FINAL

MANAGEMENT PLAN

SITE INVESTIGATION
Former North Pacific Division Laboratory
Troutdale, Oregon

Prepared for

U.S. Army Corps of Engineers
Seattle District
4735 East Marginal Way South
Seattle, Washington 98134-2835

August 2001

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SAMPLING AND ANALYSIS PLAN

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Part I

FIELD SAMPLING PLAN

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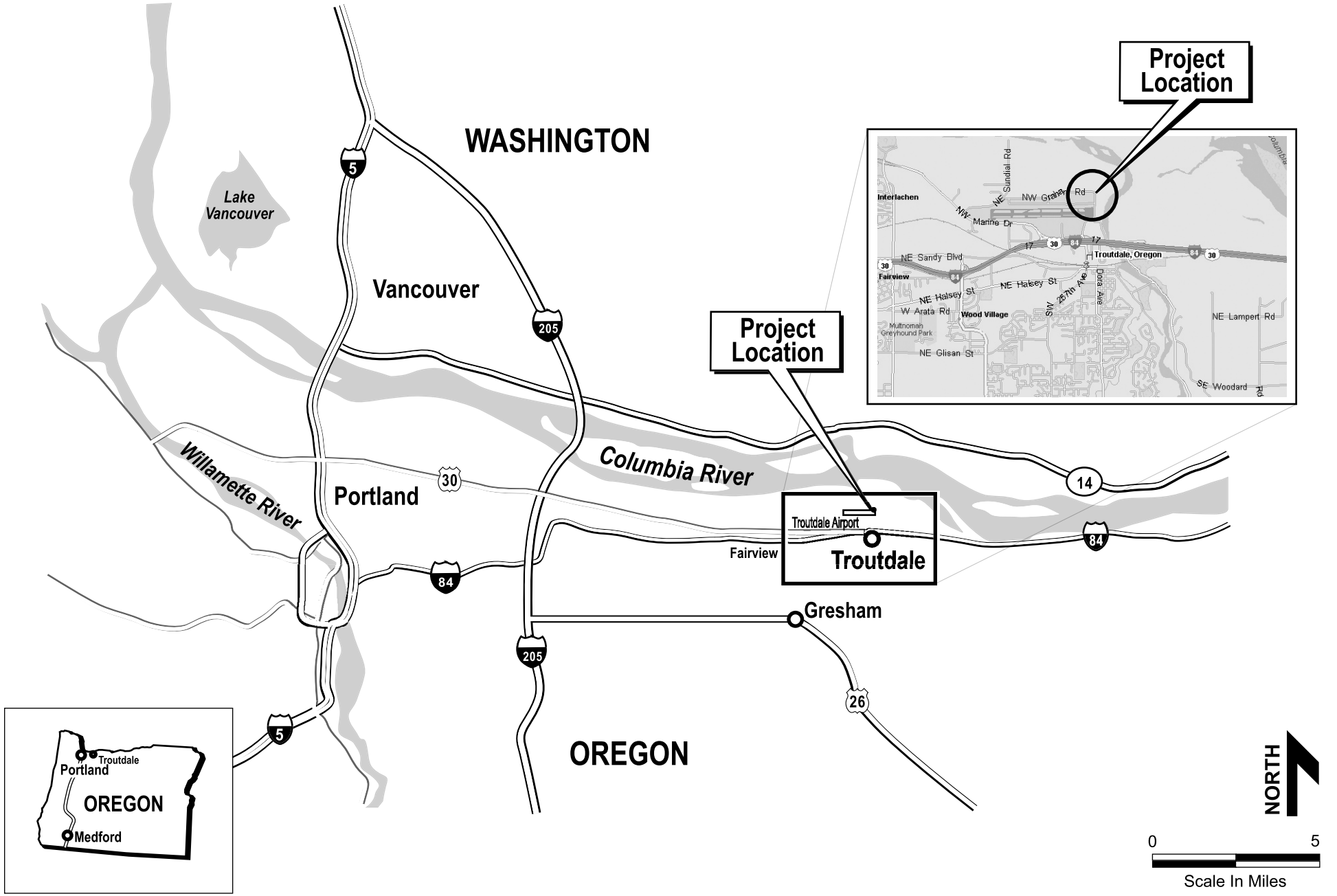
ABBREVIATIONS AND ACRONYMS

ASTM	American Society for Testing and Materials
bgs	below ground surface
CLP	Contract Laboratory Program
DCQCR	daily chemical quality control report
DO	dissolved oxygen
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FSP	field sampling plan
HSP	health and safety plan
IDW	investigation-derived waste
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt
NAD	North American Datum
NGVD	National Geodetic Vertical Datum
NPD	North Pacific Division
NTU	nephelometric turbidity unit
OAR	Oregon Administrative Rules
ORP	oxidation-reduction potential
PCB	polychlorinated biphenyl
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAM	quality assurance manager
QAPP	quality assurance project plan
RPD	relative percent difference
SAP	sampling and analysis plan
SDG	sample delivery group
SOP	standard operating procedure
SVOC	semivolatile organic compound
TPH-Dx	total petroleum hydrocarbon—diesel extended
URS	URS Corporation and subsidiaries
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

1.0 INTRODUCTION

The Sampling and Analysis Plan (SAP) is an integral part of the Management Plan for a site investigation at the former North Pacific Division (NPD) laboratory, located in Troutdale, Oregon (Figure 1-1). The purpose of the SAP is to ensure production of high quality data that meet project objectives and requirements and accurately characterize measurement parameters. It provides the protocol for collecting samples, measuring and controlling data, and documenting field and laboratory data so that the data are technically and legally defensible.

The SAP has two major components: Part I - this Field Sampling Plan (FSP) and Part II - the Quality Assurance Project Plan (QAPP). The FSP presents the detailed scope of work associated with field activities (e.g., sample types and sampling locations) and specifies the procedures to be used for sampling and other field operations. The QAPP describes the analytical data quality objectives (DQOs), laboratory analytical procedures, quality assurance/quality control (QA/QC) procedures, and data quality evaluation criteria.



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MANAGEMENT PLAN FOR
SITE INVESTIGATION
Former NPD Laboratory
Troutdale, Oregon

Figure 1-1
Site Location

2.0 FIELD ACTIVITIES

Field activities will be conducted to characterize subsurface conditions at the former NPD laboratory site. Each activity described in this section will support or enable the collection of representative data. Field personnel will be required to act in accordance with the site-specific Health and Safety Plan (HSP) for this site investigation. The following activities will be conducted, and are summarized on Table 2-1. The analytical program is summarized on Table 2-2.

- Site preparation for access to sampling locations, including debrushing and surface grading
- Geoprobe® soil sampling
- Manual soil sampling at locations not accessible by Geoprobe®
- Sampling of sediment from base of concrete sump
- Landfill trenching and sampling, and drum removal and sampling
- Temporary microwell installation, development, sampling, and abandonment
- Groundwater monitoring well sampling
- Collection of soil samples from Umatilla Army Depot Borrow Site material currently stored at the site
- Surveying of soil and temporary microwell sampling locations
- Dispose of investigation-derived waste (IDW)

2.1 SITE PREPARATION

In order to access specific sampling locations, it may be necessary to clear vegetation and grade the ground surface at these areas. The sampling locations in the drainage ditch and the landfill that are overgrown with blackberry thickets and other shrubs will be cleared of vegetation prior to sampling. Vegetation will be removed with a portable mower or mulcher or by hand when possible. Vegetation will be disposed of on site as mulch at the location of origin. To allow for access of the Geoprobe® rig, some sampling locations may require grading of surface soil, such

as in the drainage ditch and landfill trenches. Grading will be performed with a backhoe or other heavy equipment operated by URS personnel from Portland, Oregon. Site grading will be performed as needed at the discretion of the Geoprobe® operator and the on-site field personnel. At the end of the investigation, the site will be returned to its original condition.

2.2 SOIL INVESTIGATION

A Geoprobe® direct-push sampling rig will be used to collect soil samples as described in this section, or to install temporary microwells for groundwater sampling (Section 2.5). Surface soil samples to be collected from locations that the Geoprobe® rig cannot access will be collected manually. Geoprobe® and soil sampling procedures are described in Sections 2.2.2 and 2.2.3.

2.2.1 Sampling Locations

This section describes locations and depths of soil samples that will be collected to characterize subsurface conditions in each area. All boring locations are subject to clearance by an underground utility locate service. Sampling locations may need to be adjusted due to locations of underground utilities or overhead power lines. Table 2-3 summarizes the number of samples per location and depth to be collected during the soil investigation. Proposed sampling locations are presented on Figure 2-1.

Drainage Ditch

Soil samples will be collected from eight locations in the drainage ditch. Each sample will be collected using the Geoprobe® direct-push method described in Section 2.2.2. Samples will be collected from the following locations.

- **SS-1:** A soil sample will be collected along the south property boundary near the utility vault and MW-1, from the interval of ground surface to 1 foot below ground surface (bgs) as a background sample. Low overhead power lines require that this sample location be west of the utility vault.

- **SS-2:** A second background soil sample will be collected inside the landfill fenced area at the west end of the drainage ditch. This sample will be collected from the interval of ground surface to 1 foot bgs.

- **SS-3:** Soil samples will be collected from a location in the drainage ditch downstream (north) of the former hazardous materials storage building. These samples will be collected approximately 2 feet north (downstream) of the drain plug from this building. This sampling location also satisfies the requirement of

sampling downstream of the ditch removal area. Samples will be collected from depths of 0 to 1 foot bgs and 5 feet bgs.

- **SS-4:** Soil samples will be collected from a location in the drainage ditch removal area just south of the former hazardous materials storage shed. This location corresponds with the concrete sump effluent drain. Samples will be collected from a depth of approximately 6 to 7 feet bgs (i.e., native material). A temporary microwell (MC-1) also will be installed at this location for groundwater sampling in addition to soil sampling. Microwell installation and groundwater sampling is described in Section 2.5.

- **SS-5:** One soil sample will be collected north of Northwest Graham Road, immediately east of the landfill, from a depth of 0 to 1 foot bgs.

