absence of CDM Smith employees should be required to submit a copy of their CSE program to CDM Smith for review and provide documentation that employees have had required training.

12.3.5 Responsibilities of Clients/Owners of Confined Spaces

Owners and operators of facilities that contain confined spaces or control access to confined spaces have specific responsibilities that are outlined in the OSHA CSE standard. They include:

- Informing CDM Smith that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements the OSHA CSE standard

- Apprising CDM Smith of the elements, including the hazards identified and their experience with the space, that make the space in question a permit space

- Apprising CDM Smith of any precautions or procedures that they have implemented for the protection of their employees in or near permit spaces where CDM Smith personnel or CDM Smith subcontractors will be working

- Coordinating entry operations with CDM Smith when both client/owner personnel and CDM Smith personnel or CDM Smith subcontractors will be working in or near permit spaces

- Debriefing CDM Smith at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations

The CDM Smith project manager or CSE supervisor should be proactive in soliciting information on the hazards and configuration of confined spaces.

12.4 Procedure

12.4.1 Summary

No CDM Smith employee may enter a confined space unless these procedures, or equivalent procedures approved by the CSE coordinator or the appropriate HSM, are followed. CDM Smith's CSE program includes:

- Training for confined-space team members
- Preparation and review of the pre-entry checklist
- Requirements for appropriate safety equipment
- Coordination with clients
- Accountability of subcontractors
- Monitoring for hazardous conditions
- Procedures for entries
- Ventilation of hazardous gases
- Rescue procedures and equipment
- Periodic reviews of CSE permits and program

CDM Smith work teams who perform entries at client facilities shall coordinate their schedule and entry procedures with the client. They shall also offer to explain our procedures to the client.

12.4.2 Confined Space Entry Permits

Written entry permits issued and signed by an HSC or HSM are required for any entry into, or work in, confined spaces. Work teams that plan to enter a confined space must complete an entry permit form (Exhibit 12-A in Appendix A, CDM Smith CSE Permit). The permit characterizes possible material and energy inputs to the confined space, identifies the personnel, describes the task, describes monitoring, lists required equipment, and identifies emergency contacts.

Authorization for entry occurs when the entry supervisor confirms permit entry conditions in the field, completes the pre-entry checklist on the entry permit, and signs the form in the field.

Most entry permits address a single work project in a single confined space, under specific conditions, for 1 work period not to exceed 8 hours. Permits may be issued for tasks involving a group of spaces with common hazard potential (for example, an infiltration or inflow study on several manholes in a single branch line). Permits may be approved for longer periods if the personnel, tasks, and hazards are not expected to change. In either case, the entry supervisor must still sign a copy of the permit before each entry.

Employees should note that the permit consists mostly of a checklist on which they show the items they will use by marking a “Y” in the boxes that represent the answers they choose. Items not needed should be left blank. Where the form provides a choice (e.g., glasses or goggles) the employee should circle the one chosen. The special instructions space on the permit is used for describing lockout arrangements, coordination with client or contractor personnel, or the qualifications of the emergency rescue personnel.

The HSC or the HSM must be informed of plans to perform hot work (burning, welding, or cutting) or to introduce chemicals to the space, such as cleaning solutions. The HSC determines safety requirements based on the information he or she receives; therefore, providing complete and accurate information is essential to ensuring a complete permit and a safe entry.

When the entry is complete, the entry supervisor shall write “canceled” across the permit and send it to the HSC or HSM who issued it. The HSC should maintain a file of cancelled permits.

12.4.3 Non-Permit Confined Spaces

A space may be determined to be a non-permit-required confined space if it is determined to be (1) free of atmospheric hazards, and (2) all other hazards are completely controlled and conditions cannot change because the sources of material, energy, or possible air contamination are shut off, locked out, or controlled through ventilation. This determination will be made after completion of a confined space pre- entry hazard evaluation that has been reviewed by a designated HSC or HSM.

Confined spaces that have been approved as non-permit confined spaces may be entered without the need for a written permit, an attendant, continuous air monitoring, or onsite rescue equipment.

12.5 Equipment

Table 12-2 below lists typical equipment that could be included in a permit required CSE

Table 12-2 Permit Required Confined Space Entry Equipment

Explosion Proof Lighting	Whole Body Harness
Hard Hat	Tripod
Safety Boots	Winch
Safety Glasses	Retrieval Line or Cable
Goggles	Radios
Protective Coveralls	Fire Extinguishers
Rain Suit	Escape Respirator
Work Gloves	First Aid Kit
Rubber Boots	Traffic Cones
Chemical Protective Gloves	Traffic Barriers
SCBA	Ventilation Blower
SAR	Air Monitoring Instrumentation
Air Purifying Respirator	Duct Tape

The equipment needed for a specific entry and space will depend on the analysis of the hazards of the space and work activities to be conducted during the entry. The CSE permit should be filled out and reviewed with the HSC or HSM.

Circumstances that could affect equipment needs include the following:

- When the air monitoring equipment reveals no contaminants in the air and if there is no potential source of contaminants or oxygen depletion, respiratory protection is unnecessary. It is suggested that portable ventilation and air monitoring equipment be continuously used during these types of entries.
- An SCBA, in stand-by working order, ready for use in emergencies may be required for entries where a readily available outside rescue team cannot be identified.
- Another type of retrieval device may substitute for the tripod and winch assembly.
- Only explosion-safe equipment may be used in confined spaces that pose a potential flammability hazard. Temporary lighting in these spaces, whether electrically or battery operated, must be low-voltage, double-insulated, and explosion-safe. Tools used in confined spaces will be of a nonsparking type unless there is no potential for flammable vapors or gases in the space.

12.5.1 Preparation for Entry

Inspect the area near the confined space for tripping hazards; traffic patterns; and ignition sources such as lit cigarettes, welding, or cutting activities. Provide controls or remove the hazards. If needed, use high-visibility traffic cones, fencing, or barricades, post signs, and assign a team member to control the area. If working in a public roadway, physically protect the entry with a vehicle. Leave some space between the vehicle and the space in the event the vehicle is hit. Isolate the space as described in Section 12.4.6.

Inspect the condition of the entry steps of the confined space. Do not rely on manhole rungs or permanent ladders if the space is often wet. If it appears that the steps will not support your weight or if the confined space contains no steps, provide a ladder and approved hoist, winch, or some other form of ready entry, exit, and fall protection. Only one person at a time may ascend or descend a ladder. Personnel should not carry tools or other objects in their hands while climbing into or out of the confined space. Raise and lower supplies with a rope and bucket. Be sure knots are secure.

Potential emergencies vary with the type of confined space. The rescue equipment, including extraction device and SCBA, should be inspected and tested before space entry.

Co-workers should inspect each other's safety equipment before entry into the confined space to determine if it is properly adjusted and in the proper position. Co-workers should periodically check the integrity of each other's protective clothing and equipment. Problems, such as a tear in the clothing, should be immediately addressed.

When entrance covers are removed, the opening should be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.

If entry into the space requires opening a manhole cover, refer to Section 16.23 of this manual, Guidelines for Removing and Replacing Manhole Covers.

12.5.2 Air Monitoring

Multi-channel gas monitors will be used to test the air in the confined space before and during any confined space entries. This testing will be used to both evaluate the atmosphere within the space and to verify that the atmosphere within the space remains within acceptable ranges during the performance of the entry work. This monitoring is to be performed in the following order; oxygen concentration, flammable and combustible gas concentrations, and toxic gases and vapors. The testing can also include specific tests for additional contaminants such as hydrogen sulfide or specific toxic gases and vapors that could be present in the confined space.

- Before entry, the CSE supervisor must test the atmosphere within the confined space by the procedures described below.
- Start up, check voltage, and field check the meters. Do this on site in a clean area, not near or in the confined space.
- Insert the probe about 12 inches into the space. If possible, check for gas in the space without opening the manhole cover or hatch. Read the meters.
- Extend the probe to the level that workers in the space will occupy; read it again. Allow adequate time for sampled gas to reach the gas detectors before recording the reading.
- To the extent possible, measure gas conditions in pockets, corners, etc.
- Always check the low areas in the space since some gases are heavier than air (hydrogen sulfide is heavier, methane lighter).

The air monitors must be field checked in accordance with the instructions contained in the instrument manual. If the detector fails the prescribed field tests, it must be recalibrated by the procedures established by the manufacturer. No entry is permitted unless the required measurements have been collected.

Because gases and vapors tend to vary in concentration in a confined space, the entrant closest to the suspected source must wear or carry the meter throughout the duration of the entry.

If any of the following conditions exist, the team must attempt to eliminate the condition using appropriate engineering controls such as forced ventilation. If the condition cannot be corrected, entry may be allowed using appropriate respiratory protection. All use of respirators must be in accordance with Section 11, Respiratory Protection. If any of the conditions below develop during the entry, entrants must evacuate the space and an attempt must be made to correct the condition using feasible engineering controls. If the condition cannot be corrected, reentry may be allowed using appropriate respiratory protection following the requirements outlined in Section 11.

- A toxic material is present above half of its permissible exposure limit
- Flammable gas is present above 10 percent of the lower explosive limit (LEL)
- Oxygen is below 19.5 percent or above 23.5 percent

To ensure the safety of employees, the confined space shall be monitored periodically and whenever conditions change, such as temporary stoppage of mechanical ventilation or an increase in ambient air temperature. The required frequency of testing shall be a decision of the entry supervisor, based on the ongoing evaluation of the degree of hazard and recommendations from the HSC.

12.5.3 Isolation of the Space

If material or energy can enter the space during entry, take necessary precautions such as preventing accidental introduction of materials into the confined space and locking or tagging out energy sources. Coordinate all lock out/tag outs with the client/owner of the space. Locks, tags, and other lock out/tag out equipment can be obtained from the CDM Smith equipment centers.

Before employee(s) enter a confined space, the space shall be isolated to preclude the entry of materials and energy by one or more of the following methods:

- Remove a valve or connection in the piping and cap the open end of the piping leading to the confined space. Do this as close to the space as possible.
- Install a full-pressure blank in lines with flanged connections as close to the space as possible.
- Close, lock, and tag at least two valves in the piping leading to the confined space. Lock or tag open a drain valve to the atmosphere and check it to ensure it is not plugged.
- De-energize, lock, and tag machinery, pumps, mixers, or other equipment with moving parts or conductors in the confined space.
- Lock the gates to any dump/chute or loading port that connects with the space, or station a person at the port throughout the duration of the entry.

All employees working in the confined space shall be informed of the means by which the space was isolated. All blanks or caps shall be made of a material compatible with the liquid, vapor, or gas with which it may contact. Sometimes CDM Smith employees will enter a space through which flow cannot be stopped (e.g., some municipal sewers). In these cases, the procedures documented in the permit must provide equivalent protection.

12.5.4 Ventilation

When air monitoring indicates a need for ventilation, provide a fresh air inflow until acceptable air levels are achieved. Provide local exhaust or continuous general ventilation when the work itself (e.g., welding or painting with solvent-based paint) generates a toxic atmosphere. Blowers should be coupled with large-diameter, flexible hose that can direct air into the work area.

The blowers used must meet both the explosion safety and wiring requirements of the National Electrical Code. They shall provide enough airflow to keep contaminant concentrations below 10 percent of the LEL and below 50 percent of the lower of OSHA's permissible exposure levels or the ACGIH threshold limits values.

Gasoline, diesel, or gas-operated equipment used near confined spaces must be oriented so that their exhaust cannot enter the confined space. Exhausted air from the space must be directed away from the work area, downwind, to an area where it presents no hazard.

Ventilation shall continue until acceptable air levels are achieved. Continuing ventilation may be required during entry. All ventilation equipment shall be located upwind to ensure fresh air intake and to ensure that contaminated air does not reach the blower, a potential source of ignition.

12.6 Rescue Procedures

12.6.1 Entrants

Upon detecting an emergency condition, personnel in the confined space must adhere to the following procedures:

- Immediately inform the attendant of the nature of the hazard.
- Exit the space. Assist incapacitated co-workers toward the exit.
- Take no action for which you are not properly trained and equipped. Do not move co-workers who have suffered, or potentially suffered, spinal injury and if in no other danger from the confined space. Only doctors and paramedics may treat spinal injuries.

12.6.2 Attendants

Upon detecting an emergency, the entry attendant must:

- Notify the rescue worker(s).
- Remain outside the confined space to lower necessary rescue equipment into the space and render other necessary assistance.
- Withdraw the worker(s) with the safety line.
- Notify the emergency service providers specified in the permit. Give the location of the emergency and any other pertinent information and guide emergency units to the scene.

12.6.3 Rescue Personnel

Upon notification of an emergency, rescue workers must:

- Report to the confined space as quickly as possible.
- If appropriate, don an SCBA.
- Enter, if safe, to offer assistance to entrants in leaving the space.

- Not enter the space, if they cannot provide assistance with minimal risk to themselves.

Protection of employee life and health is the first priority of the rescue worker. No employee may enter the confined space without a SCBA until all causes of the incapacitation have been eliminated. Rescue workers require protective clothing as resistant as that of the entrants unless otherwise specified in the permit.

Section 13
Ergonomics

CDM Smith has established and implemented, as part of its overall H&S program, a proactive approach with the goal of minimizing musculoskeletal disorders (MSDs). The ergonomic H&S approach consists of the following:

- Management leadership
- Training
- Employee participation
- MSD management
- Hazard information and reporting
- Ongoing evaluation of the approach
- Job hazard analysis and control

13.1 Management Leadership and Employee Participation

As with all aspects of its H&S program, CDM Smith is committed to minimize and/or eliminate ergonomic hazards. Programs are in place to assist all employees in the recognition of hazards associated with various activities, as well as mechanisms to report any negative results from these potential hazards. This is accomplished accordingly:

- Division HSMs and HSCs are responsible for the implementation of the program within their respective divisions and assigned areas of responsibility.
- The HSMs have the authority, resources, information, and training necessary to meet their responsibilities with the H&S program effort.
- Employees are encouraged to report any discomfort or injury resulting from assigned tasks.
- Direct managers and resource managers are responsible for assisting employees in addressing ergonomic concerns and coordinating effort with the division HSMs.
- Concerns with regard to MSDs, as well as other H&S issues, are periodically communicated with all employees through company-wide emails, and office and group meetings.
- Employees are encouraged to promptly report incidents resulting from any exposure to potential hazards. Employees may notify their HSC or HSM via phone, e-mail, and/or completing a first report of injury form.

- Division HSMs and HSCs respond promptly to these reports by performing initial ergonomic assessments and/or having employees evaluated by medical professionals. Information with regard to ergonomics and the H&S program is readily accessible on the CDM Smith H&S home page.
- All employees are continually encouraged to participate in all H&S program efforts.

13.2 Hazard Information and Reporting

CDM Smith periodically provides information to all employees concerning hazard potentials that could be associated with assigned tasks through training programs, Inside/Online articles, company-wide e-mails, and postings on the CDM Smith H&S home page. Topics include MSD hazards, the signs and symptoms of MSDs, the importance of reporting these early, and how to promptly report any discomfort associated with any assigned task. The HSMs are responsible for receiving and responding to any such reports in a timely fashion.

13.3 Job Hazard Analysis

Ergonomic evaluations are performed using a combination of in-house and outside ergonomic specialists. These evaluations:

- Include all employees working in potentially problem areas such as drafters, designers, graphics artists, editors, and administrative staff
- Ask the employees which physical work activities or conditions they associate with potential problems
- Observe the employees performing various activities to identify ergonomic risk factors
- Evaluate the duration, frequency, and magnitude of employee exposure to the risk factors

13.4 Hazard Control

CDM Smith's goal is to effectively control ergonomic risk factors identified as a result of the hazard analyses. These controls include:

- Employee recommendations about eliminating or materially reducing the MSD hazards
- Feasible controls implemented in a timely fashion
- Monitoring by the HSM or HSC to ensure progress in eliminating or materially reducing MSD hazards
- Identifying and reevaluating MSD hazards whenever there is a substantial change

13.5 Training

CDM Smith employees involved with activities that that may present MSD hazards participate in programs designed to train them as to those hazards, CDM Smith's overall ergonomic program effort, and measures available for eliminating or materially reducing the hazards. This training is provided periodically during their employment and it includes employees and supervisors. The training is designed to assist with the recognition of MSD signs and symptoms, how to report these MSD signs and symptoms early, and what MSD hazards exist in their jobs and the methods they should follow to protect themselves.

13.6 Musculoskeletal Disorders Management

CDM Smith takes a very proactive approach to the management of any MSDs. The approach includes a network of clinics and physicians established in proximity to CDM Smith offices, a close working relationship with CDM Smith's workers compensation insurance carrier, and a flexible return to work policy.

13.7 Ongoing Evaluation

The ergonomic effort is periodically evaluated and monitored for overall effectiveness. Employees performing activities that may involve ergonomic risk factors are consulted to assess their views of the program and to identify any significant program deficiencies. The six key program elements are also evaluated to ensure that they remain functioning properly. Corporate HSM and HSMs review the program annually. Significant findings and the status of MSDs are included in reports to senior management.

Section 14

First Aid and Bloodborne Pathogens

14.1 Purpose and Scope

This section describes how CDM Smith provides First Aid Coverage for employees working at its offices and engaged in engineering services and is intended to meet the requirements of the OSHA General Industry Standards for Medical Services and First Aid (29 CFR 1910.151) and the OSHA Bloodborne Pathogens Standard (29 CFR 1910.1030). CDM Smith employees not working for CDM Smith Constructors, Inc. do not engage in construction work and are not subject to the OSHA Construction Industry Standard for Medical Services and First Aid, (29 CFR 1926.50).

14.2 First Aid

14.2.1 Offices

All CDM Smith offices have readily available access to municipal emergency services and are in areas where 911 notification of emergency services are available. Procedures to summon emergency services are provided to new employees during the new employee orientation and are listed in each office's Emergency Plan. In addition, in most cases office security personnel (non-CDM Smith employees) have first aid and/or CPR training and may provide first aid to office occupants. Some CDM Smith employees have voluntarily taken first aid and CPR training and may if they choose to do so, provide first aid to employees who may be injured in the office. However, they are not obligated to do so and providing first aid is not considered part of their job function. (Note: Employees who volunteer to provide first aid are considered "Good Samaritans" and are not subject to the OSHA Bloodborne Pathogens Standard.)

All offices are equipped with a first aid kit appropriate for the number of personnel the kit is intended to serve. First aid kits are located with the office receptionist or kitchen or break area, stored in weatherproof containers containing individually sealed items. There is no one standard Office First Aid kit. Office first aid kits should be checked by the office services or health and safety coordinator.

Employees that voluntarily participate in first aid/CPR training shall be provided information on:

- Hazards associated with bloodborne pathogens and potential routes of exposure,
- Universal precautions, and
- This procedure and the opportunity for post-exposure evaluation and follow up.

14.2.2 Field Engineering Activities

Field engineering projects at locations where access to a medical facility, hospital or other provider of first aid services is not in near proximity shall include an employee or subcontractor employee who is trained in first aid and have access to a first aid kit. (Note: This does not apply to project locations controlled and operated by an owner or third party that have first aid and or emergency services available in proximity to the project location.) Field engineering projects where a first aid trained employee is required by contract shall also have an employee or subcontractor employee assigned to the project site who is trained in first aid and have access to a first aid kit.

First aid supplies shall be stored in a weatherproof container and contain individually sealed items. The First aid kit will be checked by the project manager or his/her designee prior to commencing work at the project location. First aid supplies will be restocked as needed and checked weekly by the project H&S coordinator.

Field engineering project s with potential exposure to corrosive materials shall have available a portable eyewash station or bottle.

14.3 Bloodborne Pathogens

14.3.1 Exposure Assessment

The program applies to all CDM Smith employees who may be occupationally exposed to blood or other potentially infectious materials.

CDM Smith employees do not normally work where skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials would reasonably result from the normal performance of their duties.

There are two job functions that may reasonably expose employees to blood or other infectious materials without regard to the use of PPE;

List of Exposure Determinations:

- Employees assigned to provide first aid services on field engineering projects.
- Employees assigned to solid waste characterization projects.

CDM Smith's medical consultants evaluated the risk associated with potential hepatitis exposure to employees working around sewage and wastewater treatment plants and the merits of providing prophylactic vaccination against hepatitis. They provided a written opinion indicating that the risk of contracting hepatitis did not warrant administration of the vaccine. The full text of the physician opinion is available on the H&S home page.

14.3.2 Exposure Control Plans

Exposure Controls for Field Engineering Project First Aid Providers

Employees providing first aid care in the field shall observe "universal precautions" and use PPE provided in first aid kits. "Universal precautions" are defined as "an approach to infection control. According to the concept of Universal Precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, or other bloodborne pathogens."

First aid kits shall contain appropriate PPE such as latex gloves and face shields. Employees working on field engineering project normally wear safety glasses. Employees shall wear the provided PPE when providing first aid when designated as a field project first aid provider.

In addition, first aid kits shall contain hand sanitizer or disinfectant wipes employees are to use after providing first aid.

Any bandages or blood-soaked materials shall be place in a leak proof plastic bag for proper disposal. Any employee clothing soiled with blood or infectious material while applying first aid shall be cleaned or disposed of and replace at CDM Smith's expense.

Employees who are assigned responsibilities as first aid providers on field engineering projects shall be provided the opportunity be vaccinated for Hepatitis B at CDM Smith's expense.

Employees who are assigned responsibilities as first aid providers on field engineering projects shall be provided information on:

- Hazards associated with bloodborne pathogens and potential routes of exposure,
- Universal precautions, and
- This procedure and the opportunity for post-exposure evaluation and follow up.

14.3.3 Exposure Controls for Solid Waste Characterization Projects

Employees engaged in solid waste characterization projects shall observe "universal precautions" and use appropriate PPE identified in a project H&S plan and provided by CDM Smith. "Universal precautions" are defined as "an approach to infection control.

According to the concept of Universal Precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens."

Employees who are assigned to solid waste characterization projects that come into direct contact waste material shall be provided the opportunity be vaccinated for Hepatitis B at CDM Smith's expense.

Employees who are assigned to solid waste characterization projects shall be provided information on:

- Hazards associated with bloodborne pathogens and potential routes of exposure,
- Universal precautions, and
- This procedure and the opportunity for post-exposure evaluation and follow up.

14.3.4 Post-Exposure Evaluation and Follow-Up

Following a verbal report of an exposure incident, the direct manager, resource manager, HSC or HSM should immediately offer the exposed employee confidential medical evaluation and testing as well as a post-exposure hepatitis vaccination. The results of medical evaluations and test data maintained by CDM Smith's medical consultant will be reported only to the employee or someone they designate in writing. The examining physician will inform CDM Smith's H&S staff or Human Resources manager only if needed to provide adequate support to affected employee.

Post-exposure evaluation and follow-up should consist of the following steps:

- Documentation of the route(s) of exposure.
- Collection and testing of blood of the exposed employee for HBV and HIV serological status with employee's consent. After obtaining the exposed employee's consent for follow-up testing, a sample of his/her blood shall be collected and tested for HBV and/or HIV as soon as feasible following the exposure incident.
- If the exposed employee consents to baseline blood collection but does not give consent at that time for HIV serological testing, the sample shall be preserved for at least 90 days. If, within 90 days of the exposure incident, the employee elects to have the baseline sample tested, such testing shall be done as soon as feasible.
- Post-exposure prophylaxis as recommended by the CDM Smith medical consultant when medically indicated. Note: To have maximum potential effect, initiation of post exposure Hepatitis B vaccination should begin within 48 hours of the exposure incident.
- Counseling.
- Evaluation of reported illnesses.

Following post-exposure evaluation and follow-up, the exposed employee shall be provided with a copy of the evaluating healthcare professional's written opinion.

14.3.5 Incident Reporting

Exposure incident means a specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that results from the performance of an employee's duties. If an exposure incident occurs while the employee is in a work setting or while working for CDM Smith, the following steps should be taken:

- Employees shall notify their direct manager, resource manager, HSC, or division HSM as soon as feasible following an exposure incident.
- Employees shall complete a bloodborne pathogen (BBP) occupational exposure report, available in Exhibit 14-A of Appendix A. Employees shall sign the BBP occupational exposure report and give the signed and completed form to his/her direct manager or resource manager for review and sign-off.
- The direct manager or resource manager shall forward a copy of the report to the division HSM.

14.3.6 Post-Exposure Testing of the Source Individual

- CDM Smith shall make a good faith effort to identify and obtain consent for HBV and HIV testing of the source individual.

- The source individual's blood shall be collected and tested as soon as feasible and after consent is obtained in order to determine HBV and HIV infectivity.
- If consent is not obtained, CDM Smith shall establish that legally required consent cannot be obtained, and the source individual shall not be tested.
- When the source individual's consent is not required by law, the source individual's blood, if available, shall be collected, tested, and the results documented. The condition "if available" applies to blood samples that have been drawn from the source individual for other testing.
- When the source individual is already known to be infected with HBV or HIV, testing for the source individual's known HBV or HIV status need not be repeated.
- Results of the source individual's testing shall be made available to the exposed employee, and the exposed employee shall be informed of applicable laws and regulations concerning disclosure of the identity and infectious status of the source individual.

14.3.7 Training and Medical Records

Training records for all employee training are maintained in CDM Smiths Learning Management System and include date of training, training content, names and job titles. Records are maintained for the duration of employment or 3 years whichever is greater.

The results of medical evaluations and test data maintained by CDM Smith's medical consultant will be reported only to the employee or someone they designate in writing. The examining physician will inform CDM Smith’s H&S staff or Human Resources manager only if needed to provide adequate support to affected employee. Records will be provided in a timely manner at no cost to the employee.

Employees are notified of the right to access to medical records associated with their employment at CDM Smith annually.

14.4. BBP Engineering Controls

Virtually all of CDM Smith’s potential occupational exposure to blood or other infectious materials occurs in field locations where there are no fixed facilities making implementation and maintenance of engineering controls not feasible. Protection from BBP is provided through administration of proper work procedures, use of PPE and follow up

Section 15

Hearing Conservations

15.1 Purpose and Scope

The purpose of this section is to prevent permanent and temporary occupational hearing loss that results from overexposure to noise. This section is applicable to all CDM Smith employees and to all equipment and property used by CDM Smith.

15.2 Definitions

Action Level - An exposure to an 8-hour time-weighted average of 85 decibels measured with a dosimeter or sound-level meter on the A-scale at slow response; or equivalently, a dose of 50 percent measured as per Subsection 15.5.5. The action level is the criterion for instituting noise surveys and employee participation in the audio metric testing program.

Administrative Control - Any procedure that limits noise exposure by control of work schedules.

Audiogram - A chart, graph, or table that results from an audiometric test. An audiogram shows an individual's hearing threshold level as a function of frequency (Hz).

Audiologist - A professional who specializes in the study and rehabilitation of hearing and who is certified by the American Speech, Hearing, and Language Association or licensed by a state board of examiners.

Audiometer - An electronic instrument that measures hearing threshold levels and conforms to the requirements and specifications of the current ANSI Standard S3.6.

Baseline Audiogram - An audiogram against which future audiograms are compared. It may also be described as a reference, pre-placement, pre-assignment, or entrance audiogram.

Biological "Functional" Calibration Check - An audiometric test that uses one or more individuals with known, stable hearing levels to check proper functioning and stability of an audiometer and to identify any unwanted or distracting sounds.

Cut-Off Level - All sound levels at or above the cut-off level are averaged into the calculations that relate to noise exposure. All sound levels below the cut-off level are not included.

Deafness: The condition in which the average hearing threshold level for pure tones at 500; 1,000; 2,000; and 3,000 Hz (frequencies used for speech) is at least 93 decibels (reference ANSI S3.6-1969). This is generally accepted as representing a 100 percent hearing handicap for normal speech.

Decibel (dB) - A unit of measurement of sound-pressure level. The decibel level of a sound is related to the logarithm of the ratio of sound pressure to a reference pressure. The dB has meaning only when the reference is known. The internationally accepted reference pressure used in acoustics is 20 micropascals.

Decibels, A-Weighted (dBA) - A sound level reading in decibels made on the A- weighting network of a sound-level meter at slow response.

Decibels, Peak (dBP) - A unit used to express peak sound-pressure level of impulse noise.

Dose Criterion Sound Level - The average sound level at a given dose criterion length for which the dose represents 100 percent of the allowable exposure. The Federal Occupational Safety and Health Administration (Fed-OSHA) requires a dose criterion sound level of 90 dBA for an exposure duration of 8 hours. ARC has a dose criterion level of 85 dBA for an 8-hour exposure, per Section 29.6.

Dose Criterion Length - The permissible exposure duration (in hours) for a given dose criterion sound level for which the dose represents 100 percent of the allowable exposure.

Eight-Hour Dose - The actual dose (as a percentage) accumulated over the duration of the work shift and based on a regulations defined criterion level and criterion length.

Engineering Control - Any mechanical device, physical barrier, enclosure, or other design procedure that reduces the sound level at the source of noise generation or along the path of propagation of the noise to the individual. This does not include protection equipment such as earmuffs, plugs, or administrative controls.

Hazardous Noise - Noise generated by an operation, process, or procedure that is of sufficient duration and intensity to be capable of producing a permanent loss of hearing in an unprotected person. Generally, this is interpreted as persistent noise levels equal to or greater than 85 dBA or combinations of higher intensities for durations shorter than 8 hours.

Hertz (Hz) - A unit of measurement of frequency that is numerically equal to cycles per second.

Impulsive or Impact Noise - Variations in noise levels that involve peaks of intensity that occur at intervals of greater than 1 second. If the noise peaks occur at intervals of 1 second or less, the noise is considered continuous.

Lav - The average sound level (in dBA) computed for a chosen averaging time duration.

Lav (80) - The average sound level (in dBA) computed for a chosen averaging time duration, using an 80-dBA cut-off level. The 80-dBA cut-off level is used by Fed- OSHA for hearing conservation compliance requirements.