- **SS-6:** Soil samples will be collected from a location in the drainage ditch directly below the freeze/thaw drain pipe outfall, upstream (south) of the former ditch removal area. Samples will be collected from depths of 0 to 1 foot bgs and 5 feet bgs.

- **SS-7:** Soil samples will be collected from a location in the drainage ditch immediately north of the former oil storage building, downstream of the culvert. The samples will be collected from depths of 0 to 1 foot bgs and 5 feet bgs.

- **SS-8:** Soil samples will be collected in the drainage ditch at the culvert immediately south of Northwest Graham Road. These samples will be collected from depths of 0 to 1 foot bgs and 5 feet bgs.

Dry Well

Soil samples will be collected from four locations around the perimeter of the former dry well excavation (SS-9 through SS-12) and at one location in the center of the former excavation (SS-13). The locations will be based on the dimensions of the former excavation. Samples will be collected from two depths: (1) native material (approximately 6 feet bgs), and (2) where evidence of contamination is observed or above the water table, whichever is shallower. The sampling locations may need to be adjusted due to the overhead power lines.

A microwell (MC-2) will be installed in the center of the former excavation for groundwater sampling (Section 2.5).

Building Cleanout Pipe

Soil samples will be collected from three locations (SS-14 through SS-16) along the length of the concrete cleanout pipe associated with the laboratory portion of the main building. The samples will be collected at a depth below the pipe. The depth of the pipe will be estimated visually by observing the beginning depth at the header and the ending depth at the concrete sump.

Transformer Pad

Soil samples will be collected from four locations (SS-17 through SS-20) from a depth of 0 to 1 foot bgs in the vicinity of the transformer pad. Because of access restrictions to the transformer pad (i.e., the fence), these samples will be collected manually instead of using the Geoprobe® rig. Three samples will be collected outside of the fence at the south end of the enclosure. The fourth sample in this area will be collected from within the enclosure, north of the pad. It is not necessary to collect samples beneath the asphalt in this area.

Fuel Oil Tank Vault

One soil sample (SS-21) will be collected from a depth that is representative of the base of the toe wall associated with the former 10,000-gallon underground storage tank. The sample will be collected at a depth of approximately 5 to 6 feet bgs. The sample will be collected in the southern portion of the footprint of the former excavation near where the former fill port was located.

Landfill

Soil samples will be collected from four locations (SS-22 through SS-25) along the north edge of the landfill from a depth of 0 to 1 foot bgs. It is likely that the Geoprobe® rig will be unable to access this area, so samples will be collected manually.

As discussed in Section 2.4, four exploratory trenches (TR-1 through TR-4) will be completed in the landfill and samples will be collected from each trench. After completion of each trench, Geoprobe® soil samples will be collected from the native material in each trench (SS-26 through SS-29). The depth of the native material is unknown.

2.2.2 Geoprobe® Methodology and Procedures

All borings will be advanced using a truck-mounted, direct-push, Geoprobe® rig. A Geoprobe® is a hydraulically-powered, percussion probing machine. Probing tools are pushed into the ground using the weight of the rig combined with percussion to advance the tool string. The on-site geologist will direct the drill crew to set up on each boring location only after each has been cleared by a utility locator and surveyed for overhead conflicts. The Geoprobe® rig will then be

positioned over the sampling location and the tower will be erected. The driller will level the rig and ensure the vertical orientation of the sampler.

The push probes are constructed of 36-inch by 2-inch steel, and equipped with a hardened steel, drop-off, expendable tip. The probes will be lined with polyethylene tubing to contain the soil in a disposable, laboratory-approved receptacle and to prevent cross-contamination. When the desired depth is achieved, the probe string is removed to the surface to retrieve the sample. All work shall be conducted so as to eliminate the potential for contamination entering the boring. No petroleum-based lubricants shall be used on the probes.

If refusal is met during drilling, and after concluding each boring, the boring will be abandoned in accordance with the Oregon State Department of Water Resources monitoring well standards (Oregon Administrative Rules [OAR] Chapter 690 Division 220). Depending upon site conditions, the grouting material may consist of hydrated bentonite pellets or a grout mixture of Portland cement and bentonite powder. The grouting material will be manually placed into the hole as the push probe rods are removed. A tape measure will be used during addition of grout or pellets to ensure that bridging is not occurring. Following push probe retraction, additional pellets or grout will be added to bring the grout level to ground surface.

If refusal is met during drilling, a new boring will be started a minimum of 3 feet from the original boring to minimize the impact of the grout material. All adjustments and rationales will be noted in the field logbook or boring logs. If refusal is encountered after several additional attempts, then the U.S. Army Corps of Engineers (USACE) and URS project managers will confer about the boring locations and reevaluate the situation.

Down-hole and sampling equipment (e.g., push probe rods, soil samplers) in direct contact with the sampled materials, soil cuttings, and fluids will be decontaminated between borings and other sampling locations. Decontamination procedures are discussed in Section 2.8.

All waste generated from drilling activities will be transferred to approved 55-gallon drums for disposal IDW. IDW handling procedures are discussed in the IDW Plan.

Records of Geoprobe® and manual soil sampling operations and related activities will be documented by the overseeing geologist and by the drilling contractor. These records will consist of the soil boring log (Appendix A) and information recorded in the project field notebook. The soil boring log will include descriptions of soil encountered, percent recovery of each sample, total depth of the boring, diameter of the hole, formation contacts, occurrence of first water, sampling depths, water level measurements, amount of sealing material used for abandonment, and any other information deemed appropriate by field personnel. Copies of these records will be maintained at the site while the investigation is in progress, and subsequently will remain in the permanent project file.

A field drilling report will be prepared and maintained by the drilling contractor on a daily basis. The report will specify the number of hours worked, materials used, unusual problems, and other special comments and observations.

2.2.3 Sample Collection and Analysis

Soil samples will be collected continuously to the final depth in each Geoprobe® soil boring. Soil will be logged by or under supervision of an Oregon licensed geologist according to American Society for Testing and Materials D2488 (ASTM 2000). Information will be recorded on a boring log (Appendix A). In addition to standard geologic classification, any staining, odors, or unusual features will be noted on the form.

After logging has been completed, soil samples for chemical analysis will be collected. To minimize volatilization, soil for analysis of volatile organic compounds (VOCs) will be collected and preserved in the field using U.S. Environmental Protection Agency (EPA) SW-846 Method 5035. The procedures for collecting and preserving samples for low-level and high-level VOC analysis using this method are presented below.

- Using a disposable plastic syringe with the tip cut off and the rubber cap removed from the plunger, collect approximately 5 grams (approximately 3 cubic centimeters) of soil. When sampling material that contains gravel or is too hard for the syringe to penetrate, a clean chisel and spatula will be used to break up the material and quickly transfer it to jars containing preservative, as described below. Ensure that the spatula does not contact the liquid contents.

- The material collected for low-level analysis must be tested for the presence of carbonates prior to adding the sample to the acidic preservative. Place a drop of hydrochloric acid on a separate aliquot of the material. If it effervesces, then the low-level preservation is inappropriate and only the high-level sample can be collected.

- Each laboratory-supplied jar used for this method has been pre-weighed and pre-labeled by the analytical laboratory. Do not add additional labels to the pre-weighed containers; use only permanent ink to mark the container and lid directly. Place a 5-gram aliquots of soil into each of two jars containing aqueous sodium bisulfate for low-level analysis. Hold the jar at an angle to minimize splashing. Place a 25-gram aliquot of soil into one empty jar for high-level analysis. Add the contents of one container of methanol (25 mL) to this jar of soil.

- After the soil and preservative have been combined, wipe the lid and jar threads, if necessary, to ensure that the lid fits securely on the jar. Any material on the threads may allow preservative to leak out, thus compromising the sample integrity. Note on the sample custody form if any preservative spillage occurred. Gently tap the sampling container to while holding it in an upright position to ensure that the preservative completely contacts the soil surfaces and disaggregate any large clumps.

- Fill one 2-ounce jar without preservative with the soil to provide additional sample material for percent moisture determination if no other testing by the laboratory is required.

- Shipment of samples containing methanol collected according to the instructions above is in accordance with 49 CFR 173.150 under the limited quantity exception. If the total volume in each container is less than 1 liter, and the shipment is packaged in strong outer packaging, then shippers are not subject to hazardous materials regulations or training.

After VOC samples have been collected, soil will be transferred to a decontaminated, large, stainless steel bowl. Large grains of gravel and pieces of debris will be removed from the soil. Any unusual pieces removed will be noted in the logbook or boring log form. The sample material will then be thoroughly homogenized by stirring with a decontaminated stainless steel spoon. Soil will be placed into laboratory-supplied glass jars; containers will be completely filled. The type and number of sample containers required for each analytical method are discussed in Section 3.

Except for samples collected from the transformer pad and the fuel oil tank vault, all Geoprobe® soil samples will be analyzed for EPA Contract Laboratory Program (CLP) target compounds and analytes: VOCs, semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), metals, strontium and uranium, and cyanide using EPA SW-846 methods (Table 2-2). Soil samples collected at the transformer pad will be analyzed for PCBs only. Soil samples collected in the fuel oil tank vault will be analyzed for VOCs, SVOCs, and total petroleum hydrocarbons—diesel extended (TPH-Dx). The soil samples will be analyzed by Sound Analytical Services, Inc., according to the methods presented in Table 2-4.

2.3 SEDIMENT SAMPLING AND ANALYSIS

One sediment sample will be collected from a location (SD-1) at the base of the concrete sump vault (Figure 2-1). This vault is approximately 8 feet deep by 10 feet long by 8 feet wide. Initial observations indicate that approximately 4 feet of standing water will require removal prior to

sampling. This water will be removed using a sump pump. All water will be pumped into 55-gallon drums and properly labeled; it will be handled according to the IDW Plan.

Sediment will be collected using a decontaminated, telescoping sampling rod and a Teflon® sampling cup. The sampling cup will be lowered into the vault and moved along the bottom on its side to collect sediment. The sampling cup will be raised and emptied into a decontaminated, stainless steel bowl. This method will be repeated until the desired quantity of sediment has been obtained. The sediment will be preserved or composited as described in Section 2.2.3.