Manager - A broad term that can refer to managers, program and project managers, direct managers, site managers, supervisors, department heads, group heads, branch chiefs, owners, and/or persons that operate in a management capacity or supervisory roll with respect to affected employees.

Medical Pathology - A disorder or disease. For the purposes of this chapter, a condition or disease that affects the ear and should be treated by a physician specialist.

Monitoring Audiogram - An audiometric test obtained at least annually to detect shifts in an individual's threshold of hearing by comparison to the baseline audiogram.

Noise - Unwanted sound.

Noise Dose - A measure of cumulative noise exposure over a stated period, which takes into account both the intensity of the sound and the duration of the exposure.

Noise Dosimeter - An electronic instrument that integrates cumulative noise exposure over time and directly indicates a noise dose.

Noise Hazard Area - Any work area with a noise level of 85 dBA or greater.

Otolaryngologist - A physician who specializes in the diagnosis and treatment of disorders of the ear, nose, and throat.

Representative Exposure - The measurements of an employee's noise dose, or an 8- hour time-weighted average sound level that a qualified person deems representative of the exposure of other employees in that work area or job classification.

Standard Threshold Shift (STS) - An average hearing threshold shift of 10 dB or more at 2,000; 3,000; and 4,000 Hz in either ear. A threshold shift can be temporary or permanent. Temporary threshold shift is a change in hearing threshold, primarily due to exposure to high-intensity noise that is usually recovered in 14 to 72 hours. Any loss that remains after an adequate recovery period is termed permanent threshold shift.

Sound-Pressure Level - The term used to identify a sound measurement (expressed in decibels) obtained with a sound-level meter that has a flat frequency response. This is mathematically equivalent to 20 times the common logarithm of the ratio of the measured A-weighted sound pressure to the standard reference pressure of 20 micropascals (measured in decibels). For use with this standard, slow time response is required in accordance with the current ANSI.S1.4.

Sound-Level Meter (SLM) - An electronic instrument for the measurement of sound levels that conforms to the requirements for a Type II sound-level meter as specified in ANSI S1.4-1971.

Time-Weighted Average (TWA) Sound Level - The sound level that, if constant over an 8-hour workday exposure, would result in the same noise dose as is measured.

TWA (80) - The time-weighted average level that corresponds to a noise dose computed with an 80-dBA cut-off level.

15.3 Responsibilities

15.3.1 Health and Safety Manager

- Develops and implements a hearing conservation program.
- Provides guidance to employees (and their managers) whose jobs expose them to hazardous noise levels.
- Provides periodic noise monitoring when necessary.
- Periodically reviews the hearing conservation program for compliance standards.
- Provides employees access to noise survey/dosimetry records.
- Coordinates the medical surveillance program that includes baseline and annual audiograms.
- Recommends the selection of hearing protection and specifies performance (attenuation) requirements.
- Notifies management of all areas that have been designated as noise hazard areas.

15.3.2 Health and Safety Coordinators

- Reports suspected hazardous noise areas to the HSM so that noise monitoring can be conducted.
- Ensures that employees who work in designated noise hazard areas (or are otherwise exposed to hazardous noise) receive pre-placement, annual, and termination audiograms.
- Ensures that employees in high-noise areas use hearing protection devices.
- Notifies the HSM of any changes in operations that require noise determinations or evaluations.
- Ensures that hearing protection devices that have been approved by the HSM are available for use by employees.
- Ensures that employees who participate in the Hearing Conservation Program attend required training and provides documentation of such training to the HSM.
- Ensures that caution signs are posted in designated noise hazard areas.
- Ensures the design and application of engineering controls recommended by the HSM that are needed to reduce noise exposures to acceptable limits or to the maximum extent feasible

15.3.3 Employees

Responsibilities of employees who work in high noise areas are:

- Wear and maintain hearing protection as required by the HSC
- Cooperate with H&S personnel in activities undertaken to evaluate hazardous noise
- Notify direct or project manager or HSC of areas, operations, or equipment that may produce hazardous noise
- Attend hearing conservation training when necessary
- Participate in the medical surveillance program

15.4 Noise Exposure Limits

Protection against the effects of noise exposure shall be provided when sound levels exceed those in Tables 15-1 and 15-2 below. Noise exposure limits are generally applied as an 8-hour exposure limit of 85 dBA. For exposures of shorter or longer durations, the exposure limit may be adjusted as indicated in the table. Hearing conservation program elements are expected to be implemented whenever employee noise exposures equal or exceed an 8-hour time-weighted average of 80 dBA measured as per Subsection 15.5.5. Hearing conservation program elements include exposure monitoring, audiometric testing, medical monitoring, and training. The dose criterion of 80 dBA for an 8-hour exposure is referred to as the action level

Table 15-1 Continuous Noise Permissible Exposure Limits

Duration (Hours)	Sound Level (dBA)*
16	80
8	85
4	90
2	95
1	100
0.5	105
0.25	110
0.125 or less	115

*Measured on the A-scale of a standard sound-level meter set at slow response.

Table 15-2 Impulse Noise Permissible Exposure Limits

Sound Level (dBP)*	Permitted Impulses/Day
140	100
130	1,000
120	10,000

*Peak sound-pressure level.

15.5 Hearing Protection Methods

15.5.1 Engineering Controls

Where feasible, facilities and equipment will be procured, designed, operated, and/or modified in such a manner as to prevent employee exposure to continuous noise levels above 85 dBA over an 8-hour TWA or impulsive noise above 125 dBP. Any reduction in employee noise exposure, even if not reduced below 85 dBA, is beneficial. If engineering controls fail to reduce sound levels to within the limits of Section 15, hearing-protective equipment and/or administrative methods of noise- exposure protection must be used.

15.5.2 Personal Hearing Protection

- PPE is to be used only temporarily or if engineering controls are not feasible or practical.
- The HSCs shall enforce the use of earmuffs and/or plugs by employees assigned to work in areas where they will be exposed to continuous noise (without regard to duration of exposure) in excess of 85 dBA or to impulse noise in excess of 140 dB. Disposable earplugs and/or earmuffs will be made available for employee use (if desired) if noise exposures under 85 dBA create a nuisance. Earplugs will be provided for the exclusive use of each employee and will not be traded or shared.
- Hearing protectors must attenuate employee noise exposure to a level of 85 dBA or below. Both earmuffs and plugs are required where noise levels equal or exceed 110 dBA. For employees with standard threshold shift, protectors must attenuate exposure to an 8-hour TWA of 80 dBA. Estimation of the adequacy of hearing- protector attenuation should be performed according to the methods OSHA specifies in 29 CFR 1910.95 App B, Methods for Estimating the Adequacy of Hearing Protector Attenuation.
- If reusable preformed earplugs are used, they will be permanently issued to the employee and fitted to the employee under medical supervision. During fitting, the employee will be instructed in the proper method of insertion, storage, and cleaning of the earplugs. Earplugs will be checked during annual medical examinations.
- Earmuffs will be provided for employees when analysis of noise environments shows that the attenuation provided by earplugs is not sufficient to reduce noise exposures below 85 dBA. The user shall inspect earmuffs on a regular basis.
- Special hearing-protective equipment, such as sound-suppression communication headsets, may be used in noise hazard areas. These devices should be inspected regularly. Sound-suppression headsets may not be used if they have been damaged, altered, or modified in any way that affects the attenuation characteristics. If replacement parts (such as ear cup seals) are available, the headsets may be repaired and reused. If sound-suppression headsets are not permanently issued to employees, such equipment must be cleaned and sanitized before reissuance.

15.5.3 Administrative Controls

If hearing-protective equipment or engineering controls are not sufficient to attenuate noise to less than 85 dBA, the duration of time spent in the noise hazard area shall be limited so as not to exceed the exposure limits specified in Section 15.4.

15.5.4 Noise Monitoring

- Measurement of potentially hazardous sound levels shall be conducted when any information, observation, or calculation suggests that an employee could be exposed to a noise level in excess of an 8-hour TWA. This includes, but is not limited to, times when representative exposures need to be documented, when employees complain of excessive noise, or when it is difficult to understand a normal conversation if the speaker and the listener face each other at a distance of 2 feet. Any new equipment, operation, job, or procedure with the potential for creating hazardous noise should be evaluated with regard to noise emissions before startup. All continuous, intermittent, and impulsive sound levels from 80 to 130 dBA will be integrated into the noise measurements.
- Both noise dosimetry and area monitoring will be repeated periodically, or whenever any changes to facilities, equipment, work practices, procedures, or noise-control measures alter potential noise exposures.
- Employees and/or their representatives will be provided an opportunity to observe noise dosimetry and area monitoring activities.
- Areas determined to have noise levels at or above 85 dBA must be posted as noise hazard areas.
- Affected employees (employees whose exposures have been determined to exceed the action level) shall be notified of the results of noise monitoring.

15.5.5 Noise-Measurement Methods

- Sound-level meters must meet Type II requirements of ANSI S1.4 and must be capable of measuring sound in the range of 80 to 130 dBA.
- Noise dosimeters must meet Class 2A-90/80-5 requirements of ANSI S1.25 and be capable of integrating sound levels of 80 dB and above.
- Employee noise doses may be ascertained by using either a noise dosimeter or sound-level meter. If a sound-level meter is used to estimate an employee's dose, the noise survey will include a time and motion study to document the variations in the employee's noise exposure during the working shift. If an employee moves about or noise intensity fluctuates over time, noise exposure is more accurately estimated by personal dosimetry. Regardless of the method chosen, a sufficient number of readings/measurements will be made to accurately reflect noise exposure.
- Employee exposure measurements will be made in such a manner as to accurately represent the actual exposure to noise.

  - When using a noise dosimeter to determine an employee's noise exposure, the microphone will be attached to the employee in the area of the employee's shoulder.
  - When using a sound-level meter, the microphone should be positioned not less than 2 inches nor more than 2 feet from the employee's ear.
  - Measurements will be made with the employee at his/her regular workstations(s).
- Before and after each use, dosimeters and sound-level meters will be calibrated using acoustical calibrators to verify the accuracy of the measuring equipment.
  - If any sound-level meter or noise dosimeter is dropped, or if the microphone receives a sharp impact, a calibration check shall be performed to ensure that it is still working properly before taking additional measurements.
  - Sound-level meters and noise dosimeters that are not working properly or are out of calibration shall not be used to determine an employee's noise exposure

15.6 Medical Surveillance Program

15.6.1 Program Participation

- Whenever an employee is routinely occupationally exposed to continuous noise at or above the action level or to impact or impulsive noise in excess of the limits specified in Section 15.4, the employee shall be enrolled in a medical surveillance program. Employee noise exposure shall be determined without regard to any sound attenuation provided by the use of hearing protectors.
- Each employee placed in a job that required participation in a medical surveillance program shall undergo a physical examination before being assigned to duties that involve exposure to high-intensity noise. The examination shall include a baseline audiogram, a medical examination to determine any preexisting medical pathology of the ear, and a work history to document past noise exposures. The history shall include a detailed review of past work histories and possible occupational and nonoccupational noise exposures.
- When it is discovered that employees have been working where they encounter hazardous noise or incur exposures that exceed the action level and have not had a physical examination, one shall be conducted within 30 days. The audiogram must follow at least 14 hours of no known exposure to sound levels in excess of 80 dBA. This interval should be sufficient to allow recovery from noise-induced temporary threshold shift.
- Personnel who suffer from acute diseases of the ear shall not be placed in hazardous noise areas until the condition has abated, particularly if such diseases preclude the wearing of hearing protectors, cause hearing impairment, or produce tinnitus.

- All employees who are participants in the medical surveillance program must receive an annual audiogram.

- All CDM Smith employees who have participated in the medical surveillance program shall receive a final audiometric examination before termination of employment with CDM Smith, job changes within the installation that would alter noise exposure, transfer to another installation, or retirement.

15.7 Audiometric Testing

15.7.1 Medical Personnel

Medical personnel who perform audiometric tests must be qualified, trained, and knowledgeable in operating equipment used and be under the supervision of an audiologist or physician. If manual audiometers are used, the Council for Accreditation in Occupational Hearing Conservation must certify qualifications of personnel who operate the audiometer. Hearing threshold levels will be determined by audiometers calibrated to zero reference levels of the ANSI S3.6 standard for audiometers.

15.7.2 Pure Tone, Air Conduction Testing

Pure tone, air conduction testing shall be conducted at test frequencies of 500; 1,000; 2,000; 3,000; 4,000; and 6,000 Hz for each ear. Audiometric test equipment shall meet the specification, maintenance, and use requirements of ANSI S3.6. Where a pulsed- tone, self-recording audiometer is used, it will also meet the requirements of 29 CFR 1910.95, Table 3.

- A listening check shall be performed daily before use to ensure that the audiometer is free from distorted or unwanted sounds.

- A functional check shall be performed each day either by using an "acoustical ear" calibrator (dBA sound-level meter with 9A Type Earphone Coupler) or by testing an individual with a known and stable hearing baseline (a "biological check"). A record will be kept of the daily checks. Deviations of 5 dB or more require an acoustical calibration test.

- An acoustical calibration test (using a sound-level meter, octave-band filter set, and a National Bureau of Standards 9A Coupler) shall be performed at least annually (semi-annually for self-recording audiometers), or when a functional check indicates a deviation of 5 dB or more. The acoustical calibration tests shall conform to the requirements of 29 CFR 1910.95, Appendix E. Deviations of 10 dB or more will require an exhaustive calibration.

- An exhaustive calibration shall be performed at least every 2 years, or whenever an acoustical calibration test indicates an error of 10 dB or more. The test will meet the criteria of the current ANSI S3.6 guidelines appropriate for the instrument. Following calibration, the front panel of the audiometer shall be labeled with a tag indicating that is has been calibrated to ANSI S3.6 guidelines and the date of the calibration.

- Rooms used for audiometric testing shall not have background sound-pressure levels that exceed those in the table below. Sound-pressure levels for rooms used for audiometric testing must be checked at least every 2 years

Table 15-3 Maximum Background Sound-Pressure Levels for Audiometric Test Booths

Frequency (Hz)	Sound-Pressure Level (dBA)
500	27
1,000	30
2,000	35
4,000	42
8,000	45

- Employees must receive advance written notification of the need to avoid high levels of occupational and nonoccupational noise during the 14 hours immediately preceding an audiometric test. Properly fitted hearing protectors and/or other hearing-protective devices may be used to prevent excessive noise exposures during this period.
- A physician or other qualified person shall compare annual audiograms with the employee's baseline audiogram to determine if it is valid and if a standard threshold shift has occurred. It is desirable to review the employee's audiogram record for patterns of change over time. When determining if a standard threshold shift has occurred, allowances for the effects of aging to the hearing threshold level may be made using the procedure described in 29 CFR 1910.95, Appendix F. Audiograms referenced to ASA-1951 must be converted to ANSI S3.6-1969 before hearing threshold levels can be properly determined (see the table below for conversion).

Table 15-4 Threshold Audiogram Conversion ASA-1951 to ANSI-1969

Frequency	dB Difference
250	15
500	15
1,000	10
2,000	10
3,000	10
4,000	5
6,000	10
8,000	10

- To convert an ASA-1951 reference threshold audiogram to ANSI-1969, add the difference in values.
- To convert ANSI-1969 to ASA-1951, subtract the values.

- When evaluation of an audiogram indicates that a standard threshold shift has occurred, a retest shall be scheduled within 30 days to determine if the shift is temporary or permanent. A medical evaluation may be warranted at this time to determine if an acute medical condition is a contributing factor.
- An annual audiogram may be substituted for the baseline when, in the judgment of the audiologist, otolaryngologist, or physician who is evaluating the audiogram, the hearing threshold shown on the annual audiogram indicates significant improvement over the baseline audiogram.
- The employee will be notified of audiometric testing results in writing within 21 days of determination of a permanent threshold sift. The subcontract health care provider retained by CDM shall notify the employer and employee in writing of determinations of permanent threshold shifts.

15.7.3 Criteria for Referral to an Audiologist

The following are criteria for referral to an audiologist for more comprehensive testing:

- Average hearing threshold level greater than 25 dB at 500; 1,000; and 2,000 Hz.
- Single frequency loss greater than 55 dB at 3,000 Hz; or greater than 30 dB at 500;
- Difference in average hearing threshold level between the better and poorer ear of more than 15 dB at 500; 1,000; and 2,000 Hz; or more than 30 dB at 3,000; 4,000; and 6,000 Hz.
- Reduction in hearing threshold level in either ear from the baseline or previous monitoring audiogram of more than 15 dB at 500; 1,000; or 2,000 Hz; or more than 30 dB at 3,000; 4,000; or 6,000 Hz.
- Variable or inconsistent responses or unusual hearing loss curves.

15.7.4 Conditions that Require Follow-Up Review of Employees with Hearing Illness and Responses

- When a permanent threshold shift is detected, a follow-up review must be conducted.
- An employee who is not currently using hearing protection shall be provided (and fitted as necessary) with hearing protectors and shall be trained in their use.
- The employee shall be provided/refitted with hearing protectors that offer greater sound attenuation, as warranted, if hearing protectors are already in use.

- The employee shall be trained/retrained on the hazardous effects of noise and the need to use hearing protection.
- The employee's work area shall be investigated to determine if work practices or changes in equipment or procedures can be made that will decrease noise hazards or if changes have resulted in an increase in noise hazards.
- The employee shall be reassigned to work in a low-noise area, as necessary, to prevent further hearing impairment. The employee will continue to participate in the hearing conservation program.

15.8 Noise Hazard Warning Signs

Caution signs that clearly indicate a hazard of high noise levels and the requirements to wear hearing protection shall be posted at the entrance(s) to, and the periphery of, noise hazard areas. Decals or placards with similar statements shall be affixed to power tools and machines that produce hazardous noise levels. Signs and decals shall have wording in black letters on a yellow background (refer to Section 15.11 for noise hazard warning sign specifications).

15.9 Employee Training

- Each employee who participates in the hearing conservation program shall receive annual training. The training must include, but not be limited to:
    - An overview of the CDM Smith Hearing conservation program
    - A review of the effects of noise on hearing (including permanent hearing loss)
    - Noise control principles
    - The purpose, advantages, disadvantages, and attenuation characteristics of various types of ear protectors
    - Instruction on selection, fitting, use, and care of hearing protectors
    - An explanation of the audiometric testing and its purposes
- Personnel will be encouraged to use hearing protectors when exposed to hazardous noise in nonoccupational settings (e.g., from lawn mowers, firearms, etc.).

15.10 Records Maintenance

- Audiogram and noise-exposure records shall be maintained as a permanent part of employee medical records. If noise-exposure measurement records are representative of the exposures of other employees participating in the hearing conservation program, the range of noise levels and the average noise dose will be made a permanent part of the medical records of the other employee as well.
- In addition to audiometric test data, each medical record will, as a minimum, identify:

- The audiometric reference level to which the audiometer was calibrated at the time of testing
- The date of the last calibration of the audiometer
- The name, social security number, and job classification of the employee tested
- The employee's most recent noise exposure assessment
- The date(s) hearing conservation training was received

- Records of the background sound-pressure levels in the audiometric test rooms and data and information concerning calibration and repair of sound-measuring equipment and audiometers (as well as all audiometric test data) will be maintained by CDM Smith 's medical consultant in accordance with OSHA and other applicable regulations.
- Accurate records of noise surveys/monitoring, results of the special noise studies, and records of special actions or engineering controls installed to control noise exposures will be maintained for the duration of the affected employee's employment, plus 30 years.

15.11 Signs and Decals

15.11.1 Noise Hazard Warning Sign Specifications

Warning signs must read:

CAUTION

NOISE AREA

MAY CAUSE HEARING LOSS

USE PROPER HEARING PROTECTION IN THIS AREA

The lettering is almost always all caps, black, and on a yellow background.

15.11.2 Noise Hazard Warning Decal Specifications

Decals must have a yellow background and black lettering (all caps). The decal must be self-adhesive on the side opposite the written warning. The written warning must read:

CAUTION

NOISY EQUIPMENT MAY CAUSE HEARING LOSS

USE PROPER HEARING PROTECTION

The word caution is in yellow lettering with a black background superimposed on the yellow background of the label. As shown, the word caution is 2-point sizes larger than the lettering in the rest of the warning.

Section 16

Work Practices and Guidelines

16.1 Purpose and Scope

The work practices and guidelines in this section describe generally accepted safe work practices and include some activities and practices not regulated by OSHA. CDM Smith managers and employees should follow these guidelines when they are applicable to the projects and scope of work they perform. These work practices and guidelines are written for use by design or professional services employees and may be incorporated by reference in project HSPs when applicable work is performed on a project.

The guidelines may need to be adapted to site- and project-specific needs; however, project-specific activities and plans must meet or exceed OSHA standards and be adequate to protect CDM Smith and subcontractor personnel that work under CDM Smith HASPs. The full text OSHA standards can be accessed from the OSHA home page at http://www.osha.gov.

16.2 Housekeeping

These guidelines are for the establishment and administration of a clean and orderly work environment at field project sites. A continuous housekeeping program strongly tends to prevent accidents. A clean and orderly work environment can be achieved and maintained through ongoing housekeeping efforts undertaken by personnel at all levels. Project managers shall initiate participation in housekeeping activities and good work habits, not only at the end of a work assignment but throughout the evolution of the project.

- To achieve these benefits, the team shall plan the location of equipment and storage facilities to allow the easy flow of personnel, equipment, materials, fire hazards, and to prevent the obstruction of evacuation, firefighting, or rescue activities.
- Store materials in a manner that facilitates access of material handling equipment and personnel handling limitations. Lack of sufficient workspace and storage capacity leads to the potential for accidents and decreases efficiency.
- Avoid storage of flammable liquids, such as paints and thinners, unless they are required for specific project needs. If needed, such storage shall be within a metal storage cabinet that has been labeled and approved for the storage of flammable liquids.
- Continuously maintain work areas in a neat and orderly manner.
- Containers should be provided for the collection of waste, trash, and other nonhazardous refuse. Investigation-derived waste and other waste materials that are potentially hazardous should be stored and labeled in accordance with project-specific procedures that meet regulatory and client requirements.

- Deploy leads, hoses, and extension cords so they do not present tripping hazards and are not subject to contact with moisture or physical stress. Where possible, they should be hung overhead with nonconductive material and kept away from walkways, doors, stairs, and ladders.
- Protect protruding rebar and anchor bolts and conspicuously mark them.
- Clean small spills that create slip hazards and/or flammability hazards immediately and do not leave them unattended.
- Keep walkways, aisles, stairways, and passageways in a clear and unobstructed condition.
- Prohibit eating and drinking in work areas where there is potential exposure to toxic or hazardous materials. Smoking is limited to designated smoking areas where there is no such exposure.

16.3 Manual Material Handling

CDM employees should follow the work practices outlined below when lifting and carrying heavy objects.

- Test any load they are required to lift and compare its weight, volume, and shape to their lifting abilities. Employees shall not attempt to lift beyond their capacity.
- Obtain assistance in lifting heavy objects. Back belts or back braces may be used if desired; however, many ergonomists do not believe that these devices create a benefit or provide protection.
- When two or more persons are involved in a manual lift, one person should provide direction of the lift.
- When two or more persons are carrying an object, each employee, if possible, should face the direction in which the object is being carried.
- When two or more persons carry a heavy object that is to be lowered or dropped, there shall be a prearranged signal for releasing the load.
- The right way to lift is easiest and safest. Crouch or squat with the feet close to the object to be lifted, secure good footing, take a firm grip, bend the knees, keep the back vertical, and lift by bending at the knees and using the leg and thigh muscles. Exercise caution when lifting or pulling in an awkward position.
- Employees should avoid twisting or excessive bending when lifting or setting downloads.
- When moving a load horizontally, employees should push the load rather than pull.
- For tasks that require repetitive lifting, the load should be positioned to limit bending and twisting. The use of lift tables, pallets, and mechanical devices should be considered.

- When gripping, grasping, or lifting an object such as a pipe or board, the whole hand and all the fingers should be used. Gripping, grasping, and lifting with just the thumb and index finger should be avoided.

16.4 Electrical Safety Program

CDM Smith addresses the needs of electrical safety through this program. The program was designed to meet the requirements of the:

- National Fire Prevention Association's standard 70E for electrical safety,
- IEEE 1584 standard for arc flash safety, and
- OSHA's electrical safety standards (29 CFR 1910 subpart S & 1926 subpart K)

If this program differs from any of these standards, the more protective policy will prevail. If any word or phrase in this section is unclear, refer to the definitions in NFPA 70 E. (You can download NFPA 70E from http://subscriptions.techstreet.com/home)

Employees conducting electrical work, or employees whose work may involve contact with electrical devices, must:

- Comply with this and other sections of the CDM Smith health and safety manual AND
- Only do work for which they are "qualified" in accord with this program AND
- Complete the health and safety training required for their tasks in accord with this program AND
- Complete an electrical safety work permit (Exhibit 16A in Appendix A) that includes
    - Lock-out and tag-out, if feasible, to bring their workplace into an electrically safe (zero-state) work condition
    - Shock hazard analysis as required in program
    - Flash hazard analysis as required in program

Qualified Workers

The electrical safety program makes different provisions for "unqualified" and "qualified" personnel. Most CDM Smith personnel are "unqualified" to work on electrical devices or circuits except in an "electrically safe work condition" (an area that is reliably free of electrical charge and current).

CDM Smith allows "unqualified" personnel to perform work:

- Where electrical hazards are effectively absent
- When all electrical parts and devices present are in closed enclosures approved for site conditions.

- Within the limits of their abilities on systems that are in an “electrically safe work condition,”
- Outside the “limited approach boundary” that qualified persons may work inside.

Personnel in the following job classifications may be “qualified” to perform work on live electrical devices and circuits as described in this section if their division approves the qualification and they have also completed an acceptable electrical safety course.

- Electricians
- Electrical engineers
- Health and safety managers
- Instrument & control (I & C) engineers
- Others approved by operating units

Divisions may “qualify” persons for one type of task or situation and not for others. Each employee is responsible to know the limits of his or her qualification.

- CDM Smith employees who have valid licenses to practice as electricians are “qualified” to perform any type of electrical work for which CDM Smith has issued an energized electrical work permit (Exhibit 16A in Appendix A).
- CDM Smith’s electrical engineers are “qualified” to perform tests and collect field data and measurements on any electrical parts and devices for which CDM has issued an energized electrical work permit. They are not “qualified” to modify systems or install electrical parts and devices, except in an “electrically safe work condition.”
- CDM Smith’s I & C engineers and health and safety managers are “qualified” to perform tests and collect measurements on electrical parts and devices operating at no more than 250 volts if CDM has issued an energized electrical work permit. They are not “qualified” to modify systems or install electrical parts and devices, except in “electrically safe work conditions.” They may, however, modify “live” parts of data – management systems that operate at less than 25 volts
- CDM Smith’s electrical engineers, I & C engineers, and health and safety managers are, however, “qualified” to take steps (as conservative as possible) to reduce electrical hazards that become apparent during those tests. Examples of permitted actions might include bending a loose wire away from other conductors and notifying an electrician to properly affix it.
- Presidents of CDM Smith operating divisions may recognize other personnel as “qualified,” with the advice of their safety managers and the employee’s group leader. Of course, these presidents should seek advice from knowledgeable personnel.

Training

Your job title alone does not qualify you to conduct electrical work for CDM Smith. Qualified personnel must also complete appropriate electrical safety training. That electrical safety training should include an understanding of

- Appropriate regulations,
- CDM Smith's Company program, and the
- Information that can be derived from appropriately labeled equipment.

A person who is appropriately trained should understand personal protective equipment including how to select it, don it, doff it, understand its limitations, and know how to maintain it.

Electrically Safe Work Condition

Unqualified personnel may work on electrical devices only when in an electrically safe work condition. Even qualified personnel must work in electrically safe work condition whenever it's possible. An "electrically safe work condition" exists when which no conductor or parts that an employee can contact carries an electrical current that can harm the employee.

The most common examples of "electrically safe work condition" are places where no electricity is present or where all of the electrical devices are enclosed as required to protect unqualified workers by the National Electrical Code.

Lock-Out

If electrical devices are present, and their enclosures will be disturbed, creating a safe work condition may require lock-out or tag-out. Effective lock-out requires you to follow a specific procedure and describe it in your lockout permit. See Exhibit 16B in Appendix A.

Lockout is not complete until a qualified person verifies the safe working condition by verifying the absence of electrical potential. Any meter used for this test must first respond properly to a known live voltage source, followed by a check on the equipment that has been locked out, then again on the known live source. After this test, the qualified person should install Personal Protective Grounds to protect against accidental energization. Wear the appropriate PPE when attaching Personal Protective Grounds. Remove these grounds before re-energizing equipment.

Energized Circuit Work Condition

Some electrical tasks can only be performed while power is still present. Obvious examples include voltage testing and observation of the equipment under load conditions. Such tasks may only be conducted on systems over 50 V only by qualified persons, and only with a CDM Energized Circuit Work Permit (Exhibit 16A).

Permits are issued to qualified persons by CDM Smith's health and safety managers and other persons designated by the corporate health and safety officer. CDM Smith will normally issue an energized circuit work permit for the duration the work requires. For electricians, who will install or modify a specific electrical appliance or device, the permit may allow work for a period of one day. For electrical engineers, who typically conduct studies during preliminary design or consultation, the permit may last up to a month. For I&C engineers, who maintain an instrumentation and control system, the permit may last up to six months.

The purpose of the permit is to identify appropriate personal protective equipment and any applicable procedures. Every energized circuit work permit must include a shock hazard analysis and a flash hazard analysis. If the owner's electrical consultant has conducted these analyses and properly labeled the equipment, CDM Smith personnel may rely on those analyses.

Shock Hazard Analysis

The qualified person should perform a shock hazard analysis to identify the control distances and assess the condition of the electrical system. The purpose is to identify hazardous conditions and the appropriate personal protective equipment for the team inside the controlled work zone.