Sediment samples will be analyzed for EPA CLP target compounds and analytes: VOCs, SVOCs, pesticides/PCBs, metals, strontium and uranium, and cyanide using EPA SW-846 methods (Table 2-2). The sediment samples will be analyzed by Sound Analytical Services, Inc., according to the methods presented in Table 2-4.

Sampling equipment in direct contact with the sampled materials will be decontaminated prior to use. Decontamination procedures are discussed in Section 2.8.

2.4 LANDFILL SAMPLING AND DRUM REMOVAL

In addition to the Geoprobe® and manual soil sampling discussed in Section 2.2.1, landfill soil samples will be collected from four exploratory trenches (TR-1 through TR-4) (Figure 2-1). Additional landfill work involves moving drums of hardened concrete visible at the toe of the landfill, or any that are uncovered during trenching. Excavation of exploratory trenches and drum removal will be completed using an excavator operated by URS personnel from Portland, Oregon.

If necessary, the equipment operator will grade sample locations in the landfill and throughout the site for Geoprobe® rig access. Grading work will be completed as necessary in the field at the time of sampling, at the discretion of the Geoprobe® rig operator and field personnel. This grading will allow for safer, controlled rig access to several sampling areas that may be prohibitively steep.

2.4.1 Trenching

Four trenches will be excavated in the landfill to collect soil samples representative of the landfill material. Trenching will be supervised by the on-site geologist to determine depth to native material (if encountered) and to log the trenches. Observations and profiles of the trenches will be recorded in the field logbook. Each trench will be photographed. The exact orientation and placement of the trenches will be determined by the excavation equipment operator and field personnel at the time of excavation work. Trenching may be difficult due to

the presence of "concrete pours" in the landfill. These solid areas of concrete may impose restrictions on the trench size and location.

The size of each trench will be approximately the width of an excavator bucket (3 feet), a maximum of 10 feet in length, and 6 feet in depth. A sample representative of the contents of the landfill will be collected using a slide hammer. If conditions prevent collection of a representative sample using a slide hammer then samples will be collected from the center of the excavator bucket. The sampling procedures described in Section 2.2.3 will be used to sample soil from the excavator bucket.

Following completion of each trench, the excavation equipment operator will grade the sides of the trench to allow the Geoprobe® rig access to the base of the trench. Alternatively, the Geoprobe® rig could set up adjacent to the trench to collect a sample. One sample will be collected from each trench in the native material using the Geoprobe® rig. The depth to the native material is unknown.

Trench soil samples will be analyzed for EPA CLP target compounds and analytes: VOCs, SVOCs, pesticides/PCBs, metals, strontium and uranium, and cyanide (Table 2-2) using EPA SW-846 methods. The soil samples will be analyzed by Sound Analytical Services, Inc., according to the methods presented in Table 2-4.

The excavator bucket and sampling equipment in direct contact with the sampled materials will be decontaminated prior to use. Decontamination procedures are discussed in Section 2.8.

2.4.2 Drum Removal

There are approximately five drums partially exposed at the northern toe of the landfill. Contents of these drums are expected to be hardened concrete. These drums are all expected to contain the same material. The drums are anticipated to be 35 gallons in size and have sensors arrayed around the outside. If drums are found that do not match this description, work will stop immediately and the USACE will be notified. Each drum will be removed and staged in the fenced area near the landfill. The excavation equipment will be used to excavate and move the drums to the staging area. It is anticipated that up to five more drums may be uncovered during exploratory trenching. If so, these drums will be removed and staged in the same manner.

A sample will be collected from a representative drum to identify its contents for disposal. Sampling of the drum contents will be accomplished using a decontaminated chisel and hammer. Care will be taken to minimize impact to the concrete sample in order to limit volatilization of potential contaminants. The chip sample will be transferred to laboratory-provided glassware. The concrete sample will be sent to the laboratory as collected in chips, and the laboratory will

analyze the sample in chip form. To prevent volatilization of any VOCs that may be present in the chip sample, the laboratory will be requested to not pulverize, grind, or sift the sample.

Each drum, once removed, will be inspected and labeled, and the drum contents and condition will be noted in the field logbook. The drums will be disposed of as described in the IDW Plan by an independent waste removal contractor.

Concrete samples collected from the landfill drums will be analyzed for EPA CLP target compounds and analytes (Table 2-2) (VOCs, SVOCs, pesticides/PCBs, metals, strontium and uranium, and cyanide) using EPA SW-846 methods by Sound Analytical Services, Inc., according to the methods presented in Table 2-5. The type and number of sample containers required are discussed in Section 3.

2.5 GROUNDWATER INVESTIGATION

To establish the local groundwater conditions and determine any possible impact on groundwater from the former NPD laboratory facility, groundwater samples and water level measurements will be collected from five temporary microwells and six existing monitoring wells.

2.5.1 Sampling Locations

Five temporary microwells will be installed at the site. Three microwells (MC-3 through MC-5) will be installed on the west (downgradient) side of the former laboratory facility to assess the impact to groundwater of potentially leaky laboratory plumbing. One microwell (MC-1) will be installed in the drainage ditch to the south of the hazardous materials storage shed, concurrent with a Geoprobe® soil sampling location. The fifth microwell (MC-2) will be installed in the center of the former dry well excavation. Six monitoring wells currently exist at the site. Proposed microwell and existing monitoring well locations are presented in Figure 2-1.

Each microwell will be installed to an approximate depth of 20 feet bgs. The boring depths and screen intervals will be consistent with the existing groundwater monitoring wells (Table 2-6). Prior to selection of the locations for the three temporary microwells west of the main building, water levels in the six existing monitoring wells will be measured. The water levels will be used to determine the local groundwater flow direction. These three microwell locations will be based on the direction of groundwater flow from the laboratory portion of the main building.

2.5.2 Temporary Microwell Installation, Development, and Abandonment

Installation

For installation of a temporary microwell, a Geoprobe® boring will be advanced as described in Section 2.2.2. When the desired depth is reached, the prepacked polyvinyl chloride (PVC) well screen and riser will be inserted down the center of the push rods. Sections of PVC riser will be attached until the well screen is at the desired depth. Installation will be monitored by field personnel. All details of the microwell installation will be noted in the field logbook.

The screen will be constructed of ¾-inch inside diameter, schedule 40 PVC with 0.010-inch slots (10 slot). The sand pack in the prepacked screens will consist of 10-20 silica sand. The screen length will be 10 to 15 feet, and will be decided in the field based upon water level.

Development

The temporary microwells will be allowed to stabilize for 24 hours after installation and prior to development. Due to the small diameter of the microwells, development will consist of low-flow pumping until water quality parameters stabilize.

During development, groundwater quality parameters (pH, temperature, specific conductance, oxidation-reduction potential [ORP], dissolved oxygen [DO], and turbidity) will be monitored. Measurements will be collected at intervals of approximately 10 to 20 minutes. When readings stabilize, purging will cease. The stabilization guidelines are three successive readings within +/− 0.1 for pH; +/− 3 percent for conductance; +/− 10 percent for temperature, turbidity, and DO; and +/− 10 millivolts (mV) for ORP. A turbidity reading of 10 nephelometric turbidity units (NTUs) or less is desirable. The information will be documented on a monitoring well development data sheet (Appendix A). If the indicator parameters do not stabilize, purging will cease at the discretion of the USACE. The development water will be pumped into 55-gallon drums and handled according to the IDW Plan.

Abandonment

The temporary microwells are to be decommissioned within 72 hours in compliance with Oregon State Department of Water Resources monitoring well standards (OAR Chapter 690 Divisions 200 through 240). Abandonment will be monitored by field personnel. All details of the microwell abandonment will be noted in the field logbook.

The prepacked well screen and riser will be removed in sections and the excess piping containerized. This material will be disposed of as non-hazardous waste according to the IDW Plan. The microwell location will be grouted to ensure that vertical cross-contamination does

not occur. Depending upon site conditions, the grouting material may consist of hydrated bentonite pellets or a grout mixture of silica flour, Portland cement, and/or bentonite powder. The grouting material will be manually placed into the hole as the microwell and push probe rods are removed. Following push probe retraction, additional grout will be added to bring the grout level to ground surface.

2.5.3 Monitoring Well and Temporary Microwell Groundwater Sampling

Prior to beginning the sampling effort, static water levels will be measured in all monitoring wells and microwells within a period of 4 hours. Water levels will be measured in each well again before low-flow purging. Measurements will be collected after the microwell or monitoring well cap has been removed and the well has stabilized for a minimum of 5 minutes. Water levels and total depths of monitoring wells and microwells will be measured using an electronic water-level indicator with a precision of 0.01 foot. Water levels will be recorded in the logbook and on each groundwater sampling data sheet (Appendix A).

Microwells will be allowed to stabilize for 24 hours after development before groundwater sampling is conducted. A low-flow, minimal drawdown technique using a ¾-inch QED Environmental Systems, Inc. bladder pump will be used for groundwater purging and sampling according to the USACE standard operating procedure in Appendix B, *Low-Flow Ground Water Purging and Sampling Using Dedicated Bladder Pump System.* The bladder pump will be fitted with disposable, Teflon®-lined tubing. The bladder pump intake will be positioned at a level that is adjacent to or slightly above the midpoint of the screened interval. Purging shall proceed at a rate of approximately 0.1 to 0.5 liter per minute. During purging, the water level in the monitoring wells will be monitored at least every 2 to 5 minutes to ensure the water level is not dropping. Because of the small diameter, the water levels in the temporary microwells cannot be measured during purging.

Conductance, temperature, pH, DO, turbidity, and ORP will be measured during purging using a water quality meter with a flow-through cell. Measurements will be collected at intervals of approximately 2 to 5 minutes. When readings stabilize, purging will cease and samples will be collected. The stabilization guidelines are three successive readings within +/− 0.1 for pH; +/− 3 percent for conductance; +/− 10 percent for temperature, turbidity, and DO; and +/− 10 mV for ORP. A turbidity reading of 10 NTUs or less is desirable. The information will be documented on a groundwater sampling data sheet (Appendix A). If the indicator parameters do not stabilize, purging will cease after 60 minutes have elapsed and samples will be collected.

Groundwater samples from the bladder pumps will be collected into laboratory-supplied sample containers directly from the end of the pump discharge tubing. Dissolved metals samples will be filtered by attaching a 0.45-µm filter to the end of the tubing.

A minimal amount of purge water will be generated during low-flow purging and sampling. The purge water that is generated will be contained temporarily, then handled according to the IDW Plan.

Standard USACE Seattle District padlocks (provided by the USACE) will be placed on each monitoring well after sampling is complete. The existing padlocks will be discarded.

2.5.4 Groundwater Analytical Program

The groundwater samples will be analyzed for EPA CLP target compounds and analytes (Table 2-2) (VOCs, SVOCs, pesticides/PCBs, total and dissolved metals, strontium and uranium, and cyanide) using EPA SW-846 methods by Sound Analytical Services, Inc., according to the methods presented in Table 2-7.

2.6 SAMPLING OF UMATILLA ARMY DEPOT BORROW SITE MATERIAL

Thirty-three 5-gallon buckets containing soil samples from the Umatilla Army Depot Borrow Site are currently stored at the former NPD laboratory site. Discrete soil samples from four of these containers (94-BH-2B, 94-BH-3A, 94-BH-4A, and 94-BH-4B) will be collected, and one primary and one duplicate sample will be collected from a composite of the remaining 29 containers. Samples will be composited as described in Section 2.2.3.

These samples will be analyzed for EPA CLP target compounds and analytes (SVOCs, pesticide and PCBs, metals, and cyanide) and explosives (Table 2-2) by Sound Analytical Services, Inc., using EPA SW-846 methods. Analytical methods are presented on Table 2-4. These soil samples also will be analyzed for chemical agent breakdown products by Southwest Research Institute. If a breakdown product is detected, then the associated sample(s) also will be analyzed for the source chemical agent.

These containers and contents will be disposed of with IDW by the independent disposal contractor at the end of the investigation.

2.7 SURVEYING

Upon completion of field work, the licensed surveying subcontractor, Olson Engineering, Inc., of Vancouver, Washington, will survey all push probe, manual, and exploratory trench soil data collection locations and five temporary microwell locations created during this investigation. The microwells will be surveyed prior to decommissioning. Monitoring wells MW-6 (landfill), MW-3 (west side of the building) and MW-1 (southeast side of the building), and/or an existing on-site survey marker will be used for vertical on horizontal control.

Horizontal and ground surface elevation coordinates will be provided for all data collection locations and reported in North American Datum (NAD) 83 (horizontal) and National Geodetic Vertical Datum (NGVD) 29 (vertical). For all wells, the elevation of the top of the well riser (PVC) and the top of the steel protective casing shall also be measured. All vertical survey measurements shall be made to the nearest 0.01 foot, and horizontal survey measurements shall be made to the nearest 0.1 foot.

2.8 DECONTAMINATION OF DRILLING AND SAMPLING EQUIPMENT

Equipment used during the field investigation and sampling activities will be decontaminated before use at the site and between sampling locations to prevent cross-contamination. The field activities in which decontamination procedures will be followed include completing Geoprobe® borings; installing temporary microwells; sampling sediment, soil, and groundwater; completing trenches; and all associated sampling activities. The specific procedures for decontamination are outlined in this section.

Down-hole equipment (e.g., push probe rods, soil samplers and liners) and other equipment in direct contact with the sampled materials, soil cuttings, and fluids will be cleaned between borings and other sampling locations. This equipment will be decontaminated using a hot-water pressure washer.

Sampling equipment includes all nondisposable sampling devices, which are used to collect or contain a sample prior to placement into a laboratory-provided sample container. Such equipment may include split spoons, stainless steel spoons and bowls, stainless steel cable and the submersible pump. Disposable equipment may include tubing. Before initial use, all sampling equipment that may contribute to the contamination of a sample must be thoroughly decontaminated, unless specific documentation exists to show that the sampling equipment has already been decontaminated. Pre-cleaned equipment in factory-sealed containers does not require decontamination.

The sampling equipment will be decontaminated between sample locations according to the following procedure:

1. Thoroughly scrub equipment with phosphate-free detergent and potable water; a brush will be used to remove any particulate matter or surface film.

2. Thoroughly rinse the outside of and flush the inside of equipment with clean potable water.

3. Rinse and flush equipment with clean, laboratory-supplied water free of analytes of concern.

4. Rinse equipment with reagent-grade methanol.

5. Rinse equipment with reagent-grade cyclohexane or hexane.

6. Allow equipment to air dry, then wrap it in foil if not to be used immediately.

Geoprobe® equipment will be decontaminated on a trailer equipped with a water collection basin. Excavating equipment will be decontaminated within the landfill fenced area, and wash water will be allowed to infiltrate into the ground surface. The containment and disposal of decontamination wash water and other waste material is described in the IDW Plan.

2.9 FIELD QUALITY CONTROL SAMPLES

Field quality control (QC) samples will be employed to evaluate data quality. QC samples are controlled samples introduced into the analysis stream whose results are used to review data quality and to calculate the accuracy and precision of the chemical analysis program. The purpose of each type of field QC sample, collection and analysis frequency, evaluation criteria, and methods of collection are summarized in this section and described in more detail in the QAPP.

Field QC checks are accomplished through the analysis of controlled samples that are introduced to the laboratory from the field. Rinsate blanks, trip blanks, field duplicates, and matrix spike/matrix spike duplicates (MS/MSDs) will be collected and submitted to the laboratory to provide a means of assessing the quality of data resulting from the field sampling program. QC sample requirements are presented on Tables 2-4, 2-5, and 2-7.

2.9.1 Rinsate Blanks

Rinsate blanks are collected to determine the potential for cross-contamination of samples during collection by assessing the decontamination process. Rinsate blanks will be collected and analyzed at the rate of 5 percent if nondedicated sampling equipment is used. Rinsate blanks will consist of laboratory-supplied, deionized water collected from the final rinse of sampling equipment after the decontamination procedures described in Section 2.8 are complete.

The rinsate groundwater blank will be collected by filling a rinsed PVC tube (used in decontamination) with 2 gallons of laboratory-supplied, deionized water. A 4-foot-long piece of unused Teflon®-lined tubing will be attached to the freshly decontaminated pump. The pump will be placed into the PVC tube containing the deionized water. The pump will be started and

flow established at approximately 300 milliliters (mL) per minute. Pre-labeled sample containers will be filled from the discharge end of the tubing.

The rinsate soil blank will be collected from the stainless steel bowls that will be used to collect soil samples prior to placing them in sample containers. The rinsate blank will be collected by filling the bowl with approximately 2 gallons of laboratory-supplied, deionized water, then filling pre-labeled, laboratory-supplied sample containers.

All rinsate blanks will be submitted blind to the laboratory, with sample numbers that are indistinguishable from primary samples. QC criteria and corrective actions are the same as for method blanks (as described in the QAPP). Blank samples will be analyzed for the same parameters as the associated field samples.

2.9.2 Trip Blanks

Trip blanks are analyzed only for VOCs and are used to determine if contamination has occurred during sampling, handling, shipping, or storage of samples or sample bottles. One trip blank (40-mL vial with preserved contaminant-free water) will be submitted to the project laboratory for each cooler containing aqueous samples for VOC analysis. Two trip blanks (one 4-ounce glass jar or 40-mL vial containing methanol and one 40-mL vial containing aqueous sodium bisulfate) will be submitted to the project laboratory for each cooler containing soil, sediment, or concrete samples for VOC analysis.

Trip blanks will be provided by the laboratory. At no time after their preparation are the trip blank sample containers to be opened until they return to the laboratory. Each trip blank will be inspected for bubbles and overall condition, which will be noted in the field logbook. Each trip blank will be assigned a number which will be recorded in the field logbook and on the chain of custody form. Trip blanks will be analyzed at a rate of one per cooler containing samples for VOC analysis. Quality control criteria for trip blanks require that no contaminants be detected in the blanks.

2.9.3 Field Duplicates

Field duplicate samples will be used to check for sampling reproducibility. Field duplicates will be collected from sampling locations with potentially high concentrations of target analytes. Field duplicates will be submitted to the laboratory at a frequency of 10 percent of the field samples for every analytical method. Field duplicate samples will be collected in conjunction with and analyzed by the same methods as the primary sample. Control limits for field duplicate precision are 30 percent relative percent difference (RPD) for water samples and 50 percent RPD for soil, sediment, and concrete samples.

Field duplicates will be submitted blind to the laboratories, with sample numbers that are indistinguishable from primary samples. QC criteria for field duplicates and calculation and reporting of the RPD are described in Section 7.1 of the QAPP.

2.9.4 Matrix Spike/Matrix Spike Duplicates

MS/MSDs are used to assess sample matrix interferences and analytical errors, as well as to measure the accuracy and precision of the analysis. The MS/MSDs will be collected and analyzed at a rate of 5 percent of the field samples for each analytical method or at least one for each analytical batch, whichever frequency is greater. Known concentrations of analytes are added to environmental samples; the MS or MSD is then processed through the entire analytical procedure and the recovery of the analytes calculated. Results are expressed as percent recovery of the known spiked amount (and RPD for MS/MSD pairs).

Field duplicate and MS/MSD samples will be collected from different locations. Additionally, MS/MSD samples should not be collected from locations with potentially high concentrations of target analytes that may mask the added MS/MSD compounds.

2.9.5 Temperature Blanks

One temperature blank will be prepared and submitted to the laboratory with each cooler. The temperature blank will consist of a sample jar containing water, which will be packed in the cooler on ice in the same manner as the rest of the samples. The temperature blank is to be used to measure the cooler temperature upon receipt of the cooler at the laboratory.