After the qualified person examines the system and identifies all of the shock hazards present, he or she must determine the appropriate distances for the

- Limited approach boundary
- Restricted approach boundary and
- Prohibited approach boundary (the distance at which the hazards is the same as touching the conductors)

The most convenient way to assess the shock hazard is to rely on a previous characterization of electrical hazards provided by the owner of the location in which you work. Unless you suspect that the previous analysis was incompetent or inadequate, you may base your decisions on the shock hazard labels you see on the electrical equipment.

The most accurate way to assess the hazard risk category is to have CDM Smith's electrical engineering group performed a shock hazard analysis. If you will perform work in one location over a long period, and no previous analysis has occurred, consider asking the electrical engineering group for help. NOTE: This is a service for which CDM Smith should, normally, charge the client. If neither of the two methods above are possible in your work situation, qualified personnel may use the rules of thumb provided below to conduct shock hazard analysis.

During work on live electrical parts, "unqualified" personnel must maintain the following distance (the "Limited Approach Boundary") from the nearest live part.

- 3.5' (42") for non-moving circuits between 50 and 750 volts
- 5' (60") for non-moving circuits between 751 and 15,000 volts
- 6' (72") for non-moving circuits between 15,001 and 36,000 volts
- 8' (96") for non-moving circuits between 36,001 and 121,000 volts
- 10' (120") for movable conductors less than 72,500 volts

During work on live electrical parts, “qualified” personnel must wear electrical PPE on any parts of their body that comes within the “Restricted Approach Boundary” of the nearest live part.

- 1’ (12”) for circuits between 300 and 750 volts
- 2.3’ (26”) for circuits between 751 and 15,000 volts
- 2.6’ (31”) for circuits between 15,001 and 36,000 volts
- 2.8’ (33”) for circuits between 36,001 and 46,000 volts
- 3.2’ (38”) for circuits between 46,001 and 72,500 volts

Any body part that approaches an electrical conductor closer than allowed by the restricted approach zone must be protected with:

- Systems operating at 50 to 500 volts
  - Class 00 material (e.g. gloves)
  - Leather protectors above 250 volts
- Systems operating at 500 to 1000 volts
  - Class 0 material (e.g. gloves)
  - Leather protectors above 250 volts
- Flash Hazard Analysis

The qualified person should conduct a flash hazard analysis to determine the flash hazard present, the associated flash hazard boundary, and the required PPE. Flash hazards are represented by the Hazard Risk Category, which in turn depends on the energy intensity that could affect the hands, face, or body of an exposed employee.

The most convenient way to assess the hazard risk category is to rely on a previous characterization of electrical hazards provided by the owner of the location in which you work. Unless you suspect that the previous analysis was incompetent or inadequate, base your decisions on the arc flash hazard labels you see on the electrical equipment.

The most accurate way to assess the hazard risk category is to have CDM Smith’s electrical engineering group performed an arc flash analysis. These studies are complicated, long in duration, and expensive. If you will perform work in one location over a long period of time, and no previous analysis has occurred, consider asking the electrical engineering group for help. NOTE: this is a service for which CDM Smith should, normally, charge the client.

If neither of the two methods above are possible in your work situation, qualified personnel may use the tables in Exhibit 16C to identify the potential energy intensity associated with common levels of electric service.

The Hazard Risk Categories are shown below.

- Hazard Risk Category 0 (0 -2 cal/cm2)
- Hazard Risk Category 1 (2 -4 cal/cm2)
- Hazard Risk Category 2 (4 – 8 cal/cm2)
- Hazard Risk Category 3 (8 – 25 cal/cm2)
- Hazard Risk Category 4 (25 - 40 cal/cm2)

Personal Protective Equipment

The qualified person conducting the shock and flash hazard analyses should specify the level of protection needed for the work based on the energy that could contact the employee. The following table (from NFPA 70E) describes the ensembles of personal protective equipment that are appropriate.

Work on low-voltage circuits in PLC panels is normally Hazard level 0. Work in PLC panels that may involve contact with conductors operating between 50 and 250 volts is normally Hazard Level 1, unless that conductor is enclosed as required by NEMA codes. A personal protective ensemble for Hazard Level 1 work might include:

- Fire Resistant (FR) long-sleeved shirt and Denim jeans (> 12 oz/yd2) or a FR coverall
- Hard Hat (Type E)
- Safety glasses/goggles
- Electrical safety gloves (ASTM Class 00, minimum) for hands that penetrate the restricted approach boundary
- Insulating blankets (ASTM Class 00, minimum) over any exposed live parts that an employee might inadvertently contact

Risk Category	Protective Clothing required	Examples

0	Non-melting, flammable materials (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a fabric weight at least 4.5 oz/yd2.	- 100% cotton shirt - jeans or - 100% cotton slacks
1	FR shirt and FR pants or FR coverall.	- Nomex clothing - FR pants - Denim jeans*
2	Cotton underwear – conventional short sleeve and brief/shorts, plus FR shirt and FR pants Face shield with side protection, chin cups	Flash suits and Flash hoods must be rated above the flash energy levels expected and meet the appropriate ASTM standard.
3	Cotton underwear plus FR Shirt and FR pants plus FR coverall and Flash hood, or cotton underwear plus two FR coveralls and Flash hood *or* Flash suit and Flash hood.	
4	Cotton Underwear plus FR Shirt and FR Pants plus multilayer flash suit. *or* Flash suit meeting ASTM F1506 and ASTM F2178	

*: The requirement for Fire Resistance (FR) discourages the use of metal zippers and fasteners, and fasteners or fabric made of meltable plastic.

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- Insulating blankets (ASTM Class 00, minimum) over any exposed live parts that an employee might inadvertently contact

Safe Practices for Work with Electrical Equipment

The following work practices can eliminate or minimize the potential for electrical shock, fires, and burns when working or around electrical equipment.

- Treat all electrical circuits as live until their condition has been verified. Treat even low voltages as dangerous.
- Don't wear watches, jewelry, or other conductive objects.

- Use Ground Fault Circuit Interrupters (GFCIs) whenever you use portable electric tools or electrical equipment. If a GFCI outlet is not available, a portable GFCI outlet adapter or GFCI-equipped extension cord should be used. (available from the equipment center)
- Do NOT use your finger or any conductive object to point to circuits, panels, fixtures etc.
- Conduct a tool count before beginning work and after work is completed.
- Visually inspect electrical cords before each use for fraying, cuts, or other damage.
- Do not work with electrical equipment or tools with wet hands or standing in wet areas.

Installation and Maintenance of Electrical Equipment

Electrical equipment can cause shock, flash, or burns, if it is poorly maintained. CDM Smith personnel should observe the following rules of thumb in maintaining tools and equipment.

- Inspect all electrical equipment and tools before each use. Inspect insulation, fixtures, switches, plugs, fuses, etc. Remove from service any faulty equipment and notify the source of the equipment.
- Use the following precautions when using electrical cords:
    - Do not use light-duty (household) extension cords for field work.
    - Do not use extension cords for permanent installations.
    - Keep extension cords properly covered or raised overhead to prevent tripping hazards and damage from traffic.
- Extension cords or cables shall not be secured with staples, hung from nails, or suspended by bare wire
- Only use electrical cords that are equipped with a grounding pole on the plug (three-prong plugs). Never remove a grounding prong from a cord.
- Do not install fuses or circuit breakers larger than the circuit rating.
- Use only approved and properly rated lighting devices and tools in vessels, boilers, and confined spaces.
- All electrical equipment, including motors, generators, wiring, and controls should be installed so that exposed live parts are properly guarded or insulated to provide adequate protection to operating personnel. Avoid open panels, circuit boxes, and exposed wiring.
- In wet locations:
    - Plugs and receptacles shall be kept out of water unless they are an approved submersible type.

- Where a receptacle is used in a wet location, it shall be contained in a weatherproof enclosure, the integrity of which is not affected when an attachment plug is inserted. [Connecting through a ground-fault circuit interrupter (GFCI) is the most effective protection.]

- Temporary lighting strings in outdoor or wet locations (such as tunnels, culverts, valve pits, floating plant, etc.) shall consist of lamp sockets and connection plugs permanently molded to the hard service cord insulation.

Electrical Emergencies

If a rescue from electrical equipment is required, use the following precautions:

- Disconnect the circuit before attempting any rescue.
- Make sure you are standing on a dry surface.
- Use a dry belt, rope, coat, or other non-conductive material to loop over the victim and drag them away from the contact.
- Assess the condition of the victim; do not approach if they are still in contact with the circuit.
- Apply first aid and/or CPR (if you are qualified) and get medical help.

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- Assess the condition of the victim; do not approach if they are still in contact with the circuit.
- Apply first aid and/or CPR (if you are qualified) and get medical help.
- All electrical equipment, including motors, generators, wiring, and controls, should be installed so that exposed live parts are properly guarded or insulated to provide adequate protection to operating personnel. Avoid open panels, circuit boxes, and exposed wiring.
- Portable electrically driven tools must be grounded with a three-wire circuit. Explosion-safe (explosion-proof or intrinsically safe) tools are required in hazardous areas.
- In wet locations

- Plugs and receptacles shall be kept out of water unless they are an approved submersible type.
- Where a receptacle is used in a wet location, it shall be contained in a weatherproof enclosure, the integrity of which is not affected when an attachment plug is inserted.
- All temporary lighting strings in outdoor or wet locations (such as tunnels, culverts, valve pits, floating plants, etc.) shall consist of lamp sockets and connection plugs permanently molded to the hard service cord insulation.

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- Apply first aid and/or CPR (if you are qualified) and get medical help.

16.5 Lockout/Tagout

Although CDM Smith employees normally oversee, rather than do, construction and maintenance work, they sometimes must examine, enter, or service mechanical equipment. In many cases, CDM employees must work in or around energy sources that are owned and operated by clients or a third party. Any locks or tags CDM Smith places on equipment owned and operated by an organization other than CDM Smith must be coordinated with the owner/operator of the equipment.

These guidelines cover inspecting, servicing, and maintaining equipment where unexpected energization or startup of the equipment has the potential to harm employees. These guidelines are intended to prevent accidents and injuries caused by the accidental release of energy.

16.5.1 Definitions

Lockout - The process of preventing the release of material or energy (mechanical, kinetic, potential, electrical, or chemical) from a power source using physical means, such as a lock to maintain an energy isolation device in the safe position, and prevent the inadvertent energization of machinery, equipment, or a system. Lockout usually involves installing a lock at a power (or flow) source so that equipment supplied by that source cannot be operated. Locks may be obtained from the equipment centers. The lockout locks are provided only for lockout purposes and should not be used to lock toolboxes, storage sheds, or other devices.

Tagout - Accomplished by placing a tag on the power source. The tag acts as a warning not to restore energy. It is not a physical restraint. Tags must clearly state Do Not Operate or the like.

Identifying information must be applied by hand. CDM Smith uses tagout as a complement to lockout, not as a substitute.

Authorized Employees - Those who physically lock or tagout equipment for servicing or maintenance. Note that these individuals are not necessarily the people who normally operate the equipment. In some cases, the authorized employee may be a representative of a client or third-party operator.

Affected Employees - Those whose job requires them to operate equipment subject to lockout or tagout, or those employees who work in areas where lockout or tagout is used.

16.5.2 What Must Be Locked or Tagged Out?

Employees should implement these guidelines when they are potentially exposed to hazards such as unguarded moving parts, live electrical systems, or flow of material from open pipes, valves, or other systems. This program applies to nonroutine activities. This includes inspections, repair and replacement work, renovation work, and modifications or other adjustments to equipment that may affect CDM Smith employees. For routine activities, mechanical guarding and electrical insulation are the preferred protection.

Some types of energy that lockout/tagout must be used to control include:

Electrical	Mechanical	Pneumatic
Fluids and gases	Hydraulic	Thermal
Gravity		

16.5.3 Client-Performed Lockout

In most cases, lockouts or tagouts should follow the procedures of the owner and operator because they are more likely to understand any special conditions that apply to their facility and its equipment. CDM Smith should request that the operator either perform or oversee lockouts and tagouts for those work activities that require the lockout or tagout of equipment to protect CDM employees or subcontractors. CDM Smith should request that its employees be allowed to place personal locks on systems under the client's procedures. CDM Smith may rely on lockouts performed by client operators provided:

- The lockout follows an established procedure, as opposed to an improvised one. CDM Smith should ask for and review the procedure before performing the work.
- The CDM Smith employees observe the lockout and believe that it controls all harmful energies

The procedure below describes a procedure that CDM Smith personnel should follow when they are responsible for the lockout.

16.5.4 Lockout/Tagout Procedure

When CDM employees perform a service that requires lockout or tagout, they must coordinate all activities with the operator of the facility. The following actions should be performed to execute a lockout or tagout:

- Shut down the equipment
- Isolate equipment
- Apply lockout devices or warning tags
- Release stored energy to achieve a “zero energy state”

Shut the Equipment Down and Isolate It - First, locate all energy sources that power the piece of equipment you will work on. Always look for hidden energy sources.

Many machines have more than one power source, so you must study the machines and power sources involved. Notify any affected employees before you start a lockout procedure, then shut off each power and material feed to the equipment.

Every power source has its own procedure for shutoff. Shutoff may be accomplished by pulling a plug, opening a disconnect switch, removing a fuse, closing a valve, bleeding the line, or placing a block in the equipment. Generally, follow this sequence of events:

- Shut down the machine by following the normal method for shutdown.
- Turn off the energy at the main power source.
- Turn the machine switch back on to confirm that the power source has been deactivated.
- Attempt to restart the machine to guarantee that the power is shut off, then return the switch to the off position.

Apply Lockout Devices - Make absolutely sure the power cannot be supplied unless you know about it. If several people will work on a piece of equipment, each must apply his/her own lock. Use a multiple lockout device that can accommodate several locks at once. All personal locks shall be accompanied by a tag that identifies the employee(s), is signed and dated by the employee(s) and specifies the work activity being performed. This prevents any accidental startups while another employee may still be working on the machinery.

When all energy sources are locked, inform others of the lockout situation. One way to do this is by applying a tag to the power source. Note: Never use another employee’s lock and never lend your lock to another employee.

Safe Release of Stored Energy - Equipment must be at “zero energy state” before servicing or maintenance work can begin. To achieve a zero-energy state, release energy by draining valves, releasing springs, bleeding air or hydraulic pressure, or supporting elevated weights. When you are finished, test the machine to ensure that all energy was disconnected or released.

Putting the Power Back On - After servicing is finished, make sure all tools and personnel are removed from the area and replace all machine guards. Only then can you remove your tag and lock and reconnect all sources of energy. You may then restart the equipment in accordance with normal startup procedures.

16.5.5 Training and Inspections

Training - All affected CDM Smith employees must be trained in the purpose and use of lockout and tagout before the effort begins. All authorized CDM Smith employees will be trained in recognition of hazardous energy sources, hazardous energy sources in use, and how to follow the lockout/tagout procedure. CDM Smith will conduct retraining when an audit shows deficiencies with the procedures or at the request of a division or resource manager.

Inspections – When these procedures are applied to a single site for more than a month, an inspection must be done by an authorized employee. This inspection should include questions to determine if employees understand the purpose of lockout/tagout, if proper locks and tags are being used, and if established procedures are being followed. Each inspection should be documented with a Lockout/Tagout Inspection Form found in Exhibit 16-B in Appendix A.

16.5.6 Special Conditions

Other Contractors - Contractors and facility operators should inform each other of their lockout/tagout procedures in enough detail for their employees to recognize the function of locks or tags that they may observe during their work. If CDM Smith finds locks or tags on equipment that is related to neither CDM Smith nor client work, the project manager or site supervisor should notify the client. Work should not proceed until the need, function, and ownership of all locks or tags are clarified. Under no circumstance may CDM Smith employees or subcontractors remove locks or tags not placed by CDM Smith or its subcontractors.

Shift and Personnel Changes - The employees ending their shift should remove their locks before leaving. However, they may only remove their lock if it is safe to operate the equipment or another lock is put in place that is under the control of someone on the next shift. When a piece of equipment will remain unsafe until the employee next returns, that lock may remain in place.

Power Sources that Cannot be Locked Out - When a power source cannot be physically locked out, a tagout may be used without locks.

Plug-Supplied Equipment - Any CDM Smith employee who works on an appliance or device that obtains its power through a flexible cord must apply a plug lockout device to its attachment plug or keep the plug in his or her control throughout that effort.

16.6 Compressed Gas Cylinders

CDM Smith employees may occasionally be required to work in industrial, laboratory, or construction work environments where compressed gases are stored or used. In some circumstances, employees may be required to use or handle cylinders directly.

Employees that perform work involving compressed gas cylinders should be familiar with their hazards and safe practices

16.6.1 Identification and Labeling

- All gas cylinders should be clearly labeled with their contents and manufacturer.
    - Do not accept a compressed gas cylinder for use that does not legibly identify its contents by name.
    - Never rely on the color of the cylinder for identification.
- Gas lines leading from a remote compressed gas supply should be labeled to identify the gas, the laboratory or area served, and the relevant emergency telephone numbers.
- Signs should be posted in areas where flammable compressed gases are stored, identifying the substances and appropriate precautions (e.g., HYDROGEN - FLAMMABLE GAS - NO SMOKING - NO OPEN FLAMES).

16.6.2 Engineering Controls/Design Considerations

- Keep hazardous gas cylinders in gas cylinder cabinets or racks, with the exception of cylinders containing a nontoxic flammable gas and cylinders used in fume hood applications. Those must be firmly braced to prevent falling.
- Place a smoke detector adjacent to flammable gas cylinders, connected if possible, to the building alarm system. If possible, interlock smoke detector activation with the shutdown of hazardous gas flow.
- Connect all ducts used to exhaust hazardous compressed gas cylinders or gas- carrying components to a source of exhaust ventilation.
- Place a safety shower or eyewash with a shower wand in areas where corrosive gases are used or stored.
- Make sure that all gas piping is compatible with the gases used and capable of withstanding full cylinder pressure.
- Never lubricate, modify, force, or tamper with a cylinder valve. Use the appropriate regulator on each gas cylinder.
- Use check valves when there is the possibility of backflow into the cylinder.

16.6.3 Using Cylinders

- Always use safety glasses with side shields when handling and using compressed gases, especially when connecting and disconnecting compressed gas regulators and lines.
- Never use a cylinder that cannot be identified positively.
- Never use a cylinder of compressed gas without a pressure-reducing regulator attached to the cylinder valve.

- Use regulators and pressure gauges only with gases and pressure ratings for which they are designed and intended.
- Do not use oil or grease as a lubricant on valves or attachments to oxygen cylinders.
- Never use oxygen as a substitute for compressed air.
- Test cylinders with toxic, corrosive, and pyrophoric gases for possible leaks when receiving, installing, disconnecting, or shipping. Always close the cylinder valve before attempting to stop leaks between the cylinder and regulator.
- Damaged or leaking cylinders should be removed from service and tagged as "DAMAGED or DEFECTIVE."

16.6.4 Storing Cylinders

- Keep cylinders in storage upright, secure, and locked into a compact group.
- Cylinders containing the same gas shall be stored in a segregated group; empty cylinders shall be stored in the same manner.
- Properly secure cylinders with chain, rope, or brackets to prevent falling. Valve protection caps must be fully screwed on unless the container is in active service.
- Protect cylinders stored outside from standing water by providing proper drainage. Where outdoor storage is necessary, an overhead cover is required to avoid rain damage and overheating in sunlight.
- For short-term experiments using hazardous gases, select the smallest cylinder available.
- Return corrosive gas cylinders to the gas supplier within 1 year to avoid regulator and cylinder valve problems due to corrosion.
- Some small cylinders, such as lecture bottles and cylinders of highly toxic gases, are not fitted with rupture devices and may explode if exposed to high temperatures. Use and store these with great care.
- Never place cylinders where they may become part of an electric circuit.
- Avoid areas that are damp or subject to other corrosive materials.
- Do not store flammables, toxic gases, and oxidizers adjacent to each other. Store cylinders in well ventilated locations.
- Areas containing hazardous gas in storage must be appropriately placarded.
- Cylinders in storage must be separated from flammable or combustible liquids and from easily ignitable materials (such as wood, paper, packaging materials, oil, and grease) by at least 40 feet (12 meters) or by fire-resistant partition having at least a 1-hour rating.

- Maintain at least a 20-foot separation between fuel and oxygen cylinders or install a firewall a minimum of 5 feet high with a 30-minute fire rating.
- Empty cylinders must be closed, and the valve cap secured. They must be clearly tagged or marked as MT or EMPTY.

16.6.5 Transporting Cylinders

- Never transport a cylinder with a regulator attached.
- Cylinders larger than lecture-bottle size should be chained or strapped to a wheeled cart during transport to ensure stability.
- Only trained personnel using approved trucks may transport cylinders.
- To protect the valve during transportation, the cover cap should be screwed on hand tight and remain on until the cylinder is in place and ready for use.
- Handle only one cylinder at a time.
- Secure cylinders in a basket or similar device when moving them using a crane or derrick. Do not use slings, ropes, or electromagnets for lifting cylinders. Do not allow cylinders to strike each other.

16.6.6 Piping Incompatibilities and Restrictions

- Do not use copper piping for acetylene.
- Do not use plastic piping in any portion of a high-pressure system.
- Do not use cast iron pipe for chlorine.
- Do not conceal distribution lines where a high concentration of a leaking hazardous gas can build up and cause an accident.
- Distribution lines and their outlets must be clearly labeled as to the type of gas contained.
- Piping systems should be inspected for leaks on a regular basis, preferably weekly. Special attention should be given to fittings.

16.6.7 Emergency Procedures

- Do not remove leaking cylinders from their ventilated enclosures until the leakage has stopped.
- Trip the remote emergency gas shutoff valve/button, if present.
- Close the main cylinder valve to stop or slow the leak. The hazardous gases should be contained in their enclosure until it is clearly safe to approach.

- Do not extinguish a flame involving a combustible gas until the source of gas has been shut off.

16.6.8 Training

Employees that handle or use compressed gases need the following training:

- Safe handling practices for hazardous substances contained in gas cylinders: corrosive, explosive, toxic, etc.
- Identification and signs
- Storage and transportation requirements
- Emergency procedures

16.7 Fall Protection

CDM Smith employees who visit active construction sites may be exposed to falls. A fall exposure is considered to exist when an employee is within 6 lateral feet of a change in elevation of 6 vertical feet or more. Typical exposures can include:

- Excavations
- Roofs
- Leading edge of a surface (floor)
- Floor openings

All employees should use fall protection 100 percent of the time when exposed to a fall in excess of 6 feet or when required by rules such as those of a client or the owner or operator of a facility. Fall protection may consist of any of the following:

- Guardrails
- Safety nets
- Positioning systems
- Warning systems
- Personal fall arrest systems

> ***Employees should not use fall arrest equipment until they have been properly trained. Fall protection training can be arranged by contacting your division HSM. Project managers and site managers shall ensure fall protection is available and used as required for all employees for whom they are responsible and that employees receive adequate training in the use of the equipment.***

The following work practices and guidelines should be considered for protection against falls:

- Before working or walking on a surface, consider the strength and structural integrity of the surface. Can it support employees and any needed equipment or material safely? Employees shall work on those surfaces only when the surfaces have the requisite strength and structural integrity.
- When not protected by any other means of fall protection, such as safety nets or scaffold with proper guardrails, employees shall use full body harnesses, lanyards with double-locking snap hooks, and an adequate anchorage (fall arrest equipment). To achieve 100 percent fall protection, employees may need to use a two-lanyard system and/or vertical or horizontal lifelines, retractable lifelines, or other approved positioning devices.
- Employees shall rig fall arrest equipment so that it minimizes the potential for a fall arrest event or any potential free-fall, lateral swing, or contact with any lower object. Under no circumstances shall fall arrest equipment be rigged so that an employee can free-fall more than 6 feet.
- Anchorage points for fall arrest equipment shall be capable of supporting 5,000 pounds per employee attached. Anchorage points for fall arrest equipment shall be located above the employee's body harness attachment point where practical.
- When vertical lifelines are used, a separate lifeline shall protect each employee. The lifeline shall be properly weighted at the bottom and terminated to preclude a device such as a rope grab from falling off the line.
- Horizontal lifelines should be limited to two persons at one time between supports and maintain a safety factor (strength/requirement) of at least 2.
- Before each use, employees shall visually inspect all fall arrest equipment for cuts, cracks, tears or abrasions, undue stretching, overall deterioration, mildew, operational defects, heat damage, or acid or other corrosion. Equipment showing any defect shall be withdrawn from service. All fall arrest equipment subjected to impacts caused by a free-fall or by testing shall be removed from service. CDM personnel shall use full body harnesses for personal fall protection. Fall protection equipment is available from the field equipment centers.
- Fall arrest equipment should be stored in a cool dry place not subjected to direct sunlight.
- Fall arrest equipment shall not be used for any other purpose, such as towropes or hoist lines
- Proper guardrails shall be installed on open sides of all walkways and runways where the fall distance exceeds 4 feet. Proper guardrails shall be installed on open sided floors where the fall distance exceeds 6 feet. All floor openings or floor holes shall be protected by guardrails or hole covers. If hole covers are used, they shall be strong enough to support the maximum intended load, secured against displacement, and properly labeled.
- When guardrails are used for fall protection, they shall consist of a top rail, intermediate rail, and toeboard. The top rail shall have a vertical height of 42 inches, the midrail shall be

at 21 inches, and the toeboard 4 inches. When wood railings are used, the post shall be of at least 2-inch by 4-inch stock spaced not to exceed 8 feet, the top rail shall be of at least 2-inch by 4-inch stock, and the intermediate rail shall be of at least 1-inch by 6-inch stock. If pipe is used, it shall be at least 1½-inch nominal diameter. If structural steel is used, it shall be of 2-inch by 2-inch by 3/8-inch angles or equivalent. If wire rope is used for railings, it shall have a diameter of at least 2 inches and shall be stretched taut to allow no more than a 3-inch deflection.

- When operating a scissor-lift work platform, the lift shall have guardrails on all open sides, with the door access chains or rails in place.
- Employees operating aerial lifts shall wear a body harness and lanyard attached to the aerial lift. Employees shall not attach the lanyard to an independent structure.
- Employees riding in a crane-suspended work platform shall wear a body harness and lanyard attached to the grab rail of the platform.
- Employees working on or near wall forms or rebar shall wear a body harness lanyard and/or positioning device when exposed to a fall in excess of 6 feet.
- Positioning devices shall be rigged to prevent a free-fall greater than 24 inches.
- Stairs, ladders, or ramps shall be provided for all access ways where there is a change in elevation greater than 19 inches.
- Manila or synthetic rope shall not be used as guardrails.
- Employees shall not stand or sit on guardrails.
- Personal fall arrest systems shall not be attached to guardrail systems.
- If warning lines are used, they should consist of rope, wire, or chain and be flagged at intervals of 6 feet or less with high-visibility material. The lowest point should be no less and 34 inches from the surface, and the highest point should be no more than 39 inches. The warning line should be placed at least 6 feet from the edge.
- Safety net systems should be installed as close to the working surface as practical, but in no case more than 25 feet below the working surface and should extend outward at least 8 to 13 feet depending on the vertical fall distance. Safety nets should be drop-tested after initial installation and at 6-month intervals. The maximum size of net mesh should not exceed 36 square inches nor be longer than 6 inches on any side. Mesh opening should be secure to prevent enlargement.
- Body belts should not be used for personal fall arrest. Full body harnesses are required.

16.8 Excavations

CDM Smith employees who work in or around excavations are exposed to many of the same excavation hazards as construction personnel. CDM Smith employees should learn to recognize these hazards and avoid situations that put themselves, other employees, and subcontractors at risk. Employees should be aware of the following safe excavation work practices.

16.8.1 Pre–Excavation Activities

- Before excavation, the location of any underground utilities such as gas, sewer, electricity, and telephone lines should be determined and marked. In public areas, this can be done using the state's one-call system for utility location. On private property, government facilities, etc., the owner must be asked to locate underground utilities. In some cases, it may be necessary to use nonintrusive subsurface investigation techniques to identify underground utilities and installations.

- Excavations should be conducted under the direction of a "competent person." OSHA defines "competent person" as an individual who, by way of training and/or experience, is knowledgeable of applicable standards, is capable of identifying workplace hazards relating to the specific operation, is designated by the employer, and has authority to take appropriate actions. For excavations, the competent person should be on site and is responsible for ensuring the following:

  - Performing inspections before the start of each shift and as needed throughout the shift to ensure a safe operation

  - Removing employees from the hazardous area when there is evidence of a possible cave-in

  - Identifying and correcting hazards associated with the excavation

- Sometimes the excavation is under control of CDM Smith, and CDM Smith should provide the competent person. Often the excavation is under the control of a contractor, and that contractor should provide the competent person.

- For many excavations an excavation permit must be completed before excavating. The permit is usually generated by the owner/operator of a facility or sometimes a prime contractor. The permit should be completed by the competent person for that excavation.

- Surface encumbrances (buildings, utility poles, pavement, or other structures that may be undermined by the excavation) that have a potential to create a hazard to employees or become subject to physical damage must be removed, supported, or neutralized, as necessary, before the start of any excavation work.

- The competent person must evaluate soil conditions and determine the shoring or sloping requirements for the trench or excavation, based on the soil evaluation. If no attempt is made to determine soil type, excavations shall be sloped at an angle not steeper than 1.5 (horizontal) to 1 (vertical) (34 degrees), or a trench box or other protective system shall be used. For excavations greater than 20 feet (6 meters) in depth, sloping and/or shoring systems must be designed by a professional engineer.

16.8.2 During Excavation

- The competent person must inspect the trench or excavation daily before performing any work within the trench or excavation deeper than 5 feet.
- For trenches less than 5 feet deep, the competent person must inspect and evaluate the potential for a cave-in.
- All excavations that are 4 feet deep or deeper shall have a ladder for access into the excavation with no more than 25 feet of lateral travel in any direction.
- All excavations that are 5 feet deep or deeper and excavations shallower than 5 feet in unstable soil shall be sloped, braced, or shored to prevent cave-ins.
- No material, including trench spoil, may be stored within 2 feet of the edge of the excavation.
- All excavations shall be barricaded with the appropriate barrier tape and other protective devices to protect against falls or other inadvertent entry.
- If possible, excavations should not be left open. If an excavation must be kept open, proper covers, fencing, and security should be provided to prevent public access to the excavation during nonworking hours.
- Tools, equipment, or heavy machinery should not be placed near an excavation where they may affect the structural stability of the walls or fall into the excavation.
- When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system such as barricades, hand or mechanical signals, or stop logs should be used. Where possible, the grade should slope away from the excavation.
- An emergency lighting system should be in place in the event of an electrical failure. This may consist of battery-operated flashlights.
- If employees or small equipment must cross over the excavation, provide walkways or bridges with a minimum clear width of 20 inches, equipped with standard rails, and extending a minimum of 24 inches past each surface edge of the trench.
- For excavation work adjacent to natural waterways, avoid polluting of the water by placing spoil piles away from the water and preventing any accumulation of spoils on slopes.
- Place any environmentally impacted soils on plastic liners and cover the spoil piles to prevent further spreading of the contamination. The liners and covers should be durable enough for the intended period of storage.

For excavations that may contain a hazardous atmosphere, air monitoring should be conducted before entry and periodically during the work to ensure that a safe atmosphere is maintained during excavation work. Air monitoring shall be performed for explosive/flammable vapors, oxygen, and any hazardous gases that may be present such as hydrogen sulfide, carbon monoxide, or other hazardous gases that may be present as a result of activities conducted in the excavation or contaminants in the soil. Use forced ventilation if needed. Acceptable entry conditions are:

Oxygen content: 20.5 percent to 23.5 percent

Flammable atmosphere: <10 percent of the lower explosive limit (LEL)

Hydrogen sulfide: <10 ppm

Carbon monoxide: <25 ppm

Toxic vapor/gases: < one half compound exposure limit

Note: If air monitoring results indicate levels outside of the conditions above, CDM Smith employees and subcontractors should not enter the excavation and contact the safety coordinator or HSM for guidance.

- Heavy equipment, tools, or individuals shall not operate/work within 10 feet of any power line or exposed electrical distribution component unless it has been de- energized and visibly grounded or provided with an effective insulating barrier.
- Workers should wear PPE including a hard hat, safety glasses, and safety boots.
- Water accumulation is not permitted in any excavation that will be occupied. Remove standing water using pumps and continuously monitor the water level and pump operation.
- The competent person must evaluate soil conditions and stability as new soil layers are uncovered.
- Do not stand under any live load, including an excavator bucket.
- Stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials.
- Do not stand in the swing radius of excavation equipment.

16.9 Ladders

The following guidelines should be followed by CDM Smith employees when using ladders.

16.9.1 Portable Ladders

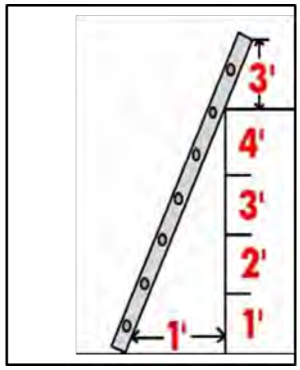
- Ladders should be used to travel from one elevation to another. Except where it is not feasible, work should not be performed from ladders. When it is necessary to perform work at high elevation, scaffolds or mobile lift equipment should be used.
- If it is necessary to work from a ladder:
    - The ladder must be secured to prevent it from slipping or falling.

- When possible, employees working more than 6 feet above grade should wear a body harness and lanyard and tie off to a secure anchor, (not the ladder!) or have another employee hold the ladder.

Before using any ladder it should be inspected. Look for:

- Missing non-skid feet.
- Worn or frayed ropes.
- Cracks in sides or rungs.
- Missing rivets or other fasteners.
- Bent or missing spreaders.
- Bowed or distorted members.
- Loose rungs.
- Any condition that could cause a safety problem.
- Ladders that have fallen or been misused should be checked for excessive dents or damage.
- Ensure that tie-off rope is attached and in good condition.
- Ensure that the spreaders and locking mechanisms on stepladders are in good condition.
- Ensure that hinges move easily and are in good condition.

- Ladders should not be painted. Paint can hide damage and defects.
- Select the correct type of ladder for the job. Only fiberglass ladders should be used at electricity-generating facilities. Only nonconductive ladders should be used for work involving electricity or the use of electrically powered tools. Make sure the ladder is long enough to reach the desired point without compromising recommended safe-use procedures.
- Secure ladders by tying the top or bottom to a fixed structure that will support more than the anticipated total load. Maintain an adequate slope with the base at least one quarter of the length of the ladder away from the supporting structure.
- The ladder should extend 3 feet above any landing you will access.



- Do not leave unattended step or straight ladders standing. They should be closed, lowered to the ground, and placed where they do not present tripping hazards.
- Keep the area around the base and top of the ladder free of tripping hazards, and barricade the area if the base or top projects into a passageway.
- When either the length or the weight of a ladder makes it difficult to handle, two people should raise and secure the ladder. One should secure the feet while the other walks under the ladder from the opposite end until it is raised enough to place or move. Raise the extension, if needed. Reverse the process for lowering the ladder.
- Extension ladders must be equipped with necessary irons, locks, and hooks and assembled so the sliding (upper) section is on top of the base (lower) section. In addition, extension ladder sections should overlap at least 3 feet. If the ladder extends more than 4 feet above the top tie-off, place a barrier or flag on the ladder to prevent personnel from climbing beyond a safe point.
- Ensure that shoes/boots are free of mud, oil, or grease before ascending or descending a ladder. Ladder rungs must be cleaned immediately if they become soiled to reduce slipping hazards.
- Employees should use a tool pouch or bucket-and-line to raise or lower materials, rather than carrying them while ascending or descending a ladder.
- Only one employee may climb or descend a ladder at a time.
- When climbing or descending a ladder, face the ladder and maintain three points of contact at all times. (i.e., two feet and one hand, two hands and one foot.)
- Straight ladders should not be climbed beyond the third step from the top.
- Excavations and trenches more than 4 feet deep should have a ladder (or ladders) that extends at least 3 feet above the ground surface placed so that personnel will not travel more than 25 feet horizontally to get to a ladder.
- When storing ladders, take the following precautions:

- Ladders stored horizontally should have support in a sufficient number of places to prevent sagging and permanent set.
- Tie together or secure ladders that are stored vertically to keep them from falling into aisles or equipment.
- Do not store wooden ladders near radiators, stoves, or other heat sources that could dry the wood and cause deterioration.
- Do not store wooden ladders near steam lines or other places where they are kept wet or damp enough to rot wood.
- Clean ladders after every use before returning them to storage. Remove all mud, oil, and grease.

16.9.2 Stepladders

- Stepladder legs should be fully spread with the spreader bars locked in place.
- Stepladders should not be used as straight ladders.
- The top two steps should not be used.
- Do not leave tools or materials on the top shelf of a stepladder, remove them before descending a ladder and/or moving it.

16.9.3 Fixed Ladders

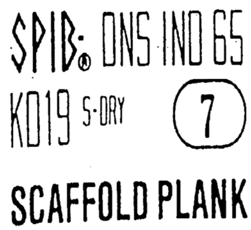
- Fixed ladders more than 20 feet high must be caged unless other fall prevention safety devices are installed and used. Fixed ladders with cages exceeding 20 feet high shall have landing platforms installed every 30 feet. Use of the body harness and lanyard described in Section 16.9.1 would meet this requirement.
- Fixed ladders should be securely attached to an immobile structure and attachments should be inspected annually for signs of deterioration or detachment. Repairs must be made immediately.

16.10 Scaffolds

The following guidelines should be followed when working from scaffolds:

- All scaffolds should be checked before use to ensure it is of sufficient strength and rigidity to safely support the weight of persons and material to which it will be subjected. Scaffolds should be designed and erected to be able to support its own weight and at least 4 times the maximum intended load applied or transmitted to it.
- Questions regarding the capability of a particular scaffold should be addressed to the competent person responsible for the scaffold. Check to see if a scaffold tagging system is in use at the site.

- Scaffolds over 6 feet in height require a standard guardrail. If a standard guardrail is not feasible, employees should use another form of fall protection such as a personal fall arrest system (harness).
- Scaffold planks should be secured in place and extend the end supports by at least 6 inches and (unless they are cleated) no more than 12 inches.
- Scaffold platforms and ramps should be at least 18 inches wide.
- Wooden scaffold planks should be marked for use as scaffold planking and should not be painted (see below).



Grade stamp courtesy of Southern Pine Inspection Bureau

Grade stamp courtesy of West Coast Lumber Inspection Bureau

- Footing and anchorage points for scaffolds should be sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick, or concrete blocks should not be used to support scaffolds or planks.
- Screw jacks should not extend more than 12 inches.
- Scaffolds should be erected level, plumb, and braced to prevent swaying and displacement.
- Ropes should not be used as guardrails.
- Do not stand on any object to increase reach when on a scaffold, including ladders, step stools, etc.
- The installer of the scaffold should survey and clear the scaffold site of debris that would endanger secure footing for the scaffold or cause a rolling scaffold to tip over.
- Use ladders for access to scaffold platforms. Scaffold rails or braces may only be used if specifically designed by the manufacturer as an access ladder.
- Scaffolds that are 3 times higher than the smallest base dimension must be secured to the building or other solid structure at the second lift and every other lift thereafter.
- Rolling scaffolds may be used only on smooth, level surfaces unless the wheels are contained in wooden or channel-iron runners that are level and stabilized. The following precautions must be observed when working on mobile scaffolds:

- Check overhead clearances before moving scaffolds. Maintain safe clearance from electrical lines.
- Remove or secure tools and materials on the deck before moving a rolling scaffold. Do not ride a rolling scaffold while it is being moved.
- Apply the force as close to the base as practical to move a rolling scaffold.
- All wheels and casters on rolling scaffolds must have a positive locking device, securely fastened to the scaffold, to prevent accidental movement.
- Casters or wheels must be locked when the scaffold is in use.

16.11 Mechanized Personnel Lifts

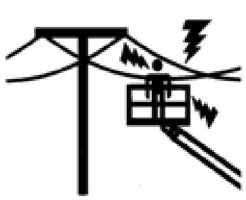
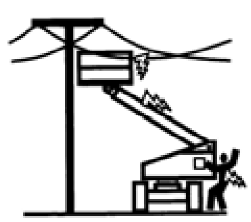
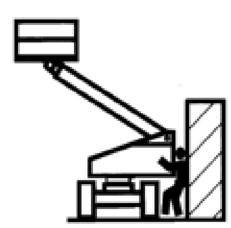
CDM Smith personnel work periodically from mechanized lift equipment. The following information is summarized from the JLG Industries, Inc. web site at: http://www.jlg.com/ and provides recommended work practices to be implemented when working from mechanized personnel lifts. Instructions for CDM Smith employees who will ride a lift operated by another organization appear at the end of the section.

16.11.1 Pre-Operation

- Only trained, authorized, and qualified personnel may operate lift equipment. They should demonstrate an understanding of safe and proper operation and maintenance of the unit.
- Precautions to avoid all known hazards in the work area must be taken by operators and their supervisor before starting the work.
- Perform a prestart inspection and function check before placing the machine into operation.

16.11.2 Power lines

- Maintain safe clearance from electrical lines and apparatus. The machine does not provide protection from contact with or proximity to an electrically charged conductor.
- Maintain a clearance of at least 10 feet between any part of the machine or its load and any electrical line or apparatus carrying up to 50,000 volts. One foot of additional clearance is required for every additional 30,000 volts.
- Allow for boom sway, rock, or sag and electrical line swaying in estimating these distances.

16.11.3 Wind and Temperature

- Do not add notice boards or similar items to the platform. The addition of such items increases the exposed wind area of the machine.
- Do not operate machine when wind conditions exceed 30 miles per hour (mph).
- Some mechanized lifts can only be operated in nominal ambient temperatures of 0°F to 104°F. Consult the manufacturer to optimize operation outside this range.

16.11.4 Signs and Warning Labels

- Read and obey all dangers, warnings, cautions, and operating instructions on machine and in the operators and safety manual.
- Be familiar with location and operation of ground station controls.
- Do not operate any machine on which danger, warning, caution, or instruction placards or decals are missing or illegible.

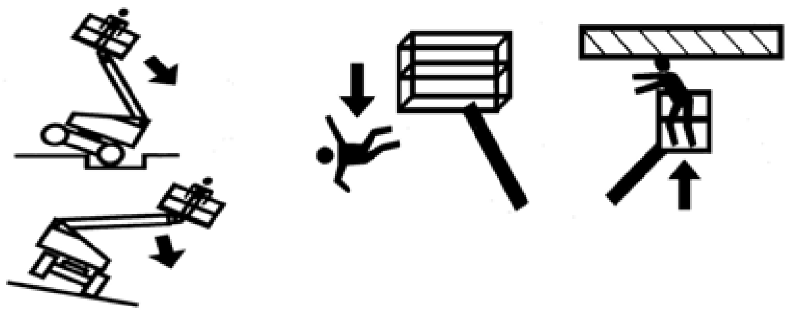
16.11.5 Driving and Crushing Hazards

- Watch for obstructions around machine and overhead when driving.
- Always position boom over rear (drive) axle in line with direction of travel. Remember, if boom is over front (steer) axle, direction of steer and drive movement will be opposite from normal operation.
- Do not use high-speed drive when in restricted or close quarters, or when driving in reverse.
- Keep nonoperating personnel at least 6 feet away from machine during driving operations.
- Check travel path for persons, holes, bumps, drop-offs, observations, debris, and coverings that may conceal holes and other hazards.

16.11.6 Operation

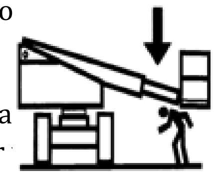
- Read and understand the manufacturer’s operating manual.
- Operation with boom raised is restricted to a firm, level, and uniform surface. Ensure a firm, level, and uniform supporting surface before raising or extending boom.
- Never position ladders, steps, or similar items on unit to provide additional reach for any purpose.
- When riding in or working from platform, both feet must be firmly positioned on the floor.
- Personnel should wear a full-body harness and lanyard of a length that prevents a fall arrest event, (i.e., short enough so they are unable to fall over the railing).

- Check clearance above, on sides, and bottom of platform when raising, lowering, swinging, and telescoping boom.
- Never slam a control switch or lever through neutral to the opposite direction. Always return switch to neutral and stop, then move switch to the desired position. Operate levers with slow, even pressure.



16.11.7 Barricading, Crushing Hazard

- The operator is responsible for avoiding operation of the machine over ground personnel and warning them not to work, walk, or stand under a raised boom or platform. Po barricades or warning tape/cones.



- Ensure that operators of other overhead and floor machines are aware of the aeria platform's presence. Disconnect power to overhead cranes. Position barricades or tape/cones.

- Keep personnel away from pinch points. Position barricades or warning tape/cones.

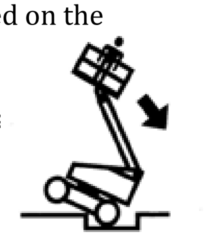
16.11.8 Transfer to a Structure, Falling Hazard

- To avoid falling, use extreme caution when entering or leaving platform above ground. Enter or exit through gate only. Platform floor must be within 1 foot of adjacent safe and secure structure. Allow for platform vertical movement as weight is transferred to or from platform.

- Transfers between a structure and the aerial platform expose operators to fall hazards. This practice should be discouraged wherever possible. Where transfer must be accomplished to perform the job, two lanyards with an approved fall protection device will be used. One lanyard should be attached to the aerial platform. The other to the structure. The lanyard that is attached to the aerial platform should not be disconnected until such time as the transfer to the structure is complete. Otherwise, do not step outside of platform.

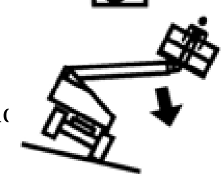
16.11.9 Machine Capacity and Tip Hazards

- Ensure that ground conditions are adequate to support maximum tire load indicated on the tire load decals located on the chassis adjacent to each wheel.



- Never exceed manufacturer's rated platform capacity - refer to capacity decal on m Distribute loads evenly on platform floor.

- Do not carry materials on platform railing.



16.11.10 Improper Use

- Do not remove, modify, or disable footswitch by blocking or any other means. Do n disable safety interlocks or limit switches.

- Never "WALK" the length of the boom to gain access to or leave platform.

- Do not use the lift, swing, or telescope functions for the boom to move either the machine or other objects.

- Never use boom for any purpose other than positioning the platform containing personnel, tools, and equipment.

- Do not use the boom as a crane. Structural damage or tipping may occur.

- Never operate a malfunctioning machine. If a malfunction occurs, shut down the machine, tag it as DO NOT USE, and notify your project manager or direct manager.

- Do not assist a stuck or disabled machine by pushing or pulling except by pulling at chassis tie-down lugs.

16.11.11 Towing and Hauling

- Do not tow a machine except in an emergency. See the applicable section in the applicable operators and safety manual for emergency towing procedures.

- Lock turntable before traveling long distances or before hauling machine on a truck or trailer.

16.11.12 Work on Lifts Operated by Others

- When CDM Smith personnel board a lift operated by another organization (e.g., when we inspect work that that organization accomplished using the lift), the CDM Smith representative may either:

  - Complete the training required by the operator and manufacturer and operate the lift in accordance with the previous sections

  - Complete any training needed to act as a passenger and verify that the operator complies with the previous sections for the duration that the CDM Smith representative will be exposed to the hazards of the lift

16.12 Tools and Power Equipment

16.12.1 Hand Tools

CDM employees who have a need to use basic hand tools should use the following work practices:

- All tools used on CDM Smith projects, regardless of ownership, shall be of an approved type and maintained in good condition. Tools are subject to inspection at any time. The project manager has the authority and responsibility to condemn unserviceable tools, regardless of ownership.

- Tag defective tools to prevent their use or removal from the job site.

- Use the proper tool for the job performed.

- Do not use hammers with metal handles, screwdrivers, knives with metal continuing through the handle, and metallic measuring tapes on or near energized electrical circuits or equipment.

- Do not throw tools from place to place or from person to person. Tools that must be raised or lowered from one elevation to another shall be placed in tool buckets or firmly attached to hand lines.

- Do not place tools unsecured on elevated places.

- Dress, repair, or replace all impact tools such as chisels, punches, drift pins, etc., that become mushroomed or cracked before further use.
- Use suitable holders or tongs, not the hands, to hold chisels, drills, punches, ground rods, or pipes that are struck by another employee.
- Do not use shims to make a wrench fit.
- Do not use wrenches with sprung or damaged jaws.
- Do not use pipe or other means to extend a wrench handle for added leverage unless the wrench was designed for such use.
- Use tools only for the purposes for which they have been designed.
- Store and handle tools with sharp edges so that they will not cause injury or damage. They shall not be carried in pockets.
- Use eye protection when using or working around impact type tools (e.g., hammer, chisel, axe, hatchet, etc.).
- Replace wooden handles that are loose, cracked, or splintered. The handle shall not be taped, glued, or lashed with wire.
- Keep all cutting tools such as saws, wood chisels, knives, or axes in suitable guards or in special compartments.
- When using such tools as screwdrivers and wrenches, avoid using your wrists in a bent, flexed, extended, or twisted position for long periods of time. Employees should maintain their wrists in a neutral or straight position.
- Do not leave tools lying around where they may cause a person to trip or stumble.
- When working on or above open grating, use a canvas or other suitable covering to cover the grating to prevent tools or parts from dropping to a lower level where others are present, or barricade or guard the danger area.
- Do not depend on the insulation on hand tools to protect users from shock.

16.12.2 Electric Tools

CDM employees who have a need to use electric power tools should use the following work practices:

- The non-current carrying metal parts of portable electric tools such as drills, saws, and grinders shall be effectively grounded when connected to a power source unless the tool is an approved double-insulated type or the tool is connected to the power supply by means of an isolating transformer or other isolated power supply, such as a 24-volt DC system.

- All power tools shall be examined before use to ensure general serviceability and the presence of all applicable safety devices. The electric cord and components shall be given a thorough examination for cracks, exposed wires, or other defects.
- Power tools shall be used only within their capability and shall be operated in accordance with the manufacturers' instructions.
- The use of eye protection is required when using or working around power tools.
- Operators should take care to use appropriate hand positions on cutting tools such as saws, drills, or grinders to avoid hand injury.
- All tools shall be kept in good repair and disconnected from the power source while repairs are being made.
- Electrical tools shall not be used where there is a hazard of flammable vapors, gases, or dusts until that hazard is firmly under control.
- GFCI should be used with all electric power tools.
- All guards and safety interlocks with which the tools were purchased shall be in place and in working order.
- Any tool that is identified as defective should be tagged "not for use," and set aside for repair and/or discarded.
- Do not wear loose or frayed clothing while operating power tools and equipment. Hair should not stick out from hard hats.
- Do not use electrical cords to transport, suspend, hoist, or lower tools.
- Do not allow power cords to lie in water.
- Disconnect rotating tools from the power source before adjusting, servicing, or cleaning them. Follow the lockout procedure described in Section 16.5.
- Do not modify tools.

16.12.3 Pneumatic Tools

CDM employees that use pneumatic power tools should use the following work practices:

- Compressed air and compressed air tools shall be used with caution
- Pneumatic tools shall never be pointed at another person.
- Pneumatic hose connections should be secured by some positive means to prevent them from becoming accidentally disconnected. Chicago fittings have wire holes to allow such security.

- Pneumatic power tools shall be secured to the hose by some positive means to prevent the tool from becoming accidentally disconnected.
- Safety clips or retainers shall be securely installed and maintained on pneumatic impact tools to prevent attachments from being accidentally expelled.
- Compressed air shall not be used for cleaning purposes except when reduced to less than 30 psi and then only with effective chip guarding and PPE.
- Compressed air shall not be used to blow dust or dirt from clothing (or skin).
- The manufacturer's safe operating pressure for hoses, pipes, valves, filters, and other fittings shall not be exceeded.
- The use of hoses for hoisting or lowering tools shall not be permitted.
- All compressed air hoses exceeding 30 psi shall have a safety device at the source of supply or branch line to reduce pressure in case of hose failure or disengagement of a connection.
- Before making adjustments or changing air tools, the air shall be shut off at the air supply valve ahead of the hose. The hose shall be bled at the tool before breaking the connection. Disconnection at the quick-change connectors is one way to meet this goal.
- Eye protection is required when using or working around pneumatic tools.
- Use hearing protection if noise exposure is a concern (i.e., if it is too loud to conduct a normal conversation).
- Pneumatic tools shall be operated only by persons trained in their use.
- A pneumatic tool used where it may contact exposed live electrical parts shall have a nonconductive hose and an accumulator to collect moisture.
- Employees shall not use any part of their bodies to locate or attempt to stop an air leak.
- All guards and safety interlocks must be in place and functional.

16.12.4 Engine-Powered Tools

CDM Smith employees that use engine-powered tools should use the following work practices:

- Stop the engine and allow it to cool before refueling, servicing, or maintenance.
- Use care in refueling. Clean up any small spills of fuel or oil immediately.
- The use of eye protection is required when using or working around engine- powered tools.
- Use hearing protection if noise exposure is a concern (i.e., if it is too loud to conduct a normal conversation).

- If possible, disconnect the spark plug before performing an adjustment, maintenance, or service.

- Use tools in well ventilated areas to eliminate any accumulation of fumes.
- Do not use tools in a flammable or explosive atmosphere.
- Equip engines with spark-arresting mufflers.
- Avoid contact with hot engine components.
- All guards and safety interlocks should be in place and functional.

16.13 Heat Stress

CDM Smith employees may be exposed to hazards associated with hot work environments. Factors that contribute to heat exposure include temperature, humidity, PPE radiant heat, sunlight, access to drinking water, exposure duration, and work activity. Individuals vary widely in their susceptibility to heat stress. Factors that may influence individual susceptibility to heat stress include the following:

- Lack of physical fitness
- Lack of acclimatization
- Age
- Dehydration
- Obesity
- Alcohol and drug use
- Infection
- Sunburn
- Diarrhea
- Chronic disease

The following guidelines should be considered when CDM Smith employees or subcontractors perform work:

- In ambient air temperatures above 80°F
- That involves heavy physical labor in temperatures above 70°F
- In chemical-protective clothing above 70°F

16.13.1 Hazards Associated with Heat Stress

Heat Stroke – Heat stroke is a serious medical emergency and can lead to death if left untreated. It is an acute and dangerous reaction caused by the failure of heat regulating mechanisms of the body. Persons who are elderly, obese, chronically ill, alcoholic, diabetic, or have circulatory system problems are at greater risk.

- Symptoms include red, hot, dry skin; nausea; headache; weakness; dizziness; elevated body temperature (BT); rapid respiration and pulse; coma; or loss of consciousness.
- Treatment for heat stroke:

- Heat stroke is a serious medical emergency. Emergency medical services (911) should be contacted if heat stroke is suspected.
- Move the victim to a cool place (shade, air-conditioned building, vehicle).
- Remove heavy clothing.
- Cool the victim with ice packs, wet towels, or cloth.
- Keep head and shoulders elevated.
- Keep victim's airway open, check breathing and pulse.

Heat Exhaustion – A state of exhaustion or weakness caused by loss of fluids through perspiration and inadequate fluid replacement. Severe cases may result in loss of consciousness (fainting). This condition can progress to heat stroke if left untreated.

- Symptoms include:
  - Pale, clammy, moist skin; heavy sweating; and extreme weakness.
  - BT is normal, pulse is weak and rapid, breathing is shallow.
  - The person may have a headache, nausea, or feel dizzy.
- Treatment for heat exhaustion:
  - Remove the victim to a cool location (shade, air-conditioned building, or vehicle).
  - Allow the victim to lie down and prop their legs up.
  - Cool the victim with wet towels, cloth, or cold packs.
  - If the victim in not nauseous, they should drink water slowly.
  - If the victim loses consciousness, transport to local medical facility.
  - Continue treatment until symptoms are gone. Consult with CDM Smith medical consultant before returning to work.

Heat Cramps – Heat cramps are a condition that can progress to heat exhaustion or heat stroke. Symptoms include severe cramping of the arms, legs, and abdomen.

Treatment includes:

- Removing the victim to a cool location; loosen clothing
- Having the victim slowly drink cool water
- Resting the cramping muscles

Heat Rash – Heat rash is a mild red skin rash in areas where the body is in contact with clothing or protective gear. The area is likely to itch and can be a source of irritation.

Treatment includes decreasing the amount of time in protective gear and applying talcum powder to absorb moisture. When possible, wear breathable clothing to prevent a buildup of moisture within the clothing.

16.13.2 Heat Stress Monitoring

Since the susceptibility to heat stress hazards can vary greatly from one individual to another, often the best way to monitor for heat stress is through observing employees and individual physiological monitoring. When working in conditions that have the potential to create heat stress, either heart rate (HR) or BT should be monitored in accordance with the suggested frequency given in Table 16-1 below:

Table 16-1 Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[a]

Adjusted Temperature[b]	Normal Work Ensemble[c]	Impermeable Ensemble
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° to 90°F (30.8° to 32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5° to 87.5°F (28.1° to 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5° to 82.5°F (25.3°to 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5° to 77.5°F (22.5°to 25.3°C)	After each 150 minutes of work	After each 120 minutes of work

[A]For work levels of 250 kilocalories/hour.

[B] Calculate the adjusted air temperature (Ta adj) by using this equation: Ta adj °F = Ta °F + (13 X % sunshine). Measure air temperature (T a) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow (100 percent sunshine - no cloud cover and a sharp, distinct shadow; 0 percent sunshine - no shadows).

[C] A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

- Heart Rate – HR should be measured by the radial pulse for 30 seconds as early as possible in the initial rest period. On an individual basis, if the HR exceeds 110 beats per minute (BPM), that individual should not return to work until their HR drops below 110 BPM and they are fully recovered. If more than one worker has an HR that exceeds 110 BPM, a work rest regimen or other control measures should be implemented to maintain HRs below 110 BPM.

- Body Temperature – The BT may be measured using a clinical oral thermometer or a clinical ear thermometer. On an individual basis, if the BT exceeds 99.6°F, that individual should not return to work until their BT drops below 99.6°F and they are fully recovered. If more than one worker has a BT in excess of 99.6°F, a work rest regimen or other control measures should be implemented to maintain BTs below 99.6°F.

- Personnel should monitor themselves and each other for the development of symptoms such as sudden fatigue, nausea, dizziness, irritability, malaise, flu-like symptoms, and lightheadedness.

16.13.3 Heat Stress Controls and Prevention

- Develop work/rest regimen to maintain physiological parameters within limits described above and prevent development of initial symptoms of heat stress related conditions. If the physiological limits are exceeded or symptoms develop, the work period should be reduced, and rest period increased. Rest areas should be cool (in areas such as shade, air-conditioned buildings, or vehicles) and away from heat exposure.
- In extreme heat conditions, employees may wear heat-control clothing such as ice vests or cool suits. Physiological monitoring should still be conducted, and work/rest regimens implemented to keep physiological parameters within recommended limits.
- Mobile showers or hoses can be used to cool down workers in waterproof protective clothing.
- Shield sources of radiant heat.
- Provide shaded work areas.
- Conduct activities in early morning and late evening to avoid the hottest parts of the day.
- Allow employees to become acclimatized to the heat by performing less strenuous activities for the first few days. Schedule more physically demanding work later.
- Provide adequate, cool drinking water for consumption during break periods.
- Avoid consumption of beverages such as coffee, tea, or colas that act as diuretics and dehydrate the body.