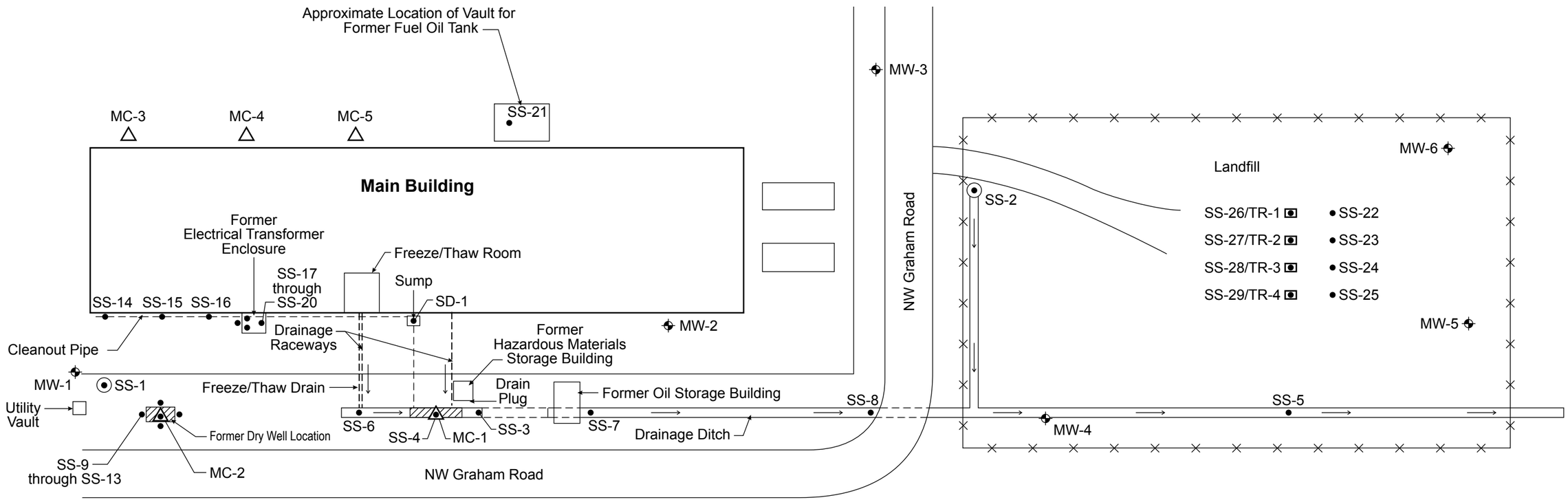
2.10 CALIBRATION OF FIELD INSTRUMENTS

All calibration procedures and measurements will be made in accordance with the manufacturer's specifications and the USACE SOP for low-flow purging and sampling (Appendix B). Field instruments will be checked and calibrated before their use on site, and batteries will be charged and checked daily. A three-point initial calibration will be conducted if applicable to the instrument being used. One-point calibrations may be used thereafter.

Instrument calibration will be conducted at the beginning of each workday and if necessary through the course of the day. A final calibration will be conducted at the end of the day after the last field sample has been analyzed. Special attention will be given to instruments that may drift with change in ambient temperature or humidity. Equipment that fails calibration and/or becomes otherwise inoperable during the field investigation will be removed from service and segregated to prevent inadvertent use. Such equipment will be properly tagged to indicate that it

should not be used until repaired. Equipment that cannot be repaired or recalibrated will be replaced.

All documentation pertinent to the calibration and/or maintenance of field equipment will be maintained in an active field logbook.



LEGEND

	Fence	MW-1	Existing groundwater monitoring well
	Subsurface feature	SS-3	Proposed soil or sediment sampling location
	Former soil removal area	MC-1	Proposed groundwater microwell location
	Direction of flow	TR-1	Proposed exploratory trench location
		SS-1	Proposed background soil sampling location

NOTE

Proposed sampling and trench locations may be adjusted in the field depending on site conditions.

0 80 160

Scale in Feet

SOURCE: Tetra Tech: Final Cleanup Report – Soil Removal and Groundwater Sampling NPD Laboratory, Troutdale, Oregon, 1999.

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MANAGEMENT PLAN FOR SITE INVESTIGATION
Former NPD Laboratory
Troutdale, Oregon

Figure 2-1
Site Layout and Proposed Sampling Locations

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Table 2-1
Summary of Field Activities

Area	Debrushing or Grading	Geoprobe® Soil Sampling	Manual Soil Sampling	Sediment Sampling	Trenching and Drum Removal and Sampling	Microwell Installation	Groundwater Sampling
Drainage ditch	X	X	X			X	X
Dry well		X				X	X
Building cleanout pipe		X					
Transformer pad			X				
Fuel oil tank vault		X					
Landfill	X	X	X		X		
Concrete sump vault				X			
West of laboratory building						X	X
Existing monitoring wells							X

Note: Soil samples also will be collected from buckets containing Umatilla Army Depot Borrow Site material, currently stored at the site.

Table 2-2
Summary of Analytical Program

Parameter	Drainage Ditch (Soil)	Dry Well (Soil)	Building Cleanout Pipe (Soil)	Transformer Pad (Soil)	Fuel Oil Tank Vault (Soil)	Landfill (Soil)	Concrete Sump (Sediment)	Landfill Drums (Concrete)	Microwells and Monitoring Wells (Groundwater)	Umatilla Army Depot Borrow Site Material (Soil)
Volatile organic compounds	X	X	X		X	X	X	X	X	
Semivolatile organic compounds	X	X	X		X	X	X	X	X	X
Organochlorine pesticides/PCBs	X	X	X			X	X	X	X	X
Organochlorine PCBs				X						
Total metals	X	X	X			X	X	X	X	X
Dissolved metals									X	
Strontium and uranium	X	X	X			X	X	X	X	
Total cyanide	X	X	X			X	X	X	X	
TPH diesel-range					X					
Explosives residues										X
Chemical agent breakdown products										X

Table 2-3
Number of Primary Soil Samples at Each Location and Depth

Area	Geoprobe® (0-1 foot bgs)	Geoprobe® (Native Material)	Manual Sampling (0-1 foot bgs)	Trenching
Drainage ditch	6	5	1	
Dry well		10[a]		
Building cleanout pipe		3[b]		
Transformer pad			4	
Fuel oil tank vault		1		
Landfill		4	4	4

[a]First depth in native material; second depth at contamination or immediately above water table, whichever is shallower
[b]At depth immediately below cleanout pipe

Note: Additional soil samples (not presented on this table) will be collected from buckets containing Umatilla Army Depot Borrow Site materials currently stored at the site.

Table 2-4
Soil and Sediment Analytical Methods and Quality Control Samples

Parameter	Method	Number of Soil and Sediment Samples						
		Primary	Field Duplicate (10%)	Trip Blank[a] (per cooler)	Rinsate Blank (5%)	MS (5%)	Lab Duplicate or MSD (5%)	Total
Volatile organic compounds	EPA SW-846 Method 5035/8260B	36	4	4	2	2	2	50
Semivolatile organic compounds	EPA SW-846 Method 3550B/8270C	36	4		2	2	2	46
Organochlorine pesticides and PCBs	EPA SW-846 Method 3550B/8081A/8082	35	4		2	2	2	45
Organochlorine PCBs	EPA SW-846 Method 3550B/8082	4						4
Total metals	EPA SW-846 3051/6010B/6020/7471A	35	4		2	2	2	45
Total cyanide	EPA SW-846 Method 9013/9012A	35	4		2	2	2	45
TPH diesel-range	NWTPH-Dx	1				1	1	3
Explosives residues	EPA SW-846 Method SPE/8330	1	1		1	1	1	5
Chemical agent breakdown products	Southwest Research Institute SOPs	5	1		1	1	1	9

Notes:
MS - matrix spike
MSD - matrix spike duplicate
NWTPH-Dx - northwest total petroleum hydrocarbons—diesel extended
SDG - sample delivery group
[a]Estimated

Table 2-5
Concrete Analytical Methods and Quality Control Samples

Parameter	Method	Number of Concrete Samples						
		Primary	Field Duplicate (10%)	MS (5%)	Lab Duplicate or MSD (5%)	Trip Blank[a] (per cooler)	Rinsate Blank (5%)	Total
Volatile organic compounds	EPA SW-846 Method 5035/8260B	1	1	1	1	1	1	6
Semivolatile organic compounds	EPA SW-846 Method 3550B/8270C	1	1	1	1		1	5
Organochlorine pesticides and PCBs	EPA SW-846 Method 3550B/8081A/8082	1	1	1	1		1	5
Total metals	EPA SW-846 3051/6010B/6020/7471A	1	1	1	1		1	5
Total cyanide	EPA SW-846 Method 9013/9012A	1	1	1	1		1	5

Notes:
MS - matrix spike
MSD - matrix spike duplicate
SDG - sample delivery group
[a]Estimated

Table 2-6
Existing Monitoring Well Construction and Elevation Information

Well No.	WRD Well ID No.	Total Depth (feet bgs)	Screen Interval (feet bgs)	Surface Elevation (feet msl)	Top of Casing Elevation (feet msl)
MW-1	L18074	20	4.5 - 19.5	36.3	38.62
MW-2	L18075	20.5	5.0 - 20.0	34.4	36.66
MW-3	L18076	19	2.85 - 17.85	33.87	33.51
MW-4	L18077	19	3.5 - 18.5	35.03	34.76
MW-5	L18078	19	3.35 - 18.35	32.35	31.91
MW-6	L18079	19	3.2 - 18.2	32.52	32.09

Notes:
msl - mean sea level
WRD - Oregon State Water Resources Department

Table 2-7
Groundwater Analytical Methods and Quality Control Samples

Parameter	Method	Number of Groundwater Samples						
		Primary	Field Duplicate (10%)	MS (5%)	Lab Duplicate or MSD (5%)	Trip Blank[a] (per cooler)	Rinsate Blank (5%)	Total
Volatile organic compounds	EPA SW-846 Method 5030B/8260B	11	2	1	1	2	1	18
Semivolatile organic compounds	EPA SW-846 Method 3510C/8270C	11	2	1	1		1	16
Organochlorine pesticides and PCBs	EPA SW-846 Method 3510C/8081A/8082	11	2	1	1		1	16
Total metals	EPA SW-846 3010A/6010B/6020/7470A	11	2	1	1		1	16
Dissolved metals (field filtered)	EPA SW-846 3010A/6010B/6020/7470A	11	2	1	1			15
Total cyanide	EPA SW-846 9012A	11	2	1	1		1	16

Notes:
MS - matrix spike
MSD - matrix spike duplicate
SDG - sample delivery group
[a]Estimated

3.0 SAMPLE HANDLING AND DOCUMENTATION

This section describes sample handling and documentation procedures. The procedures described are designed to provide a thorough record of events surrounding the collection of each sample, and to ensure, as far as can be accomplished in the field, that data collected are useable.