16.14 Cold Stress

Persons working outdoors in low temperatures, especially below freezing, or in wet or snowy weather are potentially subject to cold stress disorders. Factors that contribute to cold stress exposure include temperature, humidity, wind, sunlight, rain, snow, fog, exposure duration, clothing, and work activity. Individual susceptibility to cold stress disorders can vary widely. Individual physical factors that can affect a person's response to cold work environments include a person's general fitness and age.

The following guidelines should be considered when working in ambient air temperatures below 40°F, especially when other contributing weather conditions such as snow, rain, or wind are present.

16.14.1 Hazards Associated with Cold Stress

Hypothermia – Hypothermia results from a cooling of the body's core temperature and if left unattended can become a serious condition. Hypothermia can result in the loss of physical skills and impair judgment thereby contributing to the potential for other accidents. Severe hypothermia can result in death. Hypothermia can occur at temperatures above freezing as well as below.

- Symptoms include shivering, teeth chattering, fumbling hands, slurred speech, and loss of coordination. Eventually, the pulse and respiratory rate may slow. The victim may appear blue or lose color in the face.

- Treatment for hypothermia is to catch symptoms early and move the individual to a warm environment indoors or in a vehicle. If a warm location is not immediately available, the victim should be sheltered from the wind and provided extra clothing such as coats or blankets and observed to determine if their condition is improving. If the victim continues to deteriorate and becomes colder, they should be transported to a medical facility for assistance.

Frostbite – Frostbite is a condition in which the fluids around cells of body tissue freeze. The condition can lead to body tissue damage. The most vulnerable parts of the body are the nose, ears, cheeks, fingers, and toes.

- Symptoms of frostbite include body parts becoming white, firm, cold to the touch, and may feel waxy. The victim will not feel pain in the affected area.

- Treatment of frostbite requires that the victim be brought to a warm environment and the affected areas be allowed to thaw and warm. If frostbite has progressed beyond small patches of skin and affects whole body parts such as a hand, foot, or ear, the victim should be transported to a medical facility for treatment and observation.

16.14.2 Cold Stress Monitoring

Personnel should monitor themselves and each other for signs and symptoms of frostbite and/or hypothermia. If symptoms are observed in an employee or subcontractor, steps should be taken to treat the symptoms by having the individual go to a warm environment either in a nearby structure or vehicle.

16.14.3 Cold Stress Control and Prevention

Cold stress can easily be prevented with proper planning and prevention. Some basic controls and preventative measures are listed below:

- Forecasted conditions. Consider the effect of wind chill.

- Dress in layers and stay dry. Avoid cotton clothing such as socks or T-shirts. Bring extra clothing.

- Wear hardhat liners and gloves. Wear rain gear in rain and snow.

- Curtail work if extreme weather conditions such as a blizzard, extreme wind chill (e.g., less than 0°F), torrential cold rains, or wind is expected.

- For long-term projects in cold environments, consider setting temporary structures with portable heaters.
- Take warming breaks as needed.
- Avoid beverages with caffeine, alcohol, or medications that restrict blood flow.
- Drink warm noncaffeine beverages such as hot chocolate or soups on breaks.

16.15 Working Around Heavy Equipment

Good work practices while working around heavy equipment include:

- Assume the operator cannot see you. The operator's vision may be blocked by blind spots. He or she is frequently concentrating on their work and equipment and may not notice a site visitor.
- If you must approach the operator, be sure you have made eye contact with the operator and they know you will be approaching them before approaching the equipment. Verbal contact, direct or by radio, is even better. Do not approach if the equipment is moving or in operation.
- Stay clear of pinch points and swing areas of equipment. At CDM projects, these areas should be taped or barricaded off; however, when equipment moves frequently, you cannot count on other organizations to mark these zones.
- Do not walk near a moving piece of equipment. It could turn or rotate any minute. Modern construction equipment moves fast and in any direction.
- On a noisy site, you may not notice the equipment's back-up alarm. Keep aware of what is happening around you.
- Never walk under a load on a crane or hoist. Indeed, avoid the area under the hook or bucket.
- Do not cut across the path of equipment backing up.
- Wear your hardhat and safety glasses. The safety glasses protect your eyes from dust and debris and the hardhat provides protection for your head and makes you more visible on the site.
- On sites where there is frequent vehicle or construction equipment movement, wear high-visibility clothing.

- Maintain a clearance of at least 10 feet between any part of the machine or its load and any electrical line or apparatus carrying up to 50,000 volts. One foot of additional clearance is required for every additional 30,000 volts.

16.16 Working Near or Over Water

When working on, over, or near water, basic water safety precautions must be taken. Such areas include riverbanks, channels, dock areas, working from vessels of any kind, aeration basins, or other areas where a danger of drowning may exist. Depending on the circumstances, precautions needed may include any or all of the following:

- Employees should wear Coast Guard-approved personal floatation devices (PFDs) (either vests or jackets) where a potential danger of drowning exists. PFDs are required when working from any type of boat or floating platform.

- The PFDs should be inspected before and at the end of each use for wear, torn stitching or straps, inoperable buckles, or other defects.

- Ring buoys with at least 90 feet of line shall be provided and readily available for emergency rescue operations. Distance between ring buoys shall not exceed 200 feet.

- At least one lifesaving skiff shall be immediately available at locations where employees are working over or adjacent to water, unless the width of the water body is small enough to allow any potential rescue to occur from the bank (as would be the case with most aeration basins).

In some circumstances, these precautions may also be required by OSHA regulations. If you are planning to conduct work where water hazards may be present, be sure to take all appropriate precautions. If you will work in this situation, you should review the full text of the OSHA standard, OSHA Standard for Work Over or Near Water and consult your division HSM or designated HSC.

16.17 Flammable and Combustible Liquids

Work with flammable or combustible liquids exposes the employees to fire, explosion, and toxicity hazards. They should implement the following controls.

16.17.1 Storage and Handling

- Only approved containers and portable tanks should be used for the storage and handling of flammable and combustible liquids.

  - Approved safety cans shall be used for the handling and use of flammable liquids in quantities greater than 1 gallon.

  - For quantities of 1 gallon or less, only the original container or approved safety cans shall be used for storage, use, and handling of flammable/combustible liquids.

  - The requirements for shipping these liquids exceeds those described here. If flammable or combustible liquids must be shipped, the individual offering the material for shipment must have completed DOT Hazardous Material Training. Contact your HSM for information on DOT training.

- Flammable or combustible liquids shall not be stored near exits, stairways, or pathways that people normally use for safe passage.
- No more than 25 gallons of flammable/combustible liquids shall be stored in a room outside of a storage cabinet or tank approved for the purpose.
- Quantities of flammable and combustible liquids in excess of 25 gallons shall be stored in an acceptable or approved cabinet meeting the requirements of 29 CFR 1926.152(b)(2)(i).
- Cabinets shall be labeled in conspicuous lettering, "Flammable - Keep Fire Away."
- Not more than 60 gallons of flammable or 120 gallons of combustible liquids shall be stored in any one storage cabinet. Not more than three cabinets may be located in a single storage area.

16.17.2 Outdoor Storage

- For storage of flammable and combustible liquids outdoors, containers (not more than 60 gallons each) shall not exceed 1,100 gallons in any one pile or area. Five feet of clearance shall separate piles or groups of containers. These containers shall remain at least 20 feet from any other building or structure.
- Within 200 feet of each pile of containers, there shall be a 12-foot wide access way to permit approach of fire control apparatus.
- The storage area shall be graded in a manner to divert possible spills away from buildings or other exposures or shall be surrounded by a curb or earth dike at least 12 inches high. Provisions shall be made for the controlled draining of accumulations of groundwater or rainwater, or spills of flammable or combustible liquids when curbs or dikes are used.
- At least one portable fire extinguisher, having a rating of not less than 20 pounds, shall be located not less than 25 feet or more than 75 feet from any flammable or combustible liquid storage area located outdoors
- Precautions shall be taken to prevent the ignition of flammable/combustible vapors. Sources of ignition include but are not limited to open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical, and mechanical sparks; spontaneous ignition, including heat-producing chemical reactions; and radiant heat.

16.17.3 Dispensing Flammable and Combustible Liquids

- Areas where flammable or combustible liquids are dispensed at one time, in quantities greater than 5 gallons from one tank or container to another tank or container, shall be separated from other operations by a distance of 25 feet or by construction having a fire resistance of at least 1 hour. Adequate natural or mechanical ventilation shall be provided to maintain the concentration of flammable/combustible vapor at or below 10 percent of the LEL.

- Static electricity is generated by the contact and separation of dissimilar material, such as when fluid flows through a pipe or from an orifice into a tank. If the accumulation of static charge is sufficient, a static spark may occur. Transfer of flammable/combustible liquids from one container to another should be done only when containers are electrically bonded and grounded to prevent such accumulation of static charge (Figure 16-3).
- The management of flammable and combustible liquids is much more complicated than is indicated by the length of this section, which reviews only those issues appropriate to the incidental use of these materials.
- Storage and handling of the mobile and combustible liquids should comply with the requirements of National Fire Code No. 30.

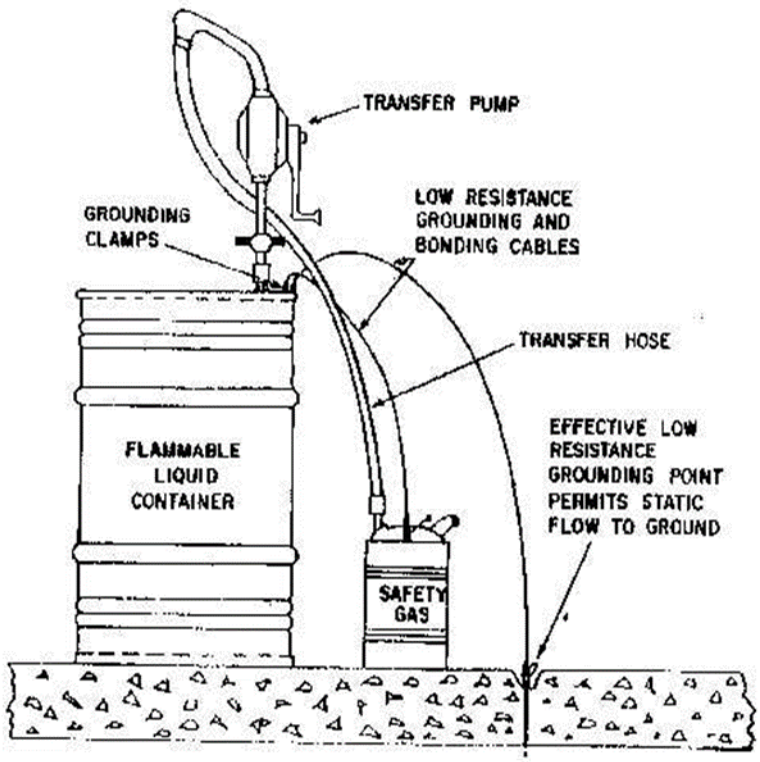


Figure 16-1 Typical Grounding System

16.18 Safety Working Around Drill Rigs

The use of mechanical drill rigs to collect soil samples and install monitoring wells presents significant hazards to operators and helpers, as well as technicians and engineers who may work in proximity to such rigs. CDM Smith employees that manage or oversee drilling operations should be aware of the basic hazards of drilling equipment and operations and have an awareness of safe drilling work practices. The guidelines and work practices described below should be implemented on all projects where mechanical drill rigs are used.

16.18.1 Preparation

- Contract documentation with drillers contracted with CDM Smith should include CDM Smith's standard contract between "Engineer & Subcontractor for Drilling Services," and "Health and Safety Protocol for Subcontractors" available on the Office of General Council's page of contract forms

- Before drilling or other subsurface operations, a survey should be conducted to identify any overhead or underground utilities, unexploded ordnance, tanks, pipes, or other underground structures. The local agency or organization for utility location should be contacted to identify underground utilities. In some cases, ground penetrating radar or magnetometer studies may be needed to identify the location of underground obstructions.

- The work area for the drill rig and crew should be cleared of sticks, logs, brush, and trash. Inspect the area for any potential tripping hazards and remove them. If they cannot be removed, they should be identified with caution tape or cones.

- Before rig setup, the planned arrangement of equipment should be such that it does not present a dangerous condition. Take into account slopes of hills, mud, standing water, overhead power lines, etc.

- OSHA regulations require that any part of the rig must be at least 10 feet away from power lines under 50kV or less. For higher voltage lines, 1 foot of additional clearance is required for every additional 30,000 volts.

- If working in an area of moving vehicular traffic, appropriate traffic control systems should be in place. Contact local police or traffic control officer, before placing any traffic control equipment (Section 16.22).

- Define an exclusion zone around the drill rig that is at least 1.5 times the height of the mast. Only personnel necessary for the immediate task being performed should be inside the exclusion zone.

16.18.2 Drill Rig Inspection

- After the rig is set up, but before operation, the work area should be inspected for eye, bump, and tripping hazards.

- The driller should inspect the rig daily before operation of the rig. The inspection should include the following:

- Condition of the vehicle. Brakes should work and tires should have adequate tread. It should have a back-up alarm. If it is driven over the road, it should have all necessary brake lights, headlights, horn, license plates, etc.
- All welds should be solid, with no sign of visible cracks.
- All gauges should be functional and legible.
- All machine guards should be in place.
- Emergency kill switches should be functional. All site personnel should be aware of the location and function of the kill switches. Have the driller review these with site personnel.
- Cable and wire rope should be inspected for fraying, decay, “bird caging,” broken strands, kinking, or flattening.
- All hoses should be secure and in good shape. They should not be loose, bulging, or leaking.
- High-pressure fittings should be secure and have whip checks (a pin or wire to prevent the hose whipping in the event of a failure of the connection).
- High-pressure relief valves should be in working order.
- Wire rope loops should be secure with at least two clamps.
- The rig should have a fire extinguisher and first aid kit.
- All tools should be clean and in good working condition. Hooks, eyes, pins, etc. should not be corroded or bent. Rod clamps should be in good condition.
- If a cathead is used, it should be clean and free of burrs. The cathead rope should be in good condition and not be frayed or have excessive wear.
- Back-up alarms should be functional.
- Vehicles should have all lug nuts and they should all be tight.

16.18.3 Work Practices

- All personnel working around drilling operations should wear appropriate PPE including a hard hat, safety glasses, and hard-toed work boots.
- Drill crews should wear work gloves.
- On hazardous waste sites, additional PPE such as respirators, protective clothing, gloves, etc. may also be required.
- In areas where there is vehicular traffic, personnel should also wear high-visibility vests or clothing.

- Maintain an organized work area free from tripping hazards.
- Drill rods or other equipment should not be stored leaning up against equipment.
- Drill holes should be completed or secured before leaving the site for the day. Drill holes should not be left open at an unattended site.
- Boring locations should be placed to minimize the possibility of contacting underground utilities or structures. Clearance should be obtained from the site project manager before drilling begins.
- Do not move the rig with the mast in the upright position.
- Use a spotter when moving the rig from one location to another on the site.
- When sampling activities require working in proximity with heavy equipment or drill rigs, sampling personnel will stand clear of the equipment until sampling is required. They will notify the operator they are going to take a sample and must receive acknowledgment from the operator.
- Do not wear loose clothing such as hooded sweatshirts, parkas, or clothing with hanging drawstrings around drill rigs.
- Monitor weather conditions. Drilling operations should be terminated and the area near the drill rig evacuated during high winds and or storms with the potential for lightning strikes. The lead driller should be consulted to help assess if weather conditions are safe for drilling.
- Drill crew personnel should wear a personal fall arrest harness, connected to a secure tie-off point, when climbing the mast or working where fall exposures exceed 6 feet.
- Hearing protection should be worn during operations that produce significant noise exposures. (If you cannot hold a conversation using a normal voice with someone within 3 feet of you because of background noise, the use of personal hearing protection is recommended.)

16.19 Working Safely with Direct Hydraulic Push (Geoprobe™) Technology

These guidelines apply to the use of direct hydraulic push (Geoprobe™ or similar) technology during site investigations. In addition to the safety precautions listed below, the equipment shall be operated and maintained according to the manufacturer's instructions.

- Contract documents for subcontractors using a Geoprobe should include CDM Smith's standard contract between "Engineer & Subcontractor for Drilling Services" and "Health and Safety Protocol for Subcontractors" available on the Office of General Council's page of contract forms.

- The probe rig should be equal to the task. Hiring a contractor who uses a pneumatic hammer when direct hydraulic push is more appropriate, requires unacceptable compromises on safety.
- Before using the Geoprobe or other subsurface operations, a survey should be conducted to identify any overhead or underground utilities, unexploded ordnance, tanks, pipes, or other underground structures. The local agency or organization for utility location should be contacted to identify underground utilities. In some cases, ground penetrating radar or a magnetometer may be needed to identify the location of underground obstructions.
- The work area for the Geoprobe and crew should be cleared of sticks, logs, brush, and trash. Inspect the area for any potential tripping hazards and remove them. If they cannot be removed, they should be identified with caution tape or cones.
- Before rig setup, the planned arrangement of equipment should be such that it does not present a dangerous condition. Take into account slopes of hills, mud, standing water, overhead power lines, etc.
- OSHA regulations require that any part of the rig must be at least 10 feet away from power lines under 50kV or less. For higher voltage lines, 1 foot of additional clearance is required for every additional 30,000 volts.
- The Geoprobe should be operated by one person at a time, including assembly and disassembly of probe rod and accessories. Other field personnel shall stay clear of the probe and vehicle while the probe is in operation, being assembled, or disassembled. This is to ensure the unit is not inadvertently engaged while the operator's hands, fingers, or feet are touching or near moving parts.
- Keep feet clear of the probe as it descends.
- Do not place hands on top of probe rod while the rod is under the probing machine.
- The hydraulic system should be turned off at the control panel when changing probe rods, inserting the hammer, anvil, or attaching any accessories.
- Do not exert downward pressure on the probe to lift the probe foot over 6 inches off the ground.
- Always take the carrier vehicle out of gear and set the emergency brake before starting the push unit up.
- Always extend the probe unit out from the carrier vehicle and deploy the foot to clear the vehicle roofline before folding the probe unit out.
- The operator should stand to the control side of the probe machine and stay clear of the probe foot and derrick while operating the controls.

- Do not exert downward pressure on the probe so that the carrier vehicle tires lift off the ground. Reducing the load on the carrier vehicle may allow the vehicle to shift or slide unexpectedly.
- Be aware that the carrier vehicle's catalytic converter may be hot and has the potential to be a fire hazard if the vehicle is parked over combustible material such as dry leaves, grass, etc.
- The hydraulic system should be shut down and the vehicle engine stopped before attempting to clean or service the probe.
- Use extreme caution when using the machine while parked on loose, soft, or uneven surfaces.

16.20 Hazardous Waste Site Controls

Work sites designated as hazardous waste sites must control access to the work area to only authorized personnel and conform to general work practices expected at hazardous waste site operations as required by the OSHA Standard for Hazardous Waste Operations, 29 CFR 1910.120. The following concepts should be reflected in the HSP for the project.

16.20.1 Access Control

Controlled access to hazardous waste site work areas is required to protect personnel working on the site as well as to limit the potential for transporting contaminants off site. Depending on the size of the work site, hazards and contaminants present, and complexity of the work, access control may range from verbally cautioning nonauthorized personnel to stay away from the work area, to a program including site security, signs, or formal sign-in and sign-out procedures. Details of site-specific access control procedures should be included in the site-specific HSP. Some general work practices for access control are noted below:

For small-scale site investigations that are short-term projects (i.e., days, not weeks or months), identify a work area to the work crew and keep persons not associated with the job site out of the work area. If the site is in an area where nonauthorized persons are likely to be encountered, traffic cones, caution tape, and signs identifying the area as a controlled access area may be used.

For more extensive projects where work may be done for weeks or longer, the team should deploy more extensive access controls. They should:

- Set up physical barriers and hire security personnel to prevent nonauthorized persons from entering the work site.
- Keep the number of personnel and equipment on site to the minimum required to do the project effectively and safely.
- Establish work zones within the site (Section 16.20.2).
- Establish controlled access points to be used by authorized personnel.
- Track the entry and exit of personnel through a check-in, checkout system.
- Establish a formal decontamination corridor from exclusion zones.

16.20.2 Work Zones

Field project managers working under HASPs for hazardous waste operations are required to establish work zones to prevent or reduce the spread of site contaminants to noncontaminated areas on or off site. Movement between zones should be restricted to those that need access to a specific area, and entry and exit between zones should be through designated access control points. A description of the three work-zone system for hazardous wastes is provided below.

Exclusion Zone – The exclusion zone should include any area where contamination is known or suspected. Areas of air, water, or soil that are contaminated with hazardous materials (biohazards, radioactive materials, chemicals) should be included in the exclusion zone. The zone should be well known to site workers. On smaller projects, this can be a verbal identification to site workers, such as "a 20-foot radius around the drill rig." On larger projects, or in areas that may be encountered by observers or the general public, the zone may need to be defined with caution tape, traffic cones, or in some instances, fencing and barriers. The need will be site-specific, and the specific method should be identified in the site-specific HASP. Some work practices that should be followed in the exclusion zone include:

- Employees in the exclusion zone must wear the PPE designated in the site HASP for tasks executed within the zone.
- No eating, drinking, chewing gum or tobacco, smoking, application of cosmetics, including application of lip balm, sunscreen, or insect repellant is allowed in the exclusion zone.
- Sitting or kneeling in areas of high concentrations of contaminants should be avoided.
- If any PPE becomes defective, the employee should leave the work area via the designated egress area, decontaminate as needed, and replace the defective PPE before returning to work in the exclusion zone.
- Prescription drugs should not be used within the exclusion zone unless approved by CDM Smith's medical consultant. The use of illegal drugs or consumption of alcohol is prohibited.
- When leaving the exclusion zone, employees should exit via the designated access/ egress point(s) and follow decontamination procedures described in the site HASP.

Contaminant Reduction Zone – A contaminant reduction zone (CRZ) is established to provide a transition between the exclusion zone and the support zone. The CRZ is set up at the access control points of the exclusion zone and will vary in size depending on the complexity of activities that need to occur within the zone. For small site investigations, the CRZ may simply be a designated area near containers set up to collect used disposable PPE and some soap and water. For larger projects, the CRZ may include specific decontamination points and be staffed by personnel specifically designated to participate in the decontamination of personnel and equipment exiting the exclusion zone. Depending on the site contaminants, level of contamination, and decontamination procedures, personnel in the CRZ may be required to wear protective clothing, gloves, or respirators. The specific requirements will be outlined in the site HSP. The CRZ should be placed in an area that is not contaminated at the boundary of the exclusion zone.

Support Zone – The support zone is established near the entrance to the site and is far enough from the exclusion zone and CRZ that specialized protective clothing or respirators are not used. The use of normal field PPE such as hard hats, safety glasses, and safety work boots is expected except for areas such as office trailers, break and lunch areas, or other areas designated as having no known or anticipated hazards. Operational support activities and equipment storage and maintenance areas are located in the support zone. No equipment or personnel should go from the exclusion zone to the support zone without passing through the CRZ and being decontaminated in accordance with the site HASP.

Mobile Work Zone – For those projects that involve brief periods of work in multiple locations, a specific area may be designated as the exclusion zone for the duration of the work performed in that area. The exclusion zone can be terminated (provided there are no ongoing hazards or potential exposures to contaminants) and moved to the next area of work. For example, during soil borings or well installation, the exclusion zone can be defined as, "1.5 times the mast height" of the drill rig. Once the boring has been closed, or well installed and secured, and all drill cuttings have been secured, the area can be opened up and a new exclusion zone established around the next boring location.

16.20.3 Considerations when Establishing Work Zones

Work zones should be large enough to perform tasks within the zone safely, with no exposure to hazards to personnel outside the zone, but they should also be small enough to be able to secure and control access. Some considerations in establishing work zones include:

- Physical and topographical features of the site
- Dimensions of the contaminated area
- Weather
- Physical, chemical, and toxicological characteristics of contaminants and chemicals used in the zone
- Potential for exposure to site contaminants
- Known and estimated concentrations of contaminants
- Air dispersion of contaminants
- Fire and explosion potential
- Planned operations and space needed to perform the work safely
- Surrounding areas
- Decontamination procedures
- History of job site

16.20.4 General Hazardous Waste Site Work Practices

- Buddy System - Work should be scheduled so that no person works unobserved within the exclusion zone at any time. Each worker within the exclusion zone should maintain visual contact with at least one other worker on the site. All site personnel should remain aware of each other and monitor each other's condition.

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited within the contaminant reduction and exclusion zones. (Exception for heat stress: Squirt bottles of water, Gatorade, or other fluids may be consumed via squirt bottles in the contaminant reduction zone with the approval of the HSM. Open bottles, cups, etc. should not be permitted.)

- Sitting or kneeling should be avoided in areas of known or suspected areas of contamination.

- Hands and face should be thoroughly washed when leaving the work area.

- Defective PPE should be repaired or replaced immediately.

Sections 5, 6, 7, 9, and 11 of this manual are particularly applicable to H&S at hazardous waste sites.

16.21 Decontamination at Hazardous Waste Sites

Proper decontamination helps protect employees and prevents the contamination of uncontaminated areas. Decontamination protects all site personnel by minimizing the transfer of harmful materials into clean areas. It helps prevent mixing of incompatible chemicals and protects the community by preventing uncontrolled transportation of contaminants from the site.

16.21.1 Prevention of Contamination

To prevent contamination, crew members should:

- Follow procedures for proper dressing before entry into the exclusion zone. Proper dressing will minimize the potential for contaminants to bypass the PPE and escape decontamination.

- Protect monitoring and sampling instruments by bagging. Make openings in the bags for sample ports and sensors that must contact site materials, or cover equipment and tools with a strippable coating, which can be removed during decontamination.

- Encase any source of contaminants on the site with barriers (e.g., plastic sheeting or over packs).

- Stress work practices that minimize contact with hazardous substances. Use remote sampling, handling, and container-opening techniques.

16.21.2 Decontamination Equipment Selection

In selecting decontamination equipment, consider whether the equipment must be decontaminated for reuse or can be easily disposed. Recommended equipment for decontamination includes:

- Storage tanks or appropriate treatment systems
- Drains or pumps
- Long-handled brushes
- Wash solutions appropriate for the contaminants present
- Rinse solutions appropriate for the contaminants present
- Pressurized sprayers for washing and rinsing
- Curtains, enclosures, or spray booths
- Long-handled rods and shovels
- Containers to hold contaminants and contaminated soils
- Wash and rinse buckets
- Brooms
- Containers for the storage and disposal of contaminated material

16.21.3 Decontamination Design

Decontamination facilities should be located in the CRZ, i.e., the area between the exclusion zone (the contaminated area) and the support zone (the clean area) and described in the site HSP.

- Site-specific factors that affect the decontamination facility design must be considered. Typical factors include:
  - The chemical, physical, and toxicological properties of the wastes
  - The pathogenicity of infectious wastes
  - The amount, location, and containment of contaminants
  - The potential for and location of exposure based on assigned worker duties, activities, and functions
  - The potential for wastes to permeate, degrade, or penetrate materials used for personal protective clothing and equipment, vehicles, tools, buildings, and structures
  - The proximity of incompatible wastes

- The movement of personnel and/or equipment among different zones
- The emergencies that may arise
- The methods available for protecting workers during decontamination
- The impact of the decontamination process and compounds on worker H&S

- Decontamination Line
  - Decontamination should be an organized process by which levels of contamination are reduced.
  - The decontamination process consists of a series of steps performed in a specific sequence. For example, outer, more heavily contaminated items are decontaminated first, followed by the decontamination and removal of inner, less contaminated items.
  - Each step should be performed at separate stations to prevent cross contamination.
  - Decontamination stations should allow enough separation to prevent cross contamination and should be arranged in order of decreasing contamination.
  - Separate decontamination areas should be provided to isolate workers from different contamination zones containing incompatible wastes or decontamination processes.
  - Entry and exit points should be conspicuously marked. Preferably the entry to the CRZ from the exclusion zone should be separate from the entry to the exclusion zone from the CRZ.
  - Dress-out stations for entry to the CRZ should be separate from redressing areas for exit from the CRZ.
  - Personnel who wish to enter clean areas of the decontamination facility, such as locker rooms, must be appropriately decontaminated first.
  - Examples of decontamination lines and procedures for personnel wearing various levels of protection are provided in Exhibit 16D in Appendix A.

16.21.4 PPE for Decontamination Workers

A rule of thumb is that decontamination workers wear a level of protection one level below the level of protection worn in the exclusion zone. However, consideration should be given to the following when determining the level of protection for a given project.

- The nature of site contamination
- Degree of contamination expected on workers leaving the exclusion zone
- The results of wipe tests and onsite air monitoring

Some site-specific cases may require that decontamination personnel wear the same level of PPE as workers in the exclusion zone. Cases include:

- Workers using a steam jet may need a different type of respiratory protection than other decontamination personnel because of the high moisture content of the steam jets.
- Cleaning solutions used and wastes removed during decontamination may generate harmful vapors, requiring a different type of respiratory or clothing protection.

16.21.5 Decontamination Methods

All personnel, clothing, equipment, and samples leaving the contaminated area of a site should be decontaminated to remove any harmful chemicals, radioactive material, or infectious organisms that may have adhered to them. The extent of decontamination will vary depending on the nature of site activity, site contamination, and other factors.

- Decontamination methods available include:
  - Physical removal
  - Chemical detoxification or disinfections/sterilization
  - A combination of both physical and chemical methods
- The selected decontamination method should be reviewed for any safety and health hazards. If the selected method poses a direct health hazard, measures shall be taken to protect both the decontamination personnel and the workers to be decontaminated.
- Physical Removal
  - Physical methods using high pressure and/or heat should be used with caution. B Loose contaminants can be removed by using a soap and water rinse with a soft bristle brush to remove dust and vapors that cling to equipment and workers, or
  - that are trapped in small openings, such as clothing or fabric weaving.
- Adhering contaminants can be removed by:
  - Scraping, brushing, and wiping.
  - Solidifying.
  - Freezing (using dry ice or ice water).
  - Adsorption or absorption (e.g., kitty litter or powdered lime).
  - Melting.
  - Volatile liquid contaminants can be removed from PPE or equipment by evaporation followed by a water rinse. Evaporation may be expedited by the use of steam jets.

- Chemical Removal
  - Decontamination using chemicals should only be done if recommended by an industrial hygienist or other qualified professional.
  - Any chemical used in the decontamination process must be chemically compatible with the equipment or clothing being decontaminated.
  - Halogenated solvents should only be used for decontamination in extreme cases where other cleaning agents will not remove the contaminant.
- Chemical removal types include the following:
  - Surface contaminants can be dissolved in a solvent.
  - Solidification of liquid or gel contaminants can enhance their physical removal. Typical solidification processes are moisture removal using adsorbents such as grounded clay or powdered lime; and chemical reactions using polymerization chemicals and/or chemical reagents.

16.21.6 Personnel Decontamination

Different levels of personnel protection, as discussed in the PPE guidelines, may be used at any given site. The following is a description of the decontamination process for each level of protection.

- **Level D**
  - An area should be designated for the gross removal of dirt and mud from gloves and boot covers. Paper towels and buckets of rinse water can be made available for this purpose.
  - Typical decontamination steps for Level D operations are provided in Exhibit 16-D.
  - Soap and water should be used to wash hands and face before leaving the site.
  - Laundering of personal clothing should be completed as soon as possible once offsite.
- **Level C and B**
  - A decontamination line should be established.
  - Site-specific procedures should be outlined in the site HSP. The recommended procedure for this layout is listed in Exhibit 16-D.
- **Level A -** It is not anticipated CDM Smith will directly participate in Level A operations. If required, site-specific procedures will be developed in coordination with the division HSM.

16.21.7 Sampling and Monitoring Equipment Decontamination

Sampling equipment often becomes grossly contaminated. Often trowels or drum thieves (coliwassas) are dedicated to a particular site. These should be left in the exclusion zone and disposed of as contaminated waste at the end of site work. Sampling equipment such as split spoons or other equipment that is used to collect several samples must be cleaned and decontaminated between samples to prevent cross contamination. These items should be cleaned and decontaminated in accordance with the project operations or sampling plan. Dirt and wash solutions from sampling equipment decontamination should be collected and disposed of as investigation-derived waste.

Once grossly contaminated, testing and monitoring instrumentation can be difficult to decontaminate without causing damage to the instrument. Care should be taken in the field to prevent gross contamination of field instruments by avoiding direct contact between the instrument and contaminated soils, water, or surfaces. In some cases, it may be necessary to place instruments in plastic bags, leaving small openings for sampling ports, detectors, and exhaust ports. The plastic bags can then be removed as the instrument comes out of the exclusion zone. The outside of instruments can be wiped down with paper towels or brushed off with clean soft brushes.

16.21.8 Heavy Equipment Decontamination

Drill rigs, trucks, backhoes, and other heavy equipment can be difficult to decontaminate. The method generally used is to wash them with water under pressure and scrub accessible areas with soap and warm water. Hot water and steam systems can be effective but may increase air concentrations of contaminants, exposing decontamination workers. Particular care should be taken where equipment comes into direct contact with contaminated soils such as tires, buckets, or treads. In severe cases, tires may need to be replaced or parts sand blasted clean or disposed of. Equipment should be visually inspected to be sure it is free of any visible signs of contamination. In some cases, wipe tests or other methods may be needed to confirm equipment has been adequately decontaminated before leaving the site.

16.21.9 Decontamination Solutions, Disposable PPE, and Site Wastes

Potentially contaminated equipment, disposable PPE, respirator cartridges, disposable sampling equipment, brushes, buckets, waste decontamination solutions, etc. should be secured in drums and labeled. Disposal methods for these materials may depend on client requirements and/or results of site investigation data. The confirmed presence of hazardous materials on the site may require disposal of investigation-derived wastes as hazardous wastes.

Care should be taken during work and decontamination activities to minimize waste materials generated.

16.22 Traffic and Work Zone Safety

These guidelines apply whenever CDM Smith employees or subcontractors work in areas exposed to vehicular traffic on public streets or highways.

- Where vehicular traffic hazards exist because of work at locations near public streets or roads, a system of traffic and work zone controls should be developed to mitigate the hazard. The system should meet the requirements of Part 6 of the Manual of Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration, or the applicable state version of the MUTCD.

- In general, when the MUTCD allows the use of traffic safety direction devices, such as cones, CDM Smith will supplement those direction devices with a physical barrier, such as a truck.
- All traffic control systems on public roads must be coordinated with local traffic control officials as required by applicable law.
- Periodically evaluate effectiveness of temporary traffic control setups by walking or riding the job area looking for evidence of poor controls and near misses such as swerving traffic, motorists braking quickly, skid marks, blind spots, etc.
- Give motorists plenty of advanced warning of upcoming work zones.
- All employees working within designated work zones or near vehicular traffic should wear high-visibility clothing such as orange, yellow, or yellow-green shirts, jackets, or vests. During wet or inclement weather, similarly colored rainwear should be worn.
- During night work, between the hours of sunset and sunrise, high-visibility clothing should incorporate reflective striping or fabric and be visible at 1,000 feet. This clothing should meet ANSI standard #107 for High Visibility Safety Apparel.

All employees working near traffic and vehicles must maintain situational awareness at all times. Stay mindful that warning signs and cones inform drivers to take action but that some drivers may not pay attention, and vehicles may still enter the work zone.

16.23 Removing and Replacing Manhole Covers

16.23.1 Purpose and Scope

CDM Smith personnel sometimes remove, handle, and replace manhole covers, hatch covers, or basin grates. These covers come in different sizes, shapes, and weights and have significant hazards associated with them. The guidelines below describe the hazards associated with manholes and manhole covers, general safety precautions to follow when removing and handling manhole covers, and specific procedures for using two tools designed specifically for the removal and replacement of manhole covers (e.g., a stand-up cover lifter and a manhole cover hook).

16.23.2 Hazards

Hazards associated with manholes and manhole covers include the following:

- Dropped manhole covers may crush fingers or break toes and feet.
- Explosion hazards (Manholes can explode, sending covers several feet in the air, when the air in the sewer exceeds the LEL. In rare cases, covers have been found several hundred feet away.
- Falls into open manholes.

- Improper lifting may cause injury to backs/shoulders/limbs.
- Impact of vehicular traffic with covers on public or private roadways.

16.23.3 General Safety Precautions

The following general safety precautions should be implemented when removing or replacing manhole covers.

- Use appropriate tools when lifting or handling manhole covers. Sections 4 and 5 include additional information.
- Ensure appropriate traffic control devices are in place where needed before working around manholes.
- Perform atmospheric testing for explosive and toxic gases using a multi-gas monitor around the edges of the manhole before opening and continue monitoring as the cover is first cracked open to determine if an explosive or toxic atmosphere is potentially present. If the LEL measured is greater than 20 percent or toxic gas concentrations are greater than ½ of the PEL (e.g., greater than 5 ppm for hydrogen sulfide), stop work on this manhole and contact your division HSM to determine ventilation requirements.
- Do not leave any open manhole unattended.
- Maintain positional awareness at all times when handling the cover. For example, place feet on a secure and stable surface and be sure that feet and hands are positioned so they will be clear when the cover is put down. Awareness of the open manhole will help you avoid the fall.
- Spread sand or other material around the manhole area to ensure safe, secure footing if snow, ice, mud, oil, or other conditions make footing difficult.
- Personnel not directly involved in removing or handling the manhole cover should stand clear of the activity.
- DO NOT place fingers under the manhole cover to assist in lifting or replacing; use proper tools.
- Wear leather work gloves that allow a firm grip on tools
- Do not use an open flame to thaw ice that is present around or over a cover. A small amount of table salt or hot water can be used.
- If a cover is stuck and does not lift easily, place a piece of wood on the cover near the rim and strike the wood with a hammer. Do not strike the cover directly. Note: An open flame or spark resulting from metal to metal contact has the potential to ignite an explosive atmosphere within the manhole.
- Clear the area of tools, people, materials, etc. where the cover is to be placed before removing.

- Place the cover in a location that minimizes hazards to other workers, vehicles, and pedestrians.
- When working in a roadway, remove the manhole cover in the direction traffic is moving so you do not have to have your back towards oncoming traffic.
- If entry into the manhole is planned, follow CDM Smith CSE procedures found in Section 12.
- If needed, ask a co-worker for assistance in handling the cover. However, as in any multi-person activity, have one person lead the work and communicate with others on how the action will be done.

16.23.4 Using a Stand-Up Cover Lifter

There are various tools available that allow an individual to safely remove a manhole cover alone. One such tool is the stand-up cover lifter. Stand-up cover lifters may be obtained from the CDM Smith Equipment Centers or from various utility supply vendors.

Opening Covers Using a Stand-Up Lifter

Before using a stand-up cover lifter for the first time, CDM Smith employees should review and follow the manufacturer's instructions. In general, the basic steps to follow include:

- Before using, inspect the hooks, chain, and tool bar for damage such as bending, wear, etc. Do not use a defective tool. Place the base of the cover lifter 6 to 10 inches from the edge of the manhole.
- Insert the hook into a hole on the manhole cover. Engage the hook behind the lip or reinforcing ring on the underside of the manhole cover.
- Lean the handle forward and attach a chain link to the hook on the tool handle so that the chain is taut when the handle is vertical.
- Brace your foot BEHIND the base of the lifter and pull the handle toward your body until the cover is 3 to 4 inches out of the frame.
- Reposition the base of the tool and repeat the step above until the cover is clear of the manhole.
- When using this procedure with a rectangular cover, keep the edges of the cover parallel to the sides of the frame of the manhole as the cover slides along the frame to prevent the cover from falling in the manhole.
- This type of tool may also be used to open a hinged cover by placing the tool on the center of the cover, engaging the hook on a handle or lift ring and pulling the handle back towards the hinged side of the cover.
- Once a hinged cover is open, be sure to set the hinge locks to prevent the cover from closing inadvertently.

Replacing Covers Using a Stand-Up Lifter

To replace a manhole cover using a stand-up lifter tool, follow the steps listed below:

- Clear loose material from the frame seat and the sides of the cover. The cover will not sit in the frame evenly if all material is not removed.
- Use the lifter to drag the cover next to the frame opening using the same technique followed to remove the cover. Take care not to fall in the open hole.

16.23.5 Using a Manhole Cover Hook

Another tool available to assist in opening manhole covers is the J-type hook. This type of cover hook can be used when there is not an adequate surface to be able to use a stand-up cover lifter. Cover hooks may also be obtained from the

CDM Smith Equipment Centers or from various utility supply vendors.

Removing Covers Using a Cover Hook

A J-type cover hook or pick can be used to remove most types of manhole covers. To use the hook, the basic steps to follow include:

- Insert the hook into one of the cover holes until the end of the hook clears the rib on the underside of the cover.
- If the holes are large enough to engage the rib, turn the hook and engage the rib and pry the cover open a few inches.
- Re-engage the hook under the rib and place your feet about shoulder width on solid footing. Stand almost over the cover at a right angle to the direction the cover is to be moved, stoop slightly and, using your leg muscles, lift and drag the cover clear of the frame.
- Use your leg muscles to lift and drag; do not use your back! Be absolutely sure your footing is secure and that your feet and those of co-workers are clear of the cover!
- Pull the cover to a position where it will not interfere with other work or be a hazard to vehicles or pedestrians. Disengage the hook and place it in a safe location.
- If the cover holes are too small to get the hook in far enough to engage the rib, use the point of the hook to pry the cover loose. Lift the cover with the hook just enough so that a second hook can be inserted and used to engage the rib. Place the first hook out of the way in a safe location and remove the cover with the second hook fully engaged using the steps described above.
- If the cover has lifting holes in the cover instead of the rim, insert the hook into the lifting hole, unseat the cover about 4 inches by lifting with your legs. Re-engage the hook underneath the cover under the rib and remove the cover as described above.

Replacing Covers Using a Cover Hook

To replace a manhole cover using a J–type cover hook, follow the steps listed below:

- Clean the frame seat, sides, and rib of the cover by removing loose material. The cover will not rest evenly in the seat frame if all loose material has not been removed.
- While standing next to the cover at a right angle to the direction the cover is to be moved, spread your feet to shoulder width and engage the hook under the rim.
- Slightly lift the cover using your leg muscles and swing/drag the cover as it pivots on its opposite edge towards the manhole.
- Move to the opposite side of the cover and repeat this technique until the cover partially covers the opening.
- From the point on the cover that is the farthest from the opening, engage the cover hook under the rim and lift the cover until it slides into the seat frame.

16.23.6 Other Manhole Cover Tools

In addition to the two tools described above, various vendors produce and sell tools or equipment to aid in removing or handling manhole covers. Employees are encouraged to bring to the attention of the equipment centers any tool that makes their job safer and more productive. Take care to review manufacturer's literature and use/maintain tools in accordance with their instructions.

16.24 Cell Phone Safety

16.24.1 Cell Phone Use and Driving

The National Highway Traffic Safety Administration (NHTSA) published a report in 2001 titled An Investigation of the Safety Implications of Wireless Communications in Vehicles. Based on the NHTSA report, the following guidelines should be followed when using your cell phone in a vehicle:

- Minimize the use of cell phones while driving. To the extent possible, place calls ahead of time while in the office, home, or if on the road, at a location where you can safely pull off the road.
- If you receive an incoming call, let your voice mail answer it and call the person back after you have stopped the vehicle at a safe location.
- If you must use your phone while driving, use hands-free systems and get to know the features such as auto-redial, speed dial, and voice-activated dialing.
- Engage in short conversations. If lengthy discussions are required, suspend the conversation and find a safe place to stop before continuing the discussion.
- Do not take notes while talking on the phone and driving. (This may seem silly but was not an uncommon observation made by the authors of the NHTSA report.)

Some of the findings in the NHTSA report are summarized below:

- The use of cell phones while driving increases the risk of an accident.
- Contributing factors included distractions while dialing, being startled when the cell phone rang, and the act of engaging in conversation.
- The most significant factor was the act of conversation. The implication of this is that hands-free systems do not mitigate the biggest hazard associated with the use of cell phones while driving.
- Dialing the cell phone, while a distraction, was similar to the distraction potential of manually tuning a car radio.
- There is currently insufficient data to determine the magnitude of the problem because of the inconsistency of reporting accident causes.
- The presence of cell phones in vehicles enhances the notification of emergency services when needed.
- While cellular telephones clearly have distraction potential from many standpoints, such effects may be minimized if drivers are aware of the hazards, are judicious in their use of the technology, and if ergonomically sound cellular telephone designs are used.
- Eighty-five percent of cell phone users use their cell phones while driving.
- Many cities and states either have passed or are considering legislation to regulate cell phone use while driving.

Additional information related to cell phone H&S can be found at the following websites:

www.nhtsa.dot.gov/people/injury/research/wireless

www.nejm.org/content/2001/0344/0002/0133.asp

16.24.2 Radio Frequency Radiation

Some of the information related to radio frequency exposure and cell phone use available from recognized peer reviewed journals and government agencies are listed below:

- Numerous studies looking at the use of hand-held cell phones and risk of brain cancer have indicated no association between the use of cell phones and risk of brain cancer. This includes the two most recent studies published in the Journal of the American Medical Association (AMA) and the New England Journal of Medicine (NEJM), which are among the most comprehensive undertaken as of January 2001.
- Some of the studies conducted have indicated there are biological effects associated with exposure to the types and levels of radio frequency radiation associated with cell phone use; however, there is no consensus that these effects are harmful to people.

- An editorial published in the NEJM referencing a study published in its January 2001 issue concluded, “This study allays fears raised by alarmist reports that the use of cellular phones causes brain tumors. Of course, we do not have the final word on this question, and results of future investigations may modify our perspective. Nevertheless, we believe that it is highly unlikely that the use of cellular telephones substantially increases the risk of brain tumors.”

Based on the information currently available, there is not a significant health hazard associated with radio frequency radiation exposure related to cell phones. Suggestions for limiting radio frequency radiation exposure related to cellular telephone use have been published by the Food and Drug Administration (FDA) and are listed below

- Limit cell phone use. Where possible, hold lengthy conversations on conventional phones and use cell phones for short conversations and for situations when conventional phones are not available.
- When using a mobile phone or a cell phone in a vehicle, connect it to an antenna located outside the vehicle.
- Use a “hands free” headset and a remote antenna with the cell phone carried at the waist.
- Use a cell phone with a low specific absorption rate (SAR) as published by the Federal Communications Commission (FCC).

The FCC has published a list of SAR values for almost all cell phone models manufactured since 2000. The SAR is a measure of the amount of radio frequency radiation absorbed under certain test conditions. This information is available at www.fcc.gov/oet/rfsafety/.

16.25 Coronavirus COVID-19

CDM Smith developed guidance regarding business travel and conducting field work in response to the global outbreak of the novel Coronavirus (COVID-19). These guidance documents were developed based on information obtained from the World Health Organization (WHO) and U.S. Centers of Disease Control (CDC). Memorandums containing the current CDM Smith COVID-19 Guidance for Field Activities and Travel Guidance are provided in **Appendix B**.

Additionally in response to the COVID-19 outbreak, New York State Department of Environmental Conservation (NYSDEC) has issued guidance in the form of a specification and Site Entry Log. These are to be used when performing field work at all NYSDEC sites. The specification and Entry Log are provided in **Appendix B**.

Appendix A

Exhibits

HEALTH AND SAFETY PLAN FORM
CDM Smith Health and Safety Program

This document is for the exclusive use of CDM Smith and its subcontractors

PROJECT NAME ______ **PROJECT#** ______ **REGION** ______

SITE ADDRESS ______ **CLIENT ORGANIZATION** ______

______ **CLIENT CONTACT** ______

CLIENT CONTACT PHONE # ______

( ) **AMENDMENT TO EXISTING APPROVED H&SP?**

( ) **H&SP AMENDMENT NUMBER?** ______ ( ) **DATE OF PREVIOUS H&SP APPROVAL** ______

OBJECTIVES OF FIELD WORK:
(e.g. collect surface soil samples):

SITE TYPE: *Check as many as applicable*

Active	( )	Landfill	( )	Unknown	( )
Inactive	( )	Uncontrolled	( )	Military	( )
Secure	( )	Industrial	( )	Other (specify)	
Unsecure	( )	Recovery	( )		
Enclosed space	( )	Well Field	( )		

All requirements described in the CDM Smith Health and Safety Manual are incorporated in this health and safety plan by reference.

PERSONNEL AND RESPONSIBILITIES

NAMES OF WORK CREW MEMBERS	Company / Division / Office	Current Training & Medical?	Project or Site Responsibilities	Tasks On Site?
			Work Assignment Manager	1-2-3-4-5-6
			Site Health & Safety Coordinator	1-2-3-4-5-6
			2nd Health & Safety Coordinator	1-2-3-4-5-6
			Site Engineer	1-2-3-4-5-6
			Site Engineer	1-2-3-4-5-6
			Site Technician	1-2-3-4-5-6
			Subcontractor	1-2-3-4-5-6

BACKGROUND REVIEW: ( ) Complete ( ) Incomplete

HEALTH AND SAFETY PLAN FORM
CDM Smith Health and Safety Program

This document is for the exclusive use of CDM Smith and its subcontractors

SITE MAP: *Show Exclusion, Contamination Reduction, and Support Zones. Indicate Evacuation and Reassembly Points*

HEALTH AND SAFETY PLAN FORM
CDM Smith Health and Safety Program

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HISTORY: *Summarize conditions that relate to hazard. Include citizen complaints, spills, previous investigations or agency actions, known injuries, etc.*

WASTE TYPES: () Liquid ( ) Solid ( ) Sludge () Gas ( ) Unknown () Other, specify:

WASTE CHARACTERISTICS: *Check as many as applicable.*

() Corrosive	( ) Flammable	() Radioactive
( ) Toxic	( ) Volatile	() Reactive
() Inert Gas	( ) Unknown	
() Other:		

WORK ZONES:

HAZARDS OF CONCERN: *Check as many as applicable.*

() Heat Stress	CDMS Guideline	() Noise	CDMS Guideline
() Cold Stress	CDMS Guideline	() Inorganic Chemicals	
() Explosive/Flammable		() Organic Chemicals	
() Oxygen Deficient		() Motorized Traffic	
() Radiological		() Heavy Machinery	
() Biological		() Slips & Falls	CDMS Guideline
() Other:			
() Other:			

FACILITY'S PAST AND PRESENT DISPOSAL METHODS AND PRACTICES:

This plan incorporates CDM Smith's procedure for: *(Click on the relevant topics to download the hazard guideline. Delete irrelevant topics.)*

Housekeeping	Traffic and Work Zone Safety	Tools and Power Equipment	Working Safely Around Geoprobes
Manual Material Handling	Excavations	Working Around Heavy Equipment	Hazardous Waste Site Controls
Electrical Safety	Ladders	Working Near or Over Water	Working Safely Around Drill Rigs
Lock Out/Tag Out	Scaffolds	Flammable and Combustible Liquids	Fall Protection
Compressed Gases	Mechanized Personnel Lifts	Hazardous Waste Site Decontamination	

HEALTH AND SAFETY PLAN FORM
CDM Smith Health and Safety Program

This document is for the exclusive use of CDM Smith and its subcontractors

DESCRIPTION AND FEATURES: *Include principal operations and unusual features (containers, buildings, dikes, power lines, hillslopes, rivers, etc.)*

SURROUNDING POPULATION: ( ) Residential ( ) Industrial ( ) Commercial ( ) Rural ( ) Urban OTHER:

HAZARDOUS MATERIAL SUMMARY: ***Highlight or bold waste types and estimate amounts by category.***

CHEMICALS: *Amount/Units:*	**SOLIDS:** *Amount/Units:*	**SLUDGES:** *Amount/Units:*	**SOLVENTS:** *Amount/Units:*	**OILS:** *Amount/Units:*	**OTHER:** *Amount/Units:*
Acids	Flyash	Paints	Ketones	Oily Wastes	Laboratory
Pickling Liquors	Mill or Mine Tailings	Pigments	Aromatics	Gasoline	Pharmaceutical
Caustics	Asbestos	Metals Sludges	Hydrocarbons	Diesel Oil	Hospital
Pesticides	Ferrous Smelter	POTW Sludge	Alcohols	Lubricants	Radiological
Dyes or Inks	Non-Ferrous Smelter	Distillation Bottoms	Halogenated (chloro, bromo)	Polynuclear Aromatics	Municipal
Cyanides	Metals	Aluminum	Esters	PCBs	Construction
Phenols	Dioxins		Ethers	Heating Oil	Munitions
Halogens					
Other - *specify*	Other - *specify*	Other - *specify*	Other - *specify*	Other - *specify*	Other - *specify*

HEALTH AND SAFETY PLAN FORM
CDM Smith Health and Safety Program

This document is for the exclusive use of CDM Smith and its subcontractors

KNOWN CONTAMINANTS	HIGHEST OBSERVED CONCENTRATION	PEL/TLV *ppm or mg/m3 (specify)*	IDLH *ppm or mg/m3 (specify)*	Warning Concentration *(in ppm)*	SYMPTOMS & EFFECTS OF ACUTE EXPOSURE	PHOTO IONIZATION POTENTIAL
Ammonia		25 ppm	300 ppm	17 ppm	Irritated nose & throat, chest pain	10.18
Sodium hydroxide		C-2 mg/m3	10 mg/m3	no odor	Irritated nose, burns eyes & skin, pneumonia	9.00

NA = Not Available **NE = None Established** **U = Unknown**

Verify your access to an MSDS for each chemical you will use at the site.

S = Soil SW = Surface Water T = Tailings W = Waste TK = Tanks SD = Sediment
A = Air GW = Ground Water SL = Sludge D = Drums L = Lagoons OFF = Off-Site

HEALTH AND SAFETY PLAN FORM
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SPECIFIC TASK DESCRIPTIONS	Disturbing the Waste?	TASK - SPECIFIC HAZARDS	HAZARD & SCHEDULE
1	Pick from the list		Pick from the list
2	Pick from the list		Pick from the list
3	Pick from the list		Pick from the list
4	Pick from the list		Pick from the list
5	Pick from the list		Pick from the list
6	Pick from the list		Pick from the list

SPECIALIZED TRAINING REQUIRED:

SPECIAL MEDICAL SURVEILLANCE REQUIREMENTS:

OVERALL HAZARD EVALUATION: ( ) High ( ) Medium ( ) Low ( ) Unknown *(Where tasks have different hazards, evaluate each.)*

JUSTIFICATION:

FIRE/EXPLOSION POTENTIAL: ( ) High ( ) Medium ( ) Low ( ) Unknown

PROTECTIVE EQUIPMENT: *Specify by task. Indicate type and/or material, as necessary. Group tasks if possible. Use copies of this sheet if needed.*

BLOCK A

TASKS: 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10
LEVEL: A - B - C - D - Modified
( ) Primary ( ) Contingency

Respiratory: ( ) Not needed
( ) SCBA, Airline:
( ) APR:
( ) Cartridge:
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not needed
( ) Safety Glasses:
( ) Face Shield:
( ) Goggles:
( ) Hard Hat:
( ) Other:

Boots: ( ) Not needed
( ) Steel-Toe ( ) Steel Shank
( ) Rubber ( ) Leather
( ) Overboots:

Prot. Clothing: ( ) Not needed
( ) Encapsulated Suit:
( ) Splash Suit
( ) Apron:
( ) Tyvek Coverall or
( ) Saranex Coverall
( ) Cloth Coverall:
( ) Hi-Visibility Vest
( ) Other:

Gloves: ( ) Not needed
( ) Undergloves:
( ) Gloves:
( ) Overgloves:

Other: specify below
( ) Tick Spray
( ) Flotation Device If Over Water
( ) Hearing Protection
( ) Sun Screen

BLOCK B

Exit Area

TASKS: 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10
LEVEL: A - B - C - D - Modified
( ) Primary ( ) Contingency

Respiratory: ( ) Not needed
( ) SCBA, Airline:
( ) [illegible]
( ) [illegible]dge:
( ) [illegible]:
( ) [illegible]

Head and Eye: ( ) Not needed
( ) Safety Glasses:
( ) Face Shield:
( ) Goggles:
( ) H[illegible]d Hat:
([illegible]

Boots[illegible]t needed
[illegible]teel S[illegible]
( ) Rubber ( ) Leather
( ) Overboots: Latex

Prot. Clothing: ( ) Not needed
( ) Encapsulated Suit:
[illegible]pla[illegible]uit
[illegible]
[illegible]yv[illegible]overall or
[illegible]ara[illegible]Coverall
[illegible]loth[illegible]rall:
( ) Other:

Gloves: ( ) Not needed
( ) Undergloves:
( ) Gloves:
( ) Overgloves:

[illegible]ow
( ) Ti[illegible]
( ) Floatation Device
( ) Hearing Protection
( ) Sun Screen

BLOCK C

TASKS: 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10
LEVEL: A - B - C - D - Modified
( ) Primary ( ) Contingency

Respiratory: ( ) Not needed
( ) SCBA, Airline:
( ) APR:
( ) Cartridge:
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not needed
( ) Safety Glasses:
( ) Face Shield:
( ) Goggles:
( ) Hard Hat:
( ) Other:

Boots: ( ) Not needed
( ) Steel-Toe ( ) Steel Shank
( ) Rubber ( ) Leather
( ) Overboots:

Prot. Clothing: ( ) Not needed
( ) Encapsulated Suit:
( ) Splash Suit
( ) Apron:
( ) Tyvek Coverall
( ) Saranex Coverall
( ) Cloth Coverall:
( ) Other:

Gloves: ( ) Not needed
( ) Undergloves:
( ) Gloves:
( ) Overgloves:

Other: specify below
( ) Tick Spray
( ) Flotation Device If Over Water
( ) Hearing Protection
( ) Sun Screen

BLOCK D

TASKS: 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10
LEVEL: A - B - C - D - Modified
( ) Primary ( ) Contingency

Respiratory: ( ) Not needed
( ) SCBA, Airline:
( ) APR:
( ) Cartridge:
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not needed
( ) Safety Glasses:
( ) Face Shield:
( ) Goggles:
( ) Hard Hat:
( ) Other:

Boots: ( ) Not needed
( ) Steel-Toe ( ) Steel Shank
( ) Rubber ( ) Leather
( ) Overboots:

Prot. Clothing: ( ) Not needed
( ) Encapsulated Suit:
( ) Splash Suit
( ) Apron:
( ) Tyvek Coverall
( ) Saranex Coverall
( ) Cloth Coverall:
( ) Other:

Gloves: ( ) Not needed
( ) Undergloves:
( ) Gloves:
( ) Overgloves:

Other: specify below
( ) Tick Spray
( ) Floatation Device
( ) Hearing Protection
( ) Sun Screen

This health and safety plan form constitutes hazard analysis per 29 CFR 1910.132

HEALTH AND SAFETY PLAN FORM **CDM Smith Health and Safety Program**	*This document is for the exclusive use of CDM Smith and its subcontractors*	CDM Smith

MONITORING EQUIPMENT: *Specify by task. Indicate type as necessary. Attach additional sheets if needed.*

INSTRUMENT	TASK	ACTION GUIDELINES		COMMENTS
Combustible Gas Indicator	1-2-3-4-5-6-7-8	0-10% LEL	*No explosion hazard*	( ) Not Needed
		10-25% LEL	*Potential explosion hazard; notify SHSC*	
		>25% LEL	*Explosion hazard; interrupt task/evacuate*	
		21.0% O2	*Oxygen normal*	
		<21.0% O2	*Oxygen deficient; notify SHSC*	
		<19.5% O2	*Interrupt task/evacuate*	
Radiation Survey Meter	1-2-3-4-5-6-7-8	3 x Background:	*Notify HSM*	( ) Not Needed
		>2mR/hr:	*Establish REZ*	
Photoionization Detector _____eV Lamp Type ____	*Specify:* 1-2-3-4-5-6-7-8			( ) Not Needed
Flame Ionization Detector Type____________	*Specify:* 1-2-3-4-5-6-7-8			( ) Not Needed
Single Gas Type____________ Type____________	*Specify:* 1-2-3-4-5-6-7-8			( ) Not Needed
Respirable Dust Monitor Type____________ Type____________	*Specify:* 1-2-3-4-5-6-7-8			( ) Not Needed
Other Type____________ Type____________	*Specify:* 1-2-3-4-5-6-7-8			( ) Not Needed
Other Type____________ Type____________	*Specify:* 1-2-3-4-5-6-7-8			( ) Not Needed

HEALTH AND SAFETY PLAN FORM
CDM Smith Health and Safety Program

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DECONTAMINATION PROCEDURES

ATTACH SITE MAP INDICATING EXCLUSION, DECONTAMINATION, & SUPPORT ZONES AS PAGE TWO

Personnel Decontamination	Sampling Equipment Decontamination	Heavy Equipment Decontamination
Summarize below or attach diagram;	*Summarize below or attach diagram;*	*Summarize below or attach diagram;*
( ) Not Needed	( ) Not Needed	( ) Not Needed
Containment and Disposal Method	**Containment and Disposal Method**	**Containment and Disposal Method**

HAZARDOUS MATERIALS TO BE BROUGHT ONSITE

Preservatives		*Decontamination*		*Calibration*	
( ) Hydrochloric Acid	( ) Zinc Acetate	( ) Alconox TM	( ) Hexane	( ) 100 ppm isobutylene	( ) Hydrogen Sulfide
( ) Nitric Acid	( ) Ascorbic Acid	( ) Liquinox TM	( ) Isopropanol	( ) Methane	( ) Carbon Monoxide
( ) Sulfuric Acid	( ) Acetic Acid	( ) Acetone	( ) Nitric Acid	( ) Pentane	( ) pH Standards
( ) Sodium Hydroxide	( ) Other:	( ) Methanol	( ) Other:	( ) Hydrogen	( ) Conductivity Std
		( ) Mineral Spirits		( ) Propane	( ) Other:

HEALTH AND SAFETY PLAN FORM **CDM Smith Health and Safety Program**	*This document is for the exclusive use of CDM Smith and its subcontractors*	CDM Smith

EMERGENCY CONTACTS	
Water Supply	
EPA Release Report #:	800 / 424 - 8802
24 Hr. First Aid/Non-Emergency Medical Services	**1-800-350-4511, Press 1**
Facility Management	
Other (specify)	
CHEMTREC Emergency #:	800 / 424 - 9300

SAFETY NARRATIVE: *Summarize below*

EMERGENCY CONTACTS	**NAME**	**PHONE**
Health and Safety Manager	**Pick from the list**	
Site Safety Coordinator		
Client Contact		
Other *(specify)*		
Environmental Agency		
State Spill Number	**Pick from the list**	
Fire Department		911
Police Department		911
State Police		911
Health Department		
Poison Control Center	Nationwide	800 / 222 - 1222
Occupational Physician	Dr. Fred Kohanna	800 / 350 - 4511

For non-emergency medical services:

1. Call AllOne Health at **1.800.350.4511, PRESS 1,** and tell them you are reporting an injury for CDM Smith. Supply requested information.
2. Follow AllOne Health instructions (e.g., first aid, go to clinic, etc.).
3. After care, follow-up with AllOne at the 1-800 #.