3.1 FIELD LOGBOOKS

Permanently bound field books with waterproof paper will be used as field logbooks because of their compact size, durability, and secure page binding. The pages of the logbook should be numbered consecutively and should not be removed for any reason. Entries will be made in black waterproof indelible ink.

Logbooks will document the procedures performed by field personnel. Each entry should be dated, legible, and contain accurate and complete documentation of the individual's activities. Documentation in the field logbook will be at a level of detail sufficient to explain and reconstruct field activities without relying on recollection by the field team members. Because the logbook is a complete documentation of field procedures, it should contain only facts and observations. Language should be objective, clear, concise, and free of personal interpretation or terminology that might be misconstrued.

No erasures will be allowed. If an incorrect entry is made, the information will be crossed out with a single strike mark and the change initialed and dated by the team member making the change.

Field logbooks will be identified by the project name and a project-specific number (e.g., "Logbook #1 for Former North Pacific Division Laboratory Site Investigation"), and stored in the field project files when not in use. Field logbooks will be photocopied after the field investigation, and photocopies will be stored in the permanent project files. After field activities are completed, logbooks will be stored in the permanent project file.

3.2 SAMPLE IDENTIFICATION AND LABELING

To provide a sample tracking mechanism, each sample collected will be given a sample identification number using the numbering system shown in Table 3-1. The sample identification number will include the sample type, station number, and an identification of the type of sample (primary, field split, etc.). The site name and sampling date will not be included in the sample identification number because this information will be recorded on the sample

label and chain of custody form. Sample type, station number, and depth designations are shown below.

MS/MSD samples will not be designated in the primary sample number. The sample to be used for MS/MSD will be specified in the comment section of the chain of custody. Trip blanks will be numbered with the prefix "TB-" followed by a sequential number starting with 001. The QC field duplicate and field/rinsate blank samples will be identified with a fictitious station number of the primary sample. The fictitious station numbers used to identify QC field duplicates and field/rinsate blanks will consist of a constant integer added to the number of the primary sample location that has been chosen as the QA station. A field duplicate sample will be designated by adding the integer 300 to the station number from which it was collected. A rinsate blank sample will be designated by adding the integer 600 to the station number from which the blank is collected. No indication that a sample is a duplicate will be provided on the sample label or chain of custody form. Cross-references for duplicate and blank sample numbers will be clearly recorded in the field book and field logs.

Example 1: A primary soil sample collected from a depth of 5 feet bgs at SS-1 would be labeled SS-001-05.

Example 2: A duplicate of primary sample SS-001-05 would be labeled SS-301-05.

Example 3: A rinsate blank of primary sample SS-001-05 would be labeled SS-601-05.

Example 4: A groundwater sample collected from microwell MC-1 would be labeled MC-001.

Example 5: An exploratory trench sample from the trench TR-3 at a depth of 5 feet bgs would be labeled TR-003-05.

Example 6: The fourth trip blank submitted for this investigation would be designated TB-004.

Sample labels, whether blank or pre-printed, will contain an abbreviated summary of the logbook entry for the sample. The following information should be included on sample container labels:

- Project number and name
- Site location
- Sample identification number
- Date and time of sampling
- Initials of sampling personnel
- Type of sample preservatives added

3.3 SAMPLE DELIVERY GROUP

Soil and groundwater samples will be sent to the analytical laboratories in sample delivery groups (SDGs). Each SDG will consist of primary samples, blind field duplicates, associated MS/MSD samples, and/or rinsate blanks.

3.4 SAMPLE PRESERVATION AND HANDLING

This section describes the techniques used to handle and preserve samples once they are collected, including descriptions of sample containers, preservation techniques, and storage requirements.

3.4.1 Sample Containers

Soil and groundwater samples (primary as well as QC) will be collected in glass or plastic containers supplied by the analytical laboratory. The containers will have screw-type lids to ensure the bottles are adequately sealed. Teflon® inserts inside the lids of the containers will prevent sample reaction with the lid and improve the quality of the seal. The specific container types, volumes, number of containers, and holding times for each analysis for soil, sediment, and concrete are listed in Table 3-2, and the same information for groundwater is listed in Table 3-3.

The containers will be precleaned and certified under chain of custody. Commercially available precleaned jars are acceptable. The field team will record batch numbers for the bottles in the logbook. With this documentation, bottles can be traced and bottle wash analyses can be reviewed.

3.4.2 Sample Preservation

Required preservatives for groundwater and rinsate blanks will be added to the sample containers by the laboratory. They will affix waterproof labels to the bottles, on which the type and amount of preservative will be written.

Sample preservation procedures are used to maintain the original character of analytes during storage and shipment. Regardless of the nature of the sample, absolute stability for all constituents cannot be achieved. Preservation techniques, such as pH control and refrigeration, may retard physicochemical and biochemical changes. As a general rule, analyzing the sample as soon as possible is the best way to minimize physicochemical and biochemical changes.

All samples will be placed in the appropriate sample container and refrigerated (on ice or ice-substitute in a cooler) immediately upon sample collection. Samples will be shipped to the laboratory on a daily basis. The analytical laboratories will meet all specified holding times (35 days) and should make every effort to prepare and analyze the samples immediately after they are received. Chemical preservation, sample container types, and temperature requirements for the analyses performed in this investigation are shown in Tables 3-2 and 3-3.

3.4.3 Storage Requirements

Samples will be placed in secure, on-site storage, or remain in the possession of the sampling personnel until they are shipped or delivered to the laboratory. Immediately after collection, and during shipment to the analytical laboratory, samples will be stored in coolers on ice or an ice-substitute at approximately 4°C. Ice packaged in plastic storage bags will be used to maintain the temperature in the shipping containers at approximately 4°C. Ice will be replenished as needed to ensure adequate cooling of samples during storage and shipping.

3.5 SAMPLE DOCUMENTATION

Entries into the logbook or other relevant sampling forms for sampling events will include, but not necessarily be limited to, the following:

- Project name, location, and number
- Rationale for collecting the sample
- Date and time of sampling
- Sample numbers
- Cross-reference of numbers for split and blank samples
- Media sampled
- Geographical location of the sampling point in reference to site facilities
- Physical location of the sampling point, such as depth below surface
- Method of sampling, including procedures, equipment, and any departure from the procedures specified in the Work Plan or the SAP

- Rationale for any deviations from Management Plan procedures and documentation
- Results of field measurements
- Sample preservation
- Type and quantity of container used for each sample
- Weather conditions at the time of sampling and previous events that may influence the representative nature of a sample—at a minimum, include temperature, approximate wind speed and direction, and sky cover
- Photographic information—briefly describe what was photographed and why, the date and time, the compass direction of the picture, number of the frame on the roll, and roll number
- Sketches, when appropriate, with reference points tied to existing structures in the area (e.g., trees, existing monitoring wells)
- Analyses requested
- Disposition of the sample (i.e., where it is being shipped)
- Airbill number of sample shipment, when applicable
- Other pertinent observations, such as the presence of other persons on the site (those associated with the job or members of the press, special interest groups, or passersby), and actions by others that may affect performance of site tasks
- Type of health and safety clothing/equipment used
- Name(s) of sampling personnel

3.6 CHAIN OF CUSTODY PROCEDURES

Verifiable sample custody is an integral part of all field and laboratory operations associated with this field investigation. The primary purpose of the chain of custody procedures is to document

the possession of the samples from collection through storage and analysis to reporting. Chain of custody forms will become the permanent records of sample handling and shipment. The Field Investigation Manager or designee will be responsible for monitoring compliance with chain of custody procedures.

Field sampling personnel are responsible for the care and security of samples from the time the samples are collected until they have been turned over to the shipping agent or laboratory. A sample is considered to be in one's custody if it is in plain view at all times, in the physical possession of the sampler, or stored in a locked place where tampering is prevented.

Empty coolers containing ice or ice substitute will be available at the study area for use each day in the field. Samples collected during the day will be stored in these coolers beginning at the time of collection. The coolers will be locked inside the field vehicle or other secure location when sampling personnel are not present.

A chain of custody form will be filled out for samples in each cooler, starting when the first sample of each batch is collected. An example of chain of custody record is shown in Appendix A. Each chain of custody form will contain the following information:

- Sample identification numbers
- Date and time of sampling
- Type of sample and number of sample containers associated with each sampling point
- Total number of sample containers in cooler
- Unique cooler identification number
- List of analyses requested
- Name and signature of sampling personnel
- Shipping air bill number, when applicable
- Comments regarding MS/MSD samples, or any other information that is necessary for the laboratory
- Spaces for transfer of custody acknowledgment

When the chain of custody forms are complete, field team members will cross-check the form for possible errors. If samples are repackaged for shipping or delivery, one team member will cross-check the chain of custody with the samples that are packed while another team member packages the samples. Corrections will be made to each record with a single strike mark that is dated and initialed. The person who initials corrections will be the same person that relinquishes custody of the samples. The chain of custody forms will be signed and dated, placed in resealable plastic bags, and taped to the inside lid of the respective coolers.

3.6.1 Transfer to Project Laboratories

After a cooler of samples is packaged and the chain of custody form has been completed, sampling personnel will close the cooler, seal it with packing tape, and affix two signed and dated custody seals so that if the cooler is opened the seals will be broken. Custody seals will contain the following information:

- Sample team member's signature (signature must match signature on chain of custody forms)
- Date

Coolers with completed chain of custody documentation will be hand-delivered, sent by courier, or shipped by overnight courier to the laboratory by the sampling team. The shipping agent will not enter into the formal chain of custody procedures, and therefore will not sign the chain of custody form. Copies of bills of lading provided by the shipping agent will be kept with chain of custody forms in order to document shipping procedures.

3.6.2 Laboratory Custody Procedures

A cooler receipt form will be filled out by the laboratory (Appendix A). Upon receipt by the laboratory, custody seals will be inspected and the chain of custody forms signed and dated by laboratory personnel. Laboratory personnel will verify sample numbers and the conditions of each cooler. The laboratory will fax each chain of custody and cooler receipt form to the URS PM within 8 hours. URS will be notified of any discrepancies immediately. Shipping manifests and chain of custody forms signed and dated by laboratory personnel will be considered sufficient documentation of sample custody transfer from the sampler, through the shipping agent, to the analyst in the contracted analytical laboratory.

A copy (pink) of each chain of custody form will be retained by the sampling team for the project file and the original (yellow and white) will be sent with the samples. Bills of lading will also be retained as part of the documentation for the chain of custody records. In conjunction

with data reporting, the analytical laboratory will return the original chain of custody forms to the project manager for inclusion into the central project file.

3.7 DAILY CHEMICAL QUALITY CONTROL REPORTS

Field activities will be documented via the daily chemical quality control report (DCQCR) form. An example DCQCR form is included in Appendix A. The reports will be prepared and submitted daily, and will summarize field and laboratory activities and results. All field measurement data and field sampling decisions will be made available to the USACE within 24 hours of sample collection. The DCQCR will contain the following information:

- Project information
- Work performed and samples collected including associated QA/QC samples, and personnel involved
- Weather
- Available analytical results, physical parameter measurements, calculation results, and required QC data
- Field audits performed and results
- Sampling, sample handling, chemical parameter measurement problems, deviations from the approved plan, and corrective actions taken
- Signatures of field personnel completing the DCQCR and initials of personnel making changes
- Summary of verbal or written instructions for retesting or changes of work

The DCQCR will be completed at the end of each day. Copies of field forms and pages of the field logbook completed for that day's work will be referenced on the form and attached to minimize transcription errors.

Table 3-1
Sample Identification Numbering System

Sample Type	Sample Type Prefix[a]	Sample Location or Drum No.[b]	Depth
Geoprobe® Boring and Surface Sample–Soil	SS	001, 002…	feet bgs
Monitoring Well–Groundwater	MW	001-006	NA
Microwell–Groundwater	MC	001-005	NA
Concrete Sump–Sediment	SD	001	NA
Exploratory Trench–Soil	TR	001-004	feet bgs
Drum–Concrete	DC	001, 002…	NA
Umatilla Samples–Soil	US	001-005	NA
Trip Blank	TB	001, 002…	NA

[a]Specify MS or MSD in comment section of the chain of custody form, but not in sample name.
[b]For duplicate, add integer of 300 to sample number; for rinsate blank, add integer of 600 to sample number.

Table 3-2
Container, Preservation, and Holding Time Requirements–Soil, Sediment, Concrete

Parameter	Method	Container Description[ab]	Number Required	Preservation Requirements	Holding Time
Volatile organic compounds	EPA SW-846 Method 5035/8260B	4 oz. Glass with Teflon®-lined lid	1	4°C, methanol	14 days
Semivolatile organic compounds	EPA SW-846 Method 3550B/8270C	4 oz. glass	1	4°C	14 days extract/40 days analysis
Organochlorine pesticides and PCBs	EPA SW-846 Method 3550B/8081A/8082	4 oz. glass	1	4°C	14 days extract/40 days analysis
Organochlorine PCBs	EPA SW-846 Method 3550B/8082	4 oz. glass	1	4°C	14 days extract/40 days analysis
Total metals	EPA SW-846 3051/6010B/6020/7471A	4 oz. glass	1	4°C	6 months (28 days for mercury)
Total cyanide	EPA SW-846 Method 9013/9012A	4 oz. glass	1	4°C	14 days
TPH diesel-range	NWTPH-Dx	4 oz. glass	1	4°C	14 days extract/40 days analysis
Explosives residues	EPA SW-846 Method SPE/8330	4 oz. amber glass	1	4°C, dark	14 days extract/40 days analysis
Chemical agent breakdown products	Southwest Research Institute SOPs	8 oz. amber glass	2	4°C, dark	14 days extract/40 days analysis

[a]Concrete samples may require 8-oz or 16-oz glass containers
[b]All glass sample containers will have Teflon®-lined lids

Notes:
HDPE - high density polyethylene
NWTPH-Dx - northwest total petroleum hydrocarbons—diesel extended
TPH - total petroleum hydrocarbons

Table 3-3
Container, Preservation, and Holding Time Requirements–Groundwater

Parameter	Method	Container Description	Number Required	Preservation Requirements	Holding Time
Volatile organic compounds	EPA SW-846 Method 5030B/8260B	40 ml VOA vial[a]	3	4°C, HCI to pH < 2	14 days
Semivolatile organic compounds	EPA SW-846 Method 3510C/8270C	1 L glass amber[a]	2	4°C	7 days extract/40 days analysis
Organochlorine pesticides and PCBs	EPA SW-846 Method 3510C/8081A/ 8082	1 L glass amber[a]	2	4°C	7 days extract/40 days analysis
Total metals	EPA SW-846 3010A/6010B/6020/ 7470A	500 mL HDPE	1	4°C, HNO_3 to pH < 2	6 months (28 days for mercury)
Dissolved metals (field filtered)[b]	EPA SW-846 3010A/6010B/6020/ 7470A	500 mL HDPE	1	4°C, HNO_3 to pH < 2	6 months (28 days for mercury)
Total cyanide	EPA SW-846 9012A	1 L HDPE	1	4°C, NAOH to pH > 12	14 days

[a]All glass sample containers will have Teflon®-lined lids.
[b]Sample will be filtered using a 0.45 µm filter prior to preservation.
Note:
HDPE - high density polyethylene

4.0 SAMPLE PACKAGING AND SHIPPING

4.1 PACKAGING

The procedures and materials used for sample packaging must adequately protect the sample container from accidental breakage during shipping. Sample packaging and labeling will conform to the requirements of Appendix F of Engineering Manual EM-200-1-3 (USACE 2001). Glass sample containers will be placed into plastic bags, and will be wrapped and cushioned in inert packing material such as Styrofoam, closed-cell foam packing material, or plastic bubble wrap. Plastic sample containers do not require individual cushioning material, but should be packed well to prevent movement during transport. Caps will be screwed on tightly. The plastic sample containers will be placed into individual, resealable plastic bags, which will then be sealed. Ice or ice-substitute will be placed in the container in a manner to ensure adequate and equal cooling for all samples.

4.2 SHIPPING

All sample containers will be placed inside a strong shipping container, such as a metal or plastic picnic cooler with a hard plastic liner. The shipping container should be sufficient to prevent leaks or spills of ice water or potentially broken sample containers. The drainage hole at the bottom of the cooler will be taped shut so that the contents from possible broken containers of sample or packaged ice will not escape. The shipping container lid will be adequately secured with tape to prevent opening during shipping. The shipping container will be adequately cleaned between shipments to prevent cross-contamination of samples.

Transfer of samples from the project site to the project analytical laboratory is expected to be performed by the field personnel or via an overnight courier service. Deliveries that will arrive at a laboratory or at the courier's office to be picked up by laboratory personnel must be arranged with the laboratory before shipping occurs.

Addresses, telephone numbers, and contacts of the laboratories to which samples will be shipped is presented in Table 2-1 of the Work Plan.

5.0 FIELD CORRECTIVE ACTIONS

The ultimate responsibility for maintaining quality throughout the field investigation rests with the Project Manager. The day-to-day responsibility for ensuring the quality of field and laboratory data rests with the Field Investigation Manager, the Project QA Manager (QAM), and the laboratory program administrator.

Any nonconformance with the established QC procedures will be expeditiously identified and controlled. Where procedures are not in compliance with the established protocol, corrective actions will be taken immediately. Subsequent work that depends on the nonconforming activity will not be performed until the identified nonconformance is corrected.

The Field Investigation Manager will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, etc., will be checked for completeness. Where procedures are not strictly in compliance with the established protocol, the deviations will be field documented and reported to the Project QAM. Corrective actions will be defined by the Field Investigation Manager and Project Manager and documented as appropriate. Upon implementation of the corrective action, the Field Investigation Manager will provide the Project QAM with a written memo documenting field implementation. The memo will become part of the field record and permanent project file.

6.0 REFERENCES

American Society for Testing and Materials (ASTM). 2000. *D2488 Standard Practice for Description and Identification of Soil (Visual-Manual Procedure).*

United States Army Corps of Engineers (USACE). 2001. *Chemical Data Quality Management for Hazardous, Toxic, Radioactive Waste Remedial Activities.* EM-200-1-3.

APPENDIX A

Standard Field Forms

CONTENTS

Boring Log

Well Development Data Sheet

Groundwater Sampling Data Sheet

Chain of Custody Record

Cooler Receipt Form

Daily Chemical Quality Control Report Form

HTRW DRILLING LOG	DISTRICT	HOLE NUMBER
1. COMPANY NAME	2. DRILLING SUBCONTRACTOR	SHEET SHEETS OF

3. PROJECT	4. LOCATION
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8. HOLE LOCATION
	9. SURFACE ELEVATION
	10. DATE STARTED / 11. DATE COMPLETED
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR

LOCATION SKETCH/COMMENTS SCALE:

PROJECT	HOLE NO.

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER	
PROJECT	INSPECTOR
SHEET	OF SHEETS

ELEV. (4)	DEPTH (5)	DESCRIPTION OF MATERIALS (6)	FIELD SCREENING RESULTS (7)	DEPTH OF SAMPLE OR CORE BOX NO. (8)	ANALYTICAL SAMPLE NO. (9)	BLOW COUNT (10)	REMARKS (11)

PROJECT	HOLE NO.