MEDICAL EMERGENCY	**PHONE**
Hospital Name:	
Hospital Address	
Name of Contact at Hospital:	
Name of 24-Hour Ambulance:	
Route to Hospital:	

Distance to Hospital ____________________

HEALTH AND SAFETY PLAN APPROVALS (H&S Mgr must sign each plan)

Prepared by ________________________ Date ____________

HSM Signature

CDM Smith

HEALTH AND SAFETY PLAN SIGNATURE FORM

updated 9/22/15

All site personnel must sign this form indicating receipt of the H&SP. Keep this original on site. It becomes part of the permanent project files. Send a copy to the health and safety manager (HSM).

SITE NAME/NUMBER: ______________________________

DIVISION/LOCATION: ______________________________

CERTIFICATION:

I understand, and agree to comply with, the provisions of the above referenced H&SP for work activities on this project. I agree to report any injuries, illnesses or exposure incidents to the site health and safety coordinator (SHSC). I agree to inform the SHSC about any prescription drugs or over-the-counter medication that may cause impairment that I take within 24 hours of site work.

PRINTED NAME	SIGNATURE	DATE

Exhibit 12A CDM Smith Confined Space Entry Permit

Project or Contract: ______________________________

Space to be Entered: ______________________________

Section drawing showing material and energy inputs attached? __YES __NO

Nature of Task: ______________________________

______________________________ Hot Work? ______

Is there a potential for:

Physical Injury?	_______	Vehicular Traffic?	______	Toxic Gases or Vapors?	______
Explosive Gases?	_______	Oxygen Deficiency?	______	Exposure to Microbes?	______
Heat Stress?	_______	Cold Stress?	______	Engulfment?	______

Duration of Permit: From: ____________________ To: ____________________

Entry Supervisor ______________________________

Authorized Entrants: ______________________________

Rescuers: ______________________________

Attendants: ______________________________

Means of Communication with Entrants: ______________________________

____

Safety Equipment Outside the Space:

Needed?	In Place?	(To Be Initialed By Entry Supervisor)
_______	_______	Traffic cones or barriers in place
_______	_______	Ventilation system in operation
_______	_______	Rescue and retrieval equipment in place
_______	_______	SCBA inspected and ready (topside) for emergency use.
_______	_______	Valves locked out or made inoperable (N/A if not applicable).
_______	_______	Electrical equipment disconnected & locked out (or N/A).
_______	_______	Pneumatic & hydraulic equipment disconnected & locked out (or N/A).
YES	_______	Rescue service is currently available.
_______	_______	Radio, phone, or portable phone reaches rescue team
_______	_______	Ignition sources eliminated/isolated.

Safety Equipment in the Space :

Needed?	In Place?		Needed?	In Place?	
______	_______	SCBA or Airline respirator	______	______	5-min. escape pack
______	_______	Air filtering respirator	______	______	Ladder for entry
______	_______	Steel-toe safety shoes	______	______	Rubber overboots
______	_______	Surgical inner gloves	______	______	Rubber outer gloves
______	_______	Leather or cloth gloves	______	______	Cloth coveralls
______	_______	Tyvek or Saranex coveralls	______	______	PVC rain suit
______	_______	Safety goggles or glasses	______	______	Face shield
______	_______	Safety harness & lifeline	______	______	Hard hat
______	_______	Fire extinguisher (topside)	______	______	Flashlight or lamp

Atmospheric Testing and Conditioning:

Calibrate instruments per manufacturer's instructions. Measure gases just inside the space and at locations workers will occupy.

Needed?		Readings			
N/A	Time of Day	______	______	________	_______
_____	Oxygen deficiency (>19.5% and <21.5%)	______	______	________	_______
_____	Flammable gases (Less than 10% LEL)	______	______	________	_______
_____	Toxics (<PEL) Specify:___________	______	______	________	_______
Yes	Initials of Attendant	______	______	________	_______

Emergency Service	Provider	Telephone Number
CDM Smith 24 hour Emergency	CDM CHSO	732 / 539 - 8128
Health and Safety Manager		
Project Manager		
Space Entry Coordinator		
Client Contact		
Fire Department		
Police Department		
Health Department		
Poison Control Center		800 / 222
- 1222		
Hospital address		
Contact at hospital		
24-hour ambulance		

Route to Hospital (instructions or map):

Special Instructions:

PERMIT APPROVED: ______________________________ ______________________________

Confined-Space-Entry Coordinator — Date

ENTRY APPROVED: ______________________________ ______________________________

Entry Supervisor — Date

Exhibit 14-A Bloodborne Pathogens Exposure Incident Report

Section 1 – To be completed by Exposed Employee, Direct Manager or Resource Manager,

First Name:____ Middle Initial: ________

Last Name:____ Division: ______

Office:_ Employee Number ___

Sex: < M < F Age: __

Address:
____

____

Phone Number: _______

Employment Category: **Length of Employment:** **Time in Occupation:**

< Regular Full time < Regular Part time < Temporary < Non-employee

Section 2 – To be completed by Exposed Employee, Direct Manager or Resource Manager,

Date of Incident________Time: _

Specific Location of Incident: _

Witness(es) to the Incident: __

Employee's Usual Occupation: ________

Occupation at Time of Incident: _______

Direct Manager or Resource Manager _

Phase of Employee's Workday at Time of Injury:

< Performing Work Duties < During Meals < During Rest Period

< Entering or Leaving Workplace < Other ________

General Type of Task Being Performed at Time of Incident: ______

____

Supervision at Time of Accident:

< Directly Supervised < Indirectly Supervised < Not Supervised < Supervision Not Feasible

Exhibit 14-A Bloodborne Pathogens Exposure Incident Report (Continued)

Description of Exposure Incident:

Location:____________________________ Date:___________________________

Time: _______________________________

Details of Exposure Incident – Identify Type of Exposure, Frequency, Duration, Intensity and Exposure Route

Name, Address, and Phone Number of Attending Physician (If Applicable):

Section 3 –	To be completed by Exposed Employee, Direct Manager or Resource Manager,

Name of Source Individual (If known): ____

Employer of Source Individual: ____________________

Contact Phone Number: ____________________

Exhibit 16A CDM Smith Permit for Work on Energized Circuits

Date work to commence: ______________ Date ______________

work complete: Equipment description: ______________

Work Description: ______________

Can this equipment be shut down? ☐ Yes ☐ No

If “No”, why not? ______________

Does this equipment have a disconnect? ☐ Yes ☐ No

Is a utility shutdown required? ☐ Yes ☐ No

Safe Work Practices:			
Results of Shock Hazard Analysis:			
Shock Protection Boundary: All points within____feet____inches of an exposed live part.			
Results of Flash Hazard Analysis:			
Flash Protection Boundary: All points within____feet____inches of an exposed live part.			
Names of individuals who will perform work:			
1.		2.	
3.		4.	
Name of individuals who will be present with a valid First Aid/CPR card:			
1.		2.	
Emergency procedures: Leave the area quickly. Contact authorities.			
Task Supervisor (name and phone #):			
Safety equipment that will be required: ______________			
(Attach a sketch of the layout and setup if necessary.)			

Submitted By:			Qualified Person
Approved By:			CDM Site Safety Representative
Approved By:			Client Representative (if required)

Exhibit 16B Lock Out/ Tag Out Inspection Form

Project Name:____________________________________ **Project Number:**_________________

1. Inspection Conducted by:______________________________on____________________________
2. Machines/Equipment Inspected:____
3. Names of Employees Checked:____
4. Deficiencies Notes:____
5. Corrective Action Taken:____

		YES	NO
6.	Have employees (contractors) been trained/instructed in our lockout procedure?	________	________
7.	Are lock and/or tag devices authorized by the company procedure?	________	________
8.	Are all effected employees (contractors) notified that a lockout is required and the reason for it?	________	________
9.	Is equipment being shut down by required shutdown procedure?	________	________
10.	Are the switches, valves, or other energy isolating devices disconnected or isolated from the equipment?	________	________
11.	Are the energy isolating devices located out/tagged out by an authorized employee’s individual lock/tag?	________	________
12.	Are the push buttons or other normal operating controls checked to see if the energy sources are disconnected and that the equipment cannot operate?	________	________
13.	Are equipment areas checked to see that personnel are not in the area and all locks/tags are removed?	________	________
14.	If more than on individual is required to lockout equipment, does each person place his/her own personal lock/tag on the energy isolating deivce(s)? Are all steps of group lockout/tagout procedures observed?	________	________
15.	If an employee or contractor is not available to clear his/her lock/tag, does the supervisor remove the lock/tag after taking all the precautions listed in our lockout/tagout program?	________	________

Exhibit 16C

System Voltage (volts, phase-to- phase)	Upstream Protection Fault-Clearing Time (sec)	Maximum 3-Phase Bolted-Fault Current for Use of HRC 2 PPE (8 CAL/CM2)	Maximum 3-Phase Bolted-Fault Current for Use of HRC 4 PPE (40 CAL/CM2)
690	0.05	39 kA	180 kA
	0.10	20 kA	93 kA
	0.20	10 kA	48 kA
	0.33	Not Recommended	29 kA
	0.50	Not Recommended	20 kA
600	0.05	48 kA	200 kA*
	0.10	24 kA	122 kA
	0.20	12 kA	60 kA
	0.33	Not Recommended	36 kA
	0.50	Not Recommended	24 kA
480	0.05	68 kA	200 kA*
	0.10	32 kA	183 kA
	0.20	15 kA	86 kA
	0.33	8 kA	50 kA
	0.50	Not Recommended	32 kA
400	0.05	87 kA	200 kA*
	0.10	39 kA	200 kA*
	0.20	18 kA	113 kA
	0.33	10 kA	64 kA
	0.50	Not Recommended	39 kA
208	0.05	200 kA*	Not Applicable 200 kA*
	0.10	104 kA	

Exhibit 16-D

Minimum Measures For Level D Decontamination

Station 1 - Equipment Drop	Deposit equipment used on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather, a cool down station may be set up in this area.
Station 2 - Outer Garment, Boots, and Gloves Wash and Rinse	Scrub outer boots, outer gloves, and suit with decon-tamination solution or detergent/water. Rinse off using copious amounts of water.
Station 3 - Hard Hat, Outer Boot, and Glove Removal	Remove hard hat, outer boots, and gloves.
Station 4 - Boots, Gloves, and Outer Garment Removal	Remove boots, suit, and inner gloves and deposit in separate containers lined with plastic.
Station 5 - Field Wash	Wash hands and face.

Minimum Measures For Level B and C Decontamination

Station 1 - Equipment Drop	Deposit equipment used on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather, a cool down station may be set up in this area.
Station 2 - Outer Garment, Hard Hat, Boots, and Gloves Wash and Rinse	Scrub outer boots, hard hat, outer gloves, and suit with decontamination solution or detergent/water. Rinse off using copious amounts of water.
Station 3 - Tank/Air Canister Change	If a worker leaves the exclusion zone to change an air tank, air canister, or mask, this is the last step in the decontamination procedure. Worker’s air tank is exchanged, new outer gloves and boots donned, and joints tapped. Worker returns to duty.
Station 4 - Outer Boots, and Glove Removal	Remove outer boots and gloves. Deposit in container with plastic liner.
Station 5 - SCBA/Respirator Removal	SCBA backpack and facepiece/respirator is removed (avoid touching face with fingers). SCBA or respirator is deposited on plastic sheets.
Station 6 - Inner Gloves and Outer Garment Removal	Remove suit and inner gloves and deposit in separate containers lined with plastic.
Station 7 - Field Wash	Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Wash hands and face.

Appendix B

COVID-19 Guidance

CDM Smith

Memorandum

Date: *April 3, 2020*
Subject: *Field Guidance*

COVID-19 Prevention Guidance for Field Activities

Per Tim Wall's memorandum on 3/16/20, Working Safely during the Coronavirus (COVID-19) Outbreak Update, we have new firm-wide policies for how to best respond to this outbreak, establish continuity of operations, and protect personnel.

This document is intended to provide basic guidance to field and project teams that have operations outside of a CDM Smith office other than CCI construction sites. Included are measures on how to best protect employees and minimize potential exposure to COVID-19.

Planning

All projects involving field work should have an H&S plan to address specific hazards associated with that project. Since potential exposure to this virus is a new hazard, those H&S plans will need to be modified at the project level to address their specific COVID-19 exposures. These modifications will need to be communicated to personnel ASAP. The practices below must be evaluated and included in any greater planning activities and project-specific H&S plans. For non-routine exposure scenarios contact your H&S Manager for assistance in working out appropriate precautions.

COVID-19 Practices to Minimize Exposure

COVID-19 exposure is most directly associated with close contact with an infected individual. There are also less direct means of contact that are not as fully understood such as contact with contaminated surfaces, droplets, and residues. To minimize exposure, it is imperative that field staff exercise the precautions below

When not to report for Site Work

Have you had exposure to or contact with someone diagnosed with COVID-19? Close contact means having been within 6 feet of that person for an extended time or being exposed to their cough or sneeze.

- You have a fever, a cough, difficulty breathing or have lost your sense of taste or smell.
- Has a Public Health Official informed you that you were potentially exposed to COVID-19?
- Do you share a household with a public health professional who might have been exposed?

What to do if you or someone gets sick while on site:

- If you become ill while on travel or at work, you should self-isolate in your hotel room and contact Allone Health to determine if you should visit a medical facility or local medical provider. From there, notify your supervisor, team lead, or HR representative of your symptoms and any recommendations from Allone Health. For COVID-19 like symptoms, most medical providers are requesting that you call first before seeking treatment.

- In general, an employee that is sick can return to the site once their healthcare provider has cleared them to return for duty. If they test positive for COVID-19, typically they would need to test negative two consecutive times before being allowed to return to work.

Best Practices

- Maintain social distancing. Stay a minimum of 5-6 feet away from other people. **<u>This is the most important action to limit exposure.</u>**

- Minimize contact with others. Do not shake hands (use non-contact greetings).

- Increase the frequency of hand washing, for a minimum of 20 seconds. Use hand sanitizer as you can.

- The voluntary use of a cloth face mask or bandanas are encouraged to minimize face touching and distribution of droplets and aerosols from individuals. CDM Smith is attempting to procure these, however staff are encouraged to obtain on their own or make them themselves. See https://www.ecommunity.com/giveppe/homemade-mask-instructions or https://www.youtube.com/watch?v=j8aYEBtUQ9E&feature=youtu.be
    - Please note that use of a cloth face mask is not adequate protection alone, physical distancing, hand washing, and disinfection of common surfaces needs to be incorporated into your daily activities and the loose-fitting face masks should not be used where the use of N95 or ½ respirators have been approved.

- No sharing of PPE without first disinfecting the equipment.

- Do not use common coffee pots or water coolers. Bring your own and use individual water bottles.

- Minimize time in shared office spaces, trailers etc. Maximize physical distancing.

- Avoid touching your face, in particular your mouth, eyes, and nose.

- Regularly disinfect common surfaces, several times per day if possible. If not available, the surface can be cleaned with soap and water or a diluted solution of bleach (https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/disinfecting-your-home.html)

- Plan work and meetings to minimize the density of people in one area.

- Organize virtual meetings as opposed to in-person meetings where possible.

- At the beginning of your work day, discuss with any CDM Smith or Client team members the precautions that are to be taken to minimize exposure.

- Disinfectants to consider (https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2)or alternative disinfectants as follows:
    - isopropyl alcohol (aka isopropanol aka IPA) min. 70%-recommended sit time 5 minutes,
    - household hydrogen peroxide, min. 3% (Note: opened/expired H_20_2 will likely be less than 3%, start with unopened/unexpired bottle) – recommended sit time 2 minutes (test as it may bleach fabrics),
    - quaternary ammonium, recommended sit time 5-10 minutes dependent on the mixture. (via spray bottle) *,

- 10% bleach (1 part 5% household bleach to 9 parts water); recommended sit time up to 10 minutes depending on the label (spray bottle) *

The physical distancing, personal hygiene, and use of protective equipment guidance above are the most effective means to minimize exposures to COVID-19

The equipment center has a limited inventory of N95 masks for activities that present potential airborne hazards that cannot be mitigated through social distancing. The equipment center also has a limited inventory of nitrile protective gloves for hazards that involve frequent contact with potentially contaminated surfaces. However, frequent handwashing, wiping of common surfaces, and the social distancing/personal hygiene actions described are considered sufficient protection in most cases.

SECTION 01 35 33 – COVID-19 RISK MANAGEMENT

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes requirements for managing and minimizing the potential for transmission of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus, which causes the Novel Coronavirus Disease 2019 (COVID-19). COVID-19 typically causes respiratory illness in people.

B. Transmission: SARS-CoV-2 is currently known to spread via respiratory droplets produced when a person infected with the virus coughs or sneezes, the same way flu and other respiratory illnesses spread. SARS-CoV-2 can also be transmitted if people touch surfaces and objects with the virus on it.

C. Symptoms: COVID-19 can cause mild to severe respiratory illness with symptoms of fever, cough, and difficulty breathing. Preliminary information suggests older adults and people with underlying health conditions or compromised immune systems may be at higher risk of severe illness from this virus. Center for Disease Control (CDC) believes that symptoms of COVID-19 begin between 2 and 14 days after exposure.

D. Best Practices to Prevent Infection: Currently the best way identified to prevent infection is to minimize the potential of exposure to SARS-CoV-2. CDC recommends everyday actions to help prevent the spread of any respiratory viruses

- Wash your hands often with soap and water for at least 20 seconds. If soap and water are not available, use an alcohol-based hand sanitizer, containing at least 60% alcohol.
- Avoid touching your eyes, nose, and mouth with unwashed hands.
- Avoid close contact with people who are sick.
- Stay home when you are sick.
- Cover your cough or sneeze with a tissue, then throw the tissue in the trash can and wash hands or use hand sanitizer.
- Clean and disinfect frequently touched objects and surfaces.
- Wear face masks
- Safe social distancing (e.g., maintain a distance of 6 feet between people, limited group meetings)

1.2 OBJECTIVE

A. The objective of this specification is to minimize transmission and subsequent infections of COVID-19 in project staff that may arise as a result of exposure to SARS-CoV-2 released into the environment during construction and renovation activities. Controlling the dispersal of airborne infectious agents is critical to achieving this objective.

1.3 PERFORMANCE REQUIREMENTS AND RESPONSIBILITIES

A. The intent of this Section is to document and formalize the Contractor's requirements for minimizing the risk of transmission of COVID-19 among site workers, project staff, and the surrounding community during construction per the latest recommendations of federal, state and local health agencies. This includes developing a COVID-19 Management Plan, establishing procedures for conducting onsite work activities to prevent virus transmission, monitoring staff health, and reporting requirements.

B. The Contractor is expected to communicate the requirements described in this section to all site workers, subcontractors, and visitors to the site daily, during daily Health and Safety meetings as well as through site postings (see attachment).

C. Contractors and their subcontractors are required at all times to guard the safety and health of all persons on and in the vicinity of the work site.

D. Contractors and their subcontractors are required to comply with all applicable rules, regulations, codes, and bulletins of the New York State Department of Labor and the standards imposed under the Federal Occupational Safety and Health Act of 1970, as amended ("OSHA").

E. Contractors and their subcontractors must comply with all City or State of New York safety requirements for projects within the City or State of New York constructed in accordance with the applicable building code.

F. Contractors and their subcontractors shall stay current and immediately implement the most up-to-date government issued practices to protect the safety and health of your employees, clients, and the general public.

1.4 RELATED SECTIONS

A. Section <INSERT APPLICABLE REFERENCE>, Contractor’s Health and Safety Plan

1.5 REFERENCES

A. Occupational Safety and Health Administration (OSHA) Guidance on Preparing Workplaces for COVID-19

B. New York State Department of Health

C. Centers for Disease Control and Prevention (CDC)

D. National Institute for Occupational Safety and Health (NIOSH)

E. Health Insurance Portability and Accountability Act (HIPAA)

1.6 SUBMITTALS

A. The Contractor shall prepare a COVID-19 Management Plan which can be a Supplement, or Addendum, to the Contractor’ Health and Safety Plan

B. The CONTRACTOR shall develop a one-page summary of site-specific practices for COVID-19 management and clearly display on site. Operating hours, delivery times, and extra considerations for works involving a high volume of personnel or potential for interaction with community members could also be included in the summary.

C. The Contractor's Daily Field Report shall include a Daily Health Checklist, with the following questions at a minimum:

DAILY HEALTH CHECKLIST

Is social distancing being practiced?	Yes ☐	No ☐
Is the tail gate safety meeting held outdoors?	Yes ☐	No ☐
Are remote/call-in job meetings being held in lieu of meeting in person where possible?	Yes ☐	No ☐
Were personal protective gloves, masks, and eye protection being used?	Yes ☐	No ☐
Are sanitizing wipes, wash stations or spray available?	Yes ☐	No ☐
Have any workers/visitors been excluded based on close contact with individuals diagnosed with COVID-19, have recently traveled to restricted areas or countries, or are symptomatic (fever, chills, cough/shortness of breath)?	Yes ☐	No ☐
Comments:		

1.7 COVID-19 MANAGEMENT PLAN

A. At a minimum, the COVID-19 Management Plan shall include:
1. Identification of potential exposure pathways and exposure risks associated with work tasks, e.g. activity hazard analysis (AHA).
2. Identification of local health department contact information and COVID-19 testing sites and procedures.
3. Detailed written description of the onsite personnel protection measures that will be utilized and a detailed explanation of how they will be implemented, monitored, and communicated.
4. Detailed written description of measures that will be taken to prevent transmission to or from the surrounding community and how they will be implemented and communicated.
5. Procedures to be followed in the event a site worker is diagnosed with or is suspected of having COVID-19, including identification of all personnel potentially exposed and isolation requirements.
6. Daily cleaning schedules and disinfection procedures per the most recent CDC guidelines.
7. Cleaning and disinfection procedures in the event there is/are suspected COVID-19 case(s) among site personnel.
8. Site access controls and entry/exit procedures.
9. Plan view of points of egress and delivery locations.

B. The COVID-19 Management Plan must be updated following any issued change(s) in federal, state, or local health agency guidance.

1.8 PRECONSTRUCTION CONFERENCE

A. Pre-Construction Conference shall include a review of methods and procedures related to COVID-19 risk management including, but not limited to the following:
1. Review of COVID-19 Management Plan

2. Review infection control procedures
3. Review staff monitoring and reporting requirements.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 RISK IDENTIFICATION

A. COVID-19 is a new disease; scientists and health agencies are continuously learning about how it spreads. The Contractor shall adjust site policies based on the most up to date government issued guidance regarding transmission.

B. Contractor shall confirm staff that have worked in locations where quarantine orders are in place, have met the minimum quarantine guidance and do not have symptoms prior to mobilizing to site.

C. Contractor shall monitor staff daily, including checking, and documenting, temperature with no contact infrared thermometer, to confirm onsite staff do not exhibit COVID-19 symptoms. Contractor shall provide daily reports of those tests upon NYSDEC's request.

3.2 RISK MINIMIZATION

A. Engineering Controls
1. Increasing ventilation rates of interior workspaces.
2. Access controls, including fences and locking gates.
3. Maintain 6 feet distances, using distance markers where appropriate in the field.

B. Administrative Controls
1. Continuous and effective communication of administrative controls/requirements to all site personnel and visitors, through the posting of site signage, preparation and distribution of site plans, presented during site meetings, and verbal warnings if necessary.
2. Require that all employees exhibiting any COVID-19 symptom do not enter the site and provide sick leave policies to support this requirement.
3. To minimize face-to-face interaction, the Site's Health & Safety Officer's (or other designated employee) phone number shall be prominently posted and disseminated to project staff to be called for the purpose of site sign in and sign out by all visitors to the site upon arrival and exit. The designated employee will receive entry and exit calls each day and will fill out the site entry/exit log for each site visitor to reduce traffic in site trailer and/or the number of individuals contacting the site access tracking log.
4. Staffing: only those employees necessary to complete critical path task(s) shall be present on-site at any given time. Work shall be scheduled to minimize the density of personnel in any given area at any given time.
5. Working Remotely; employees shall be encouraged to complete work remotely if possible.
6. Face-to-face meetings shall be replaced with video or phone conferences when practicable.

7. Social distancing shall be exercised for face-to-face meetings e.g. daily Health and Safety tailgate meeting. In addition, the Contractor shall plan to have multiple meetings (if necessary) to keep the number of participants to a threshold that allows for the practice of social distancing protocol. The Health and Safety officer will keep a record of all present for each meeting on the Health and Safety log.
8. Quarantine staff that have been in contact with a anyone that tested positive and notify NYSDEC immediately.

C. Safe Work Practices
   1. The Contractor shall employ social distancing protocol for all onsite activities when able.
   2. The Contractor provide PPE and adequate hand washing stations and hand sanitizer (containing a minimum of 60% alcohol) to allow site personnel and visitors to practice good personal hygiene.
   3. The Contractor shall provide tissues, paper towels, no-touch trash cans, and disinfectants to maintain site cleanliness.
   4. Sharing of tools and heavy equipment shall be limited to the extent practicable; handles of shared tools and equipment shall be sanitized regularly.

D. Personal Protective Equipment
   1. Employees shall be provided disposable personal protective equipment (PPE), including gloves, goggles, face shields, face masks, and respiratory protection, as appropriate based on work environment and current recommendations by OSHA and CDC.
   2. All PPE must be selected based on hazard to the worker, properly fitted and periodically refitted, consistently and properly worn when required, regularly inspected, maintained, and replaced, as necessary, and properly removed, cleaned, and stored or disposed of, to avoid contamination of self, others, or the environment.
   3. PPE worn to prevent transmission of COVID-19 is not to be confused with PPE for protection against site contaminants.
   4. PPE must be worn, removed, and disposed of correctly in order to remain effective.
      a. Face masks should fit snugly but comfortable against the side of the face and over the nose and be secured with ties or ear loops; cloth masks must include multiple layers of fabric, allow for breathing without restriction, and be able to be laundered and machine dried without damage.
      b. Face masks should be worn consistently and removed without touching eyes, nose, and mouth. An individual should wash their hands after handling a used face mask.
      c. Cloth face coverings should be sterilized by machine washing between use; disposable face masks shall be disposed of properly after using.
      d. Gloves are only effective if changed and disposed of frequently, to avoid cross-contamination.

3.3 NOTIFICATION OF POTENTIAL OR CONFIRMED INFECTION

A. The Contractor shall notify the Department immediately upon identification of a suspected or confirmed infection of COVID-19. This notification shall comply with HIPAA regulations.

B. The Contractor shall remove an individual suspected to have COVID-19 from the site immediately (to the individuals' hotel or local place of residence if transport home is not immediately feasible), as well as those who have worked in close contact with that individual for extended periods of time (an hour at a time or more) over the previous week. The individual with suspected infection shall contact their health care provider and/or follow local health department testing procedures and protocol.

C. While in the process of removing an employee exhibiting symptoms, steps should be taken to isolate the individual, place a surgical mask on the individual and inform the local health department and the NYSDEC.

D. In the event the individual with suspected infection cannot get home right away, they shall isolate in their hotel room (notifying hotel management of their symptoms), contact their health care provider, and/or follow local health department testing procedures and protocol.

E. In the absence of local health department information, the individual may call the New York State Hotline at 1-888-364-3065.

F. The Contractor shall maintain communication with potentially infected individual(s) and notify the Engineer upon receipt of COVID-19 test results.

G. Positively infected individuals may return to work at the site after 72 hours of being symptom-free and 7 days of isolation after the first symptoms appeared, or in accordance with the current federal, state, and local guidelines

H. OSHA recordkeeping requirements at 29 CFR Part 1904 mandate covered employers record certain work-related injuries and illnesses on their OSHA 300 log. COVID-19 can be a recordable illness if a worker is infected as a result of performing their work-related duties. However, employers are only responsible for recording cases of COVID-19 if all the following are met:

1. The case is a confirmed case of COVID-19 (see CDC information on persons under investigation and presumptive positive and laboratory-confirmed cases of COVID-19).

2. The case is work-related, as defined by 29 CFR 1904.5; and

3. The case involves one or more of the general recording criteria set forth in 29 CFR 1904.7 (e.g. medical treatment beyond first-aid, days away from work).

END OF SECTION

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Entry/Exit Log with COVID-19 Acknowledgement

Project Name: ____________________________________

Project #: ____

New York State Department of Environmental Conservation's (DEC) objective is to provide a safe and healthy workplace. In response to COVID-19, DEC is prohibiting access to our work areas by those who pose an elevated risk of spreading COVID-19. By completing this site Entry/Exit log, you acknowledge your understanding of this policy and confirm that your health and travel history is NOT in one of the prohibited access groups listed below, and to the best of your knowledge, you do not pose an elevated risk of transmitting COVID-19 to others. Please leave the site immediately and follow recommendations from public health agencies and your healthcare provider if you fall into one of the prohibited access groups listed below:

- You are experiencing flu-like symptoms including but not limited to fever, chills, cough, sore throat, diarrhea, vomiting, runny/stuffy nose, muscle or body aches, headaches, fatigue.
- You have traveled to CDC-restricted destinations in the last 2 weeks including China, South Korea, Iran, United Kingdom & Ireland, all European Union countries, Switzerland and regions within the U.S. for which public health agencies have prohibited travel.
- You had direct contact with a person diagnosed with COVID-19 or suspected of having COVID-19 during the last 2 weeks.

Name	Initials	Affiliation	Date	Time In	Time Out

Memorandum

Date: *April 6, 2020*
Subject: *COVID – 19 Travel Guidance*

In most states where travel may be restricted or shelter-in-place orders or advisories are in effect, CDM Smith's services have been determined to be essential.

Contact your Human Resources Business Partner (HRBP) to obtain a travel authorization letter pertaining to your assignment if needed.

Plan your travel with your supervisor to minimize the potential for exposure during all phases of travel, off time, and work. Evaluate alternatives such as virtual meetings or other means to protect yourself.

Based on the most recent information and to do our part in the global response to keep our employees, clients and communities safe, we are providing the following guidance regarding travel:

Travel

- Every effort should be made to avoid air, cruise, rail, and other public transportation.
- Maintain proper physical distancing, frequent handwashing, and regular disinfection as the primary means to minimize exposure.
- The use of PPE, such as cloth or surgical style face masks, and gloves are encouraged during travel on aircraft, trains, taxis, ride share, or other public transportation.

Air Travel

While the risk of infectious disease transmission during air travel is generally considered low (https://www.who.int/ith/mode_of_travel/tcd_aircraft/en/), the guidelines below will help to minimize risk further:

- Request seating away from others or seek permission while on board to move to a seat away from others to maintain physical distancing. If possible, request a window seat.
- Avoid directly touching door handles (i.e., bathroom, overhead compartments), faucets, meal trays, etc. Use a disposable towel/tissue.
- Avoid drink or food service on the flight. Bring your own personal meal/sealed drink.

Ground Transportation

- Disinfect vehicles, spray or wipe down steering wheel, door handles, & common surfaces with alcohol wipes or bleach*.
- Avoid shared rides or taxis. If you must, sit as far as possible from others. Keep windows open, if possible, and avoid contact with shared surfaces.
- Opt for a personal rental vehicle. Ask if vehicle has been cleaned/sterilized.

Hotels

- While at hotels, disinfect your room and common surfaces, (phones, clocks, remotes, etc.) with alcohol wipes, or bleach*.
- Avoid spending time in lobbies, cafeterias, lounges, and common areas.
- Request a room that has not been occupied recently.

Meals

- Do not use common serving scenarios, such as buffets, self-serve meals and utensil baskets.
- Most restaurants are closed, but if they are open do not use. Order room service or take out.

What to do if you or someone gets sick while on travel

- If you become ill while on travel, you should self-isolate in your hotel room and contact Allone Health (1-800-350-4511) for further guidance on when and if you should visit a medical facility or local medical provider. For COVID-19 like symptoms, most medical providers are requesting that you call first before seeking treatment.
- Notify your supervisor, field team leader, project manager and HRBP.
- In general, an employee that is sick can return to the site once a licensed healthcare provider has cleared them to return for duty.

There are many unique scenarios when traveling - make smart choices and consider the ***Safe Think*** process at all times. For example, ask yourself: How might I be exposed to the virus from my surroundings? How can I protect myself or others? Can I continue with appropriate hygiene and distancing measures? Your decision-making directly impacts your well-being and others.

Follow these two Global Health Organizations guidance: CDC Travel Site and World Health Organization: Travel Advice

Also, whether traveling or not, remember COVID-19 is transferred person to person. To reduce your risk of developing COVID-19, please follow these safety measures:

- Follow the physical distancing guidance. Maintain a minimum of 6 feet between persons and greater distances whenever feasible. Reduce the density of personnel present during your tasks to maintain physical distancing.
- Do not touch other people e.g., avoid handshakes, fist or elbow bumps.
- Avoid touching common surfaces and your face, particularly your mouth, eyes, and nose.
- Wash hands thoroughly and frequently with soap and water for a minimum of 20 seconds.
- Washing your hands or using sanitizers as soon as practical after touching any common or potentially contaminated surface will minimize your risk of contracting the virus.
- If available, carry disinfecting wipes and hand sanitizer. Wipe down "suspect" common surfaces if possible.
- Use of a dilute bleach solution* or alcohol based wipes allows for quick and efficient disinfection of surfaces in your hotel room, vehicle, or jobsite.

Please remember that we need everyone to be socially responsible in practicing physical distancing and proper personal hygiene. Here is what you can do to prepare yourself and loved ones in case COVID-19 spreads in the community where you travel to or reside: CDC Guidance and WHO Advice for the public.

General

- The voluntary use of cloth face masks or bandanas are encouraged to minimize face touching and distribution of droplets and aerosols from individuals. CDM Smith is attempting to procure these, however staff are encouraged to obtain on their own or make them themselves. See https://www.ecommunity.com/giveppe/homemade-mask-instructions or https://www.youtube.com/watch?v=j8aYEBtUQ9E&feature=youtu.be

- Please note that the voluntary use of a face mask is not adequate protection alone, physical distancing, hand washing, and disinfection of common surfaces needs to be incorporated into your daily activities. A cloth face mask should not be used where the use of N95 or ½ face respirators have been approved.
- No sharing of PPE without first disinfecting the equipment.
- Ask the hotel front desk about cleaning practices during the pandemic.
- Use the Do Not Disturb sign for cleaning staff and limit the number of people entering your room.
- Avoid hotel provided glasses. Bring a personal water bottle or use sealed items.
- Avoid fitness centers, shared fitness equipment, pools, hot tubs, and business centers.
- Keep toiletries inside a toiletry bag instead of unpacking.
- *Dilute bleach solution (1 part 5% household bleach to 9 parts water); recommended sit time up to 10 minutes depending on the label (spray bottle), use in conjunction with a spray bottle.

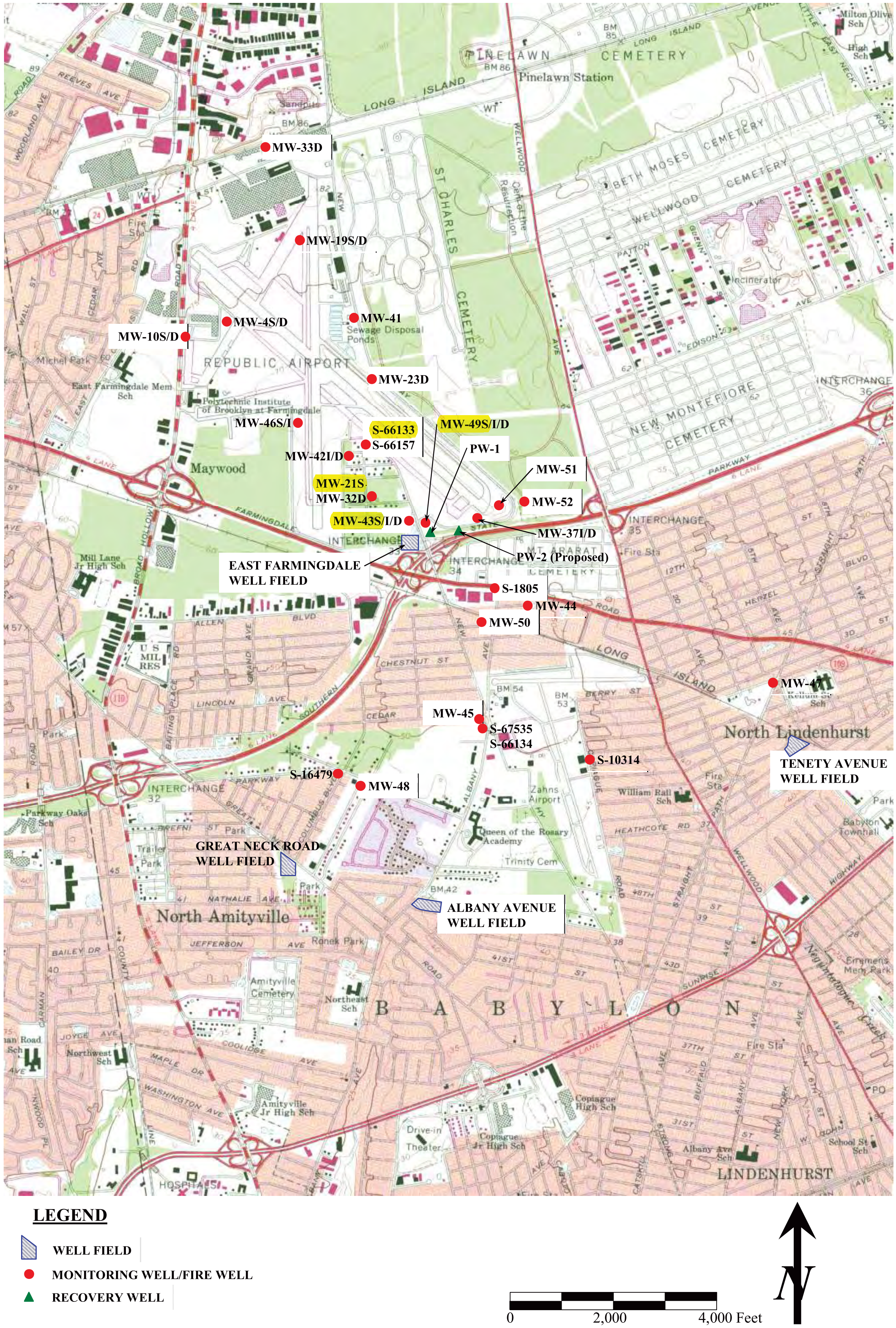
Appendix D - Previous Relevant Site Documents

ATTACHMENT 1

Site Boundary

0 0.125 0.25 0.5 Miles

Site Location Map
Republic Airport
East Farmingdale, NY



MALCOLM PIRNIE

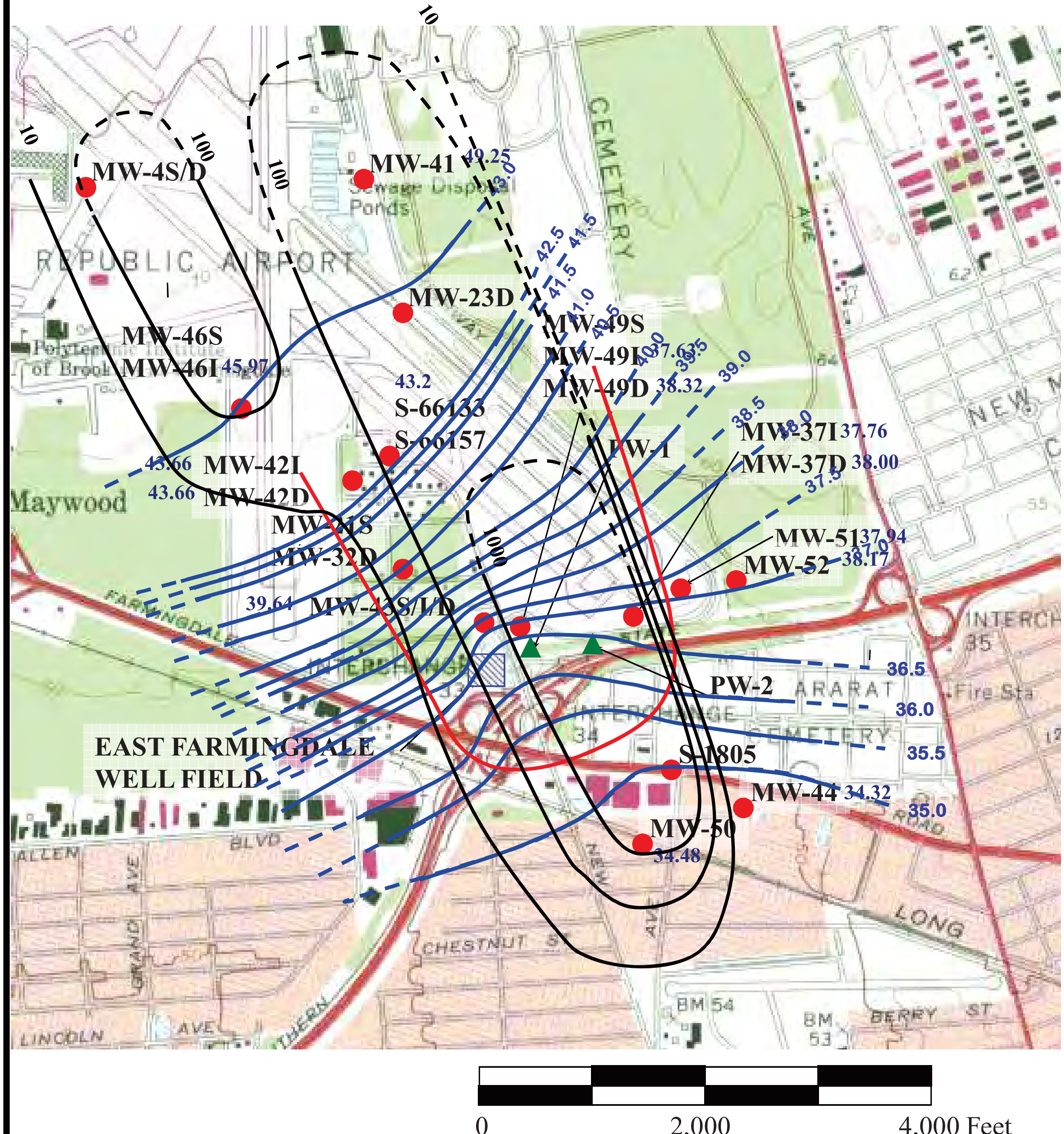
WELL LOCATIONS

MAIROLL, INC

FAIRCHILD REPUBLIC MAIN PLANT SITE

EAST FARMINGDALE, NEW YORK

ATTACHMENT 3



LEGEND

100 ISOCONCENTRATION CONTOUR – JULY 2007 (DASHED WHERE INFERRED)

LINE OF EQUAL WATER LEVEL ELEVATION (DASHED WHERE INFERRED)

CAPTURE ZONE

WELL FIELD

MONITORING WELL

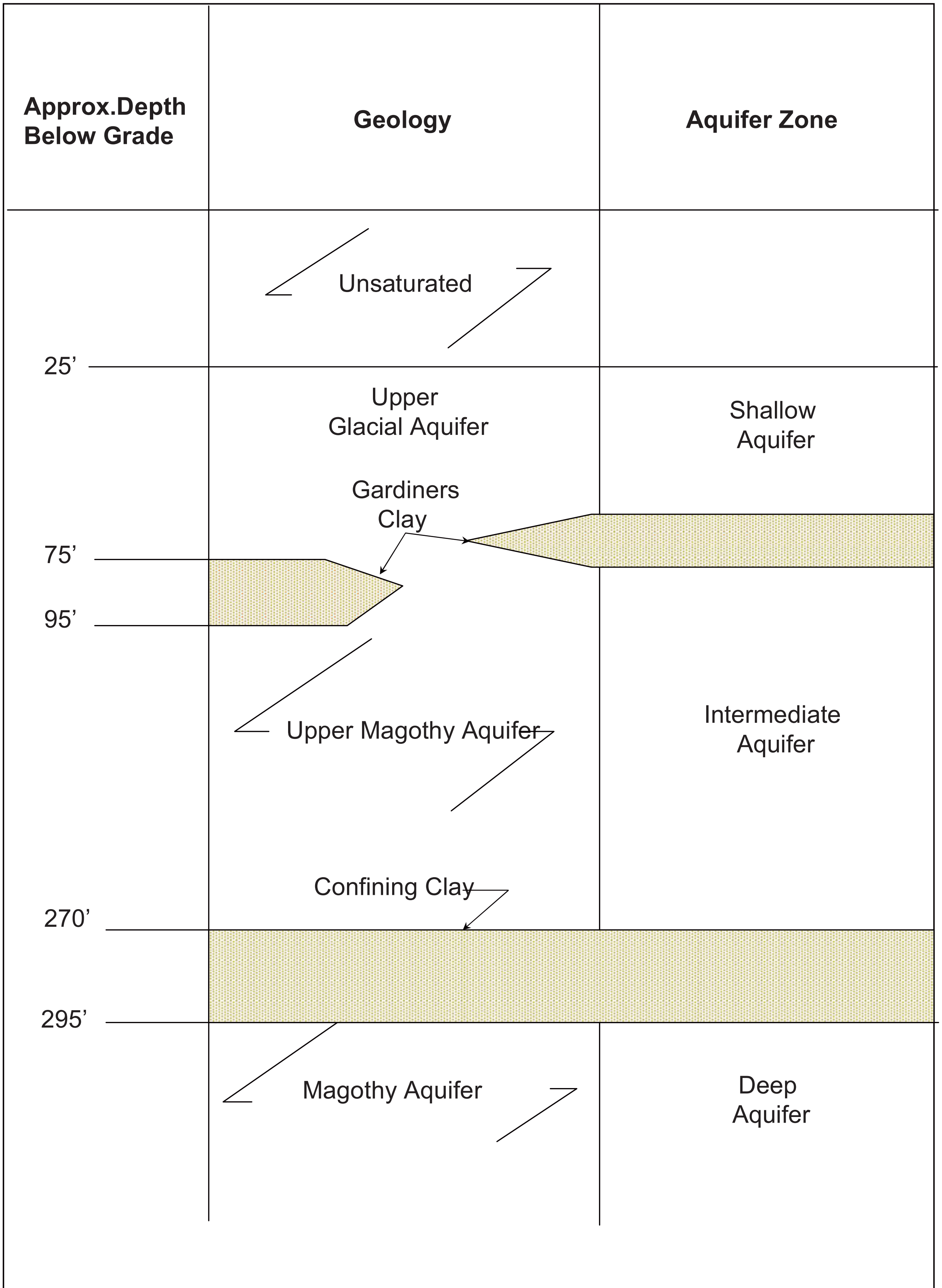
RECOVERY WELL

43.10 WATER LEVEL ELEVATION

N

MALCOLM PIRNIE

POTENTIOMETRIC SURFACE MAP – JANUARY 2008
FAIRCHILD REPUBLIC MAIN PLANT SITE
MAIROLL, INC
EAST FARMINGDALE, NEW YORK



MALCOLM PIRNIE

CONCEPTUAL GEOLOGIC / HYDROGEOLOGIC CONDITIONS
FAIRCHILD REPUBLIC MAIN PLANT SITE
MAIROLL, INC
EAST FARMINGDALE, NEW YORK

ATTACHMENT 5

MONITORING WELL DESIGNATION
FAIRCHILD REPUBLIC MAIN PLANT SITE
MAIROLL, INC.
EAST FARMINGDALE, NEW YORK

Wells targeted for EC sampling, November 2018

S-66157= 2"
MW-21S= 4"
MW-43S= 4"
MW-49S= 4"

* Wells sampled yearly as part of P&T performance monitoring

Groundwater P&T System
PW-1 & PW-2 240 ft deep, 8" ID casing
200 GPM each pump
System Started: 02/2005
200 GPM due to recharge

Well ID	Total Depth (feet)	Hydrogeologic Zone Designation	Aquifer Designation
MW-19S	35.60	Shallow	Upper Glacial
MW-19D	69.73	Shallow	Upper Glacial
MW-4S	38.69	Shallow	Upper Glacial
MW-4D	59.36	Shallow	Upper Glacial
MW-10S	33.31	Shallow	Upper Glacial
MW-10I	59.15	Shallow	Upper Glacial
MW-10D	91.93	Shallow	Upper Glacial
MW-46S	79.00	Shallow	Upper Glacial
S-66157	53.60	Shallow	Upper Glacial
MW-21S	30.33	Shallow	Upper Glacial
MW-43S	80.00	Shallow	Upper Glacial
MW-49S	30.00	Shallow	Upper Glacial
S-1805	31.70	Shallow	Upper Glacial
S-67535	71.24	Shallow	Upper Glacial
S-16479	45.00	Shallow	Upper Glacial
S-10314	45.00	Shallow	Upper Glacial
MW-37D	267.00	Intermediate	Upper Magothy
MW-37I*	193.00	Intermediate	Upper Magothy
MW-41 *	140.00	Intermediate	Upper Magothy
MW-42D *	240.00	Intermediate	Upper Magothy
MW-42I *	179.00	Intermediate	Upper Magothy
MW-43I *	200.00	Intermediate	Upper Magothy
MW-44	129.00	Intermediate	Upper Magothy
MW-45	179.00	Intermediate	Upper Magothy
MW-46I *	149.00	Intermediate	Upper Magothy
MW-48	200.00	Intermediate	Upper Magothy
MW-49D*	170.00	Intermediate	Upper Magothy
MW-49I *	110.00	Intermediate	Upper Magothy
MW-50 *	165.00	Intermediate	Upper Magothy
MW-51	190.00	Intermediate	Upper Magothy
MW-52	170.00	Intermediate	Upper Magothy
S-66133*	142.00	Intermediate	Upper Magothy
S-66134 *	144.00	Intermediate	Upper Magothy
MW-23D	310.00	Deep	Middle Magothy
MW-32D	325.00	Deep	Middle Magothy
MW-33D	310.00	Deep	Middle Magothy
MW-43D	350.00	Deep	Middle Magothy

Note:
1) Wells with an "S" prefix are Suffolk County wells

PUBLIC SUPPLY WELL SCREEN DEPTHS		
Wellfield Name	**Well No.**	**Screen Depths (feet)**
Albany Avenue Wellfield	S-34595	Retired
	S-11004	420-454;480-505
	S-47886	425-454;480-505
	S-63205	360-416

ATTACHMENT 6

PFAS, PFOA & 1,4 DIOXANE IN GROUNDWATER
FAIRCHILD MAIN PLANT SITE
MAIROLL, INC.
EAST FARMINGDALE NEW YORK

		Sample Location:	INFLUENT		MW-21S		MW-21S (Duplicate)		MW-43S		MW-49S		S-66157	
		Total Depth of Well			30		30		80		30		54	
		Sample Date:	10/24/2018		10/25/2018		10/25/2018		10/25/2018		10/24/2018		10/25/2018	
		Field ID:	IN-1-20181024		MW-21S-20181025		BD-01-20181025		MW-43S-20181025		MW-49S-20181024		S-66157-20181025	
Constituent	**CAS RN**	**Unit**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
2-(N-methyl perfluorooctanesulfonamido) acetic acid	2355-31-9	ng/l	19.6	U	20	U	19	U	18.1	U	19.3	U	19.3	U
N-Ethyl-N-((heptadecafluorooctyl)sulphonyl) glycine	2991-50-6	ng/l	19.6	U	20	U	19	U	18.1	U	19.3	U	19.3	U
Perfluorobutanesulfonic Acid	375-73-5	ng/l	2.19		4.22		4.02		2.19		2.83		1.58	J
Perfluorobutyric Acid (PFBA)	375-22-4	ng/l	10.3		80		79.3		11.7		66.2		34.7	
Perfluorodecane Sulfonic Acid	335-77-3	ng/l	1.96	U	2	U	1.9	U	0.81	J	1.93	U	1.93	U
Perfluorodecanoic Acid (PFDA)	335-76-2	ng/l	0.97	J	25.6		25.5		2.6		1.93		2.81	
Perfluorododecanoic Acid (PFDoA)	307-55-1	ng/l	1.96	U	2	U	1.9	U	1.81		1.45	J	1.93	U
Perfluoroheptane Sulfonate (PFHpS)	375-92-8	ng/l	0.83	J	0.39	J	0.42	J	1.81	U	0.29	J	0.18	J
Perfluoroheptanoic Acid (PFHpA)	375-85-9	ng/l	10.4		44.9		44.5		15.5		48.3		86.8	
Perfluorohexanesulfonic Acid	355-46-4	ng/l	19.2		33.7		32.3		7.34		14.3		5.78	
Perfluorohexanoic Acid (PFHxA)	307-24-4	ng/l	13.2		97		94.1		11.4		164		61.8	
Perfluorononanoic Acid	375-95-1	ng/l	22.4		260		240		34.6		24.1		17.7	
Perfluorooctane Sulfonamide (FOSA)	754-91-6	ng/l	1.96	U	2	U	1.9	U	1.81	U	1.93	U	1.93	U
Perfluorooctane Sulfonic Acid (PFOS)	1763-23-1	ng/l	33.7		70.5		73.8		34.9		19.1		18.7	
Perfluorooctanoic acid (PFOA)	335-67-1	ng/l	28.4		117		113		24.5		24.3		44.1	
Perfluoropentanoic Acid (PFPeA)	2706-90-3	ng/l	14.1		145		140		19.8		273		105	
Perfluorotetradecanoic Acid (PFTeA)	376-06-7	ng/l	1.96	U	2	U	1.9	U	1.81	U	1.93	U	1.93	U
Perfluorotridcanoic Acid (PFTriA)	72629-94-8	ng/l	1.96	U	2	U	1.9	U	1.81	U	1.93	U	1.93	U
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	ng/l	1.96	U	26.7		25.6		8.44		2.29		1.74	J
SODIUM 1H,1H,2H,2H-PERFLUORODECANE SULFONATE (8:2)	39108-34-4	ng/l	19.6	U	2.99	J	3.44	J	18.1	U	19.3	U	19.3	U
SODIUM 1H,1H,2H,2H-PERFLUOROOCTANE SULFONATE (6:2)	27619-97-2	ng/l	3.04	J	2.24	J	2.12	J	18.1	U	512		19.3	U
1,4-Dioxane	123-91-1	ug/l	3.7		0.058	J	0.2	U	0.056	J	0.2	U	0.2	U
	PFOA + PFOS		62.1		187.5		186.8		59.4		43.4		62.8	
	Total PFAS		158.73		910.24		878.1		175.59		1154.09		380.89	

Republic Airport | #152259
East Farmingdale, NY
Suffolk County

Emerging Contaminant Results
October 2018

Legend ATTACHMENT 7

Site Boundary

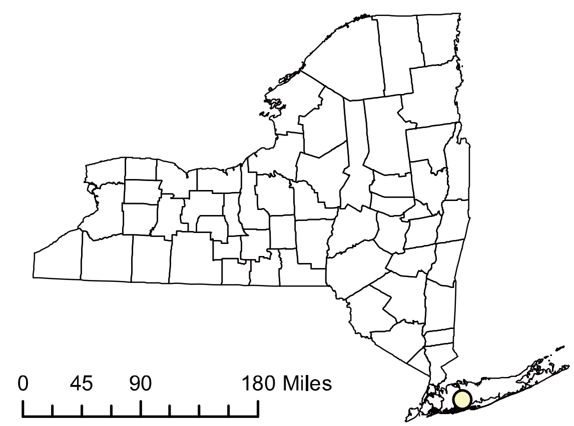
Well Locations

Not Sampled

Sampled

0 0.25 0.5 Miles

Emerging Contaminant Data was collected in association with the Fairchild Main Plant Site



NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Appendix E - Generic Community Air Monitoring Plan and Fugitive Dust and Particulate Monitoring

Appendix A-1
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.

At the Former Kenneth Trading Corp. site, the addition of two downwind CAMP units is required due to the high population density in the surrounding area.

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. APeriodic@ 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.

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

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.

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

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

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/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 A-2
Fugitive Dust and Particulate Monitoring

For work associated with hazardous waste sites, it is the responsibility of the party performing the remedial work to implement a program to suppress fugitive dust and monitor airborne particulate matter. 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° C (14 to 122° F);
(m) Particulate levels will be monitored upwind and at two locations 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.