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

WELL DEVELOPMENT REPORT

Project_____ Well No._____ Depth_____ Datum_____
Contractor_____ Rig_____ Operator_____ Inspector_____

Date	Method	Duration	Depth	Discharge Rate	% sand	Sediment Grain size	Volume	Remarks

GROUNDWATER SAMPLING DATA SHEET

Project Name: _____
Project/Task No.: _____
Date: _____
Weather: _____
Samplers: _____
Purge Method: _____
Sample Method: _____
Sampling Device: _____
Tubing Type: _____
Pump Intake Depth: _____
Water Disposal/quantity: _____

Sample Number: _____
Station Type: _____
Station Number: _____
Well Condition: _____
Well Diameter: _____
Screen Interval: _____
Measuring Point (MP): _____
Elevation of MP: _____
Elevation of Water: _____
Depth to bottom: _____
Depth to water: _____
Depth to NAPL: _____
NAPL thickness: _____

Field Test Kit Results:

PID: _____
DO: _____
Alkalinity: _____
Ferrous Iron: _____
Other: _____

Meter Information:

	Model	Calib. Date
pH:		
Eh:		
Conductivity:		
DO Meter:		
Turbidity:		
Temperature:		
Other:		

Containers:

Analysis	Type	#-Primary	#-MS/MSD

QA/QC Samples:

Duplicate: _____
Replicate: _____
MS/MSD: _____
Blank: _____

Comments:

Field Parameters	Units	0 Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes
Temperature								
pH								
Conductivity								
Eh								
DO								
Turbidity								
Time								
Water Level								
Flow Rate								

Field Parameters	Units	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Sample
Temperature								
pH								
Conductivity								
Eh								
DO								
Turbidity								
Time								
Water Level								
Flow Rate								

EPA
EPA Region 10
1200 Sixth Avenue
Seattle WA 98101

FIELD SAMPLE DATA AN[illegible] HAIN OF CUSTODY SHEET

Case No.: _____

Project Code: _____ Account: _____

Name/Location _____

Proj. Off.: _____ Tel.# _____

(EPA Lab Only, Leave Blank for Contract Lab)

- ☐ Enforcement/Custody
- ☐ Data Confidential
- ☐ Possible Toxic/Hazardous
- ☐ Data for STORET

Miscellaneous: _____

Sampling Crew: _____

Recorder: _____ (Signature Required)

SOURCE CODE	Matrix: Oil, Water, Sediment, Tissue, Prsrvd (Y/N)	# CONTAINERS: Qt. Cubit, Gal. Cubit, 16 oz., 8 oz., 120 mL, 40 mL, Other	LAB NUMBER: Yr., Wk, Seq	STORET STATION NUMBER	SAMPLING DATE & TIME: Yr, Mo, Dy, Time	TRAFFIC REPORT NUMBERS: Org., Inorg.	SAMPLER'S INITIALS	STATION DESCRIPTION

LAB NUMBER: Yr., Wk, Seq	DEPTH: Unit, Type	COL MTD CD	QA CODE	TEMP DEG C	pH	CNDCTVTY umho/cm	COMPOSITE ONLY: ENDING DATE: Mo., Day, Time	Type	Freq

Condition of Samples upon Receipt at Lab:

Custody Seals Intact: ☐ yes ☐ no ☐ none

CHAIN OF CUSTODY RECORD

Relinquished by: (signature)	Received by: (signature)	Date/Time
Relinquished by: (signature)	Received by: (signature)	Date/Time
Relinquished by: (signature)	Received by: (signature)	Date/Time
Relinquished by: (signature)	Received by Mobile Lab For Field Analysis: (signature)	Date/Time
Dispatched by: (signature) Date/Time	Received for Lab by: (signature)	Date/Time

Method of Shipment

Laboratory Copy White — Project Officer Copy Yellow — Field or Office Copy Pink

COOLER RECEIPT FORM

LIMS# _____

Contractor Cooler _____
QA Lab Cooler # _____
Number of Coolers _____

PROJECT: _____ DATE RECEIVED: _____

USE OTHER SIDE OF THIS FORM TO NOTE DETAILS CONCERNING CHECK-IN PROBLEMS.

A. PRELIMINARY EXAMINATION PHASE: Date cooler was opened: _____

By: (print) _____ (sign) _____

1. Did cooler come with a shipping slip (air bill, etc.)?.....YES NO

   If YES, enter carrier name & air bill number here: _____

2. Were custody seals on outside of cooler?.....YES NO

   How many & where: _____ Seal date: _____ Seal name: _____

3. Were custody seals unbroken and intact at the date and time of arrival?.....YES NO
4. Did you screen samples for radioactivity using the Geiger Counter?.....YES NO
5. Were custody papers sealed in a plastic bag & taped inside to the lid?.....YES NO
6. Were custody papers filled out properly (ink, signed, etc.)?.....YES NO
7. Did you sign custody papers in the appropriate place?.....YES NO
8. Was project identifiable from custody papers? If YES, enter project name at top of this form. YES NO
9. If required, was enough is used? .....Type of ice: _____ YES NO
10. Have designated person initial here to acknowledge receipt of cooler: _____ (date) _____

B. LOG-IN PHASE: Date samples were logged-in: _____

By (print) _____ (sign) _____

11. Describe type of packing in cooler: _____
12. Were all bottles sealed in separate plastic bags?.....YES NO
13. Did all bottles arrive unbroken & were labels in good condition?.....YES NO
14. Were all bottle labels complete (ID, date, time signature, preservative, etc.)?.....YES NO
15. Did all bottle labels agree with custody papers?.....YES NO
16. Were correct containers used for the tests indicated?.....YES NO
17. Were correct preservatives added to samples?.....YES NO
18. Was a sufficient amount of sample sent for tests indicated?.....YES NO
19. Were bubbles absent in VOA samples? If NO, list by QA#: _____ YES NO
20. Was project manager called & status discussed? If YES, give details on the back of form. YES NO
21. Who was called? _____
    By whom? _____ (date) _____

DAILY CHEMICAL QUALITY CONTROL REPORT

Project Name:
Project No.:

Date							
Day	S	M	T	W	TH	F	S

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32–50	50–70	70–85	85 up
Wind	Still	Mod.	High	Report No.	
Humidity	Dry	Mod.	Humid		

Personnel and Visitors on Site (List names and affiliations):

Equipment on Site:

Work Performed Today (Include tasks performed and progress/delays):

Safety (Include any infractions of approved safety plan or instructions from Government personnel. Specify corrective action taken):

Attached Forms (check box and describe):

☐ HTRW Drilling Log

☐ Groundwater Sampling Data Sheet

☐ Well Development Data Sheet

☐ EPA Region 9 Laboratory Analyses Required

☐ Well Development Data Sheet

☐ Field Sample Data and Chain of Custody Sheet

☐ Laboratory Data – ☐ SCAPS , ☐ FASP, ☐ Fixed

DAILY CHEMICAL QUALITY CONTROL REPORT

Project Name:	
Project No./Task No.:	**Date:**

Samples Collected (Field and QA)/Requested Analyses/Laboratories Performing Work:

Field Audit Results/Problems Encountered/Corrective Actions Taken:

Instructions to Contractors (Include names, reactions, and remarks):

By _____ **Title** _____
(Signature/Printed Name)

APPENDIX B

USACE Low-Flow Groundwater Purging and Sampling Standard Operating Procedures

LOW-FLOW GROUND WATER PURGING AND SAMPLING USING DEDICATED BLADDER PUMP SYSTEM

STANDARD OPERATING PROCEDURES

1.0 PURPOSE

This Standard Operating Procedure provides general information on low flow minimal draw down ground water purging and sample acquisition from a HTRW monitoring well with dedicated (left in place) bladder pump system. This SOP is intended to provide field personnel with a uniform approach to routine ground water sampling tasks using the low flow method.

2.0 SCOPE

This guideline describes equipment and method for the low flow purging and collection of ground water sample from the saturated zone. Review of these guidelines will also assist in the development and execution of a low flow purging and sampling plan that will provide meaningful and representative data.

3.0 DEFINITION

Low flow purging and sampling using dedicated bladder pumps is an EPA recommended method and is an acceptable method to use for USACE projects. The low flow purging and sampling technique induces laminar (non-turbulent) flow in the immediate vicinity of the sampling pump intake, thus drawing fresh ground water directly from the aquifer, horizontally through the well screen and into the sampling device. Low flow pumping rates are in the approximate range of 0.1 to 0.5 liter/minute. These low flow rates minimize disturbance in the aquifer, resulting in: (1)minimal production of artificial turbidity and oxidation; (2)minimal mixing of chemically distinct zones; (3)minimal loss of volatile organic compounds; and (4)collection of representative samples while minimizing purge volume.

4.0 GUIDELINES

4.1 General

Efficiency and cost-effectiveness of a sampling program will be increased by planning before starting the sampling operation. Well construction must be reviewed in order to specify the equipment and procedures to be used during purging and sampling. A table of well specifications that includes at least the well depths, casing diameters, screened intervals, recovery rates, and water level measurements is to be provided in the Project Sampling and Analysis Plan. Mobilization of equipment will be faster if accessibility of each well location is verified, the wells are accurately plotted on a site map, and the sampling order is determined in advance.

4.2 Purging, Sampling, and Monitoring Supplies and Equipment

The following is a general list of supplies and equipment that will be required when sampling monitoring wells.

- Accident Prevention Plan
- Project Sampling and Analysis Plan
- Personal protective equipment (e.g., gloves, rain gear or Tyvek-type disposable paper suits, steel toe boots, safety glasses)
- First aid kit
- Keys for well locks
- Dedicated purge and sample equipment (Well Wizard or equivalent dedicated pump with stainless steel casing and Teflon bladder, stainless steel inlet screen, Teflon-lined polyethylene twin bonded tubing with 3/8" OD sample tube and ¼" OD air line, 2" or 4" well caps with 3/8" OD discharge and ¼" OD air supply fittings and access hole for water level measurements, 3/8" OD dura-flex discharge adapter)
- In-line flow cell with multi-parameter meter that measures and displays pH, conductivity, temperature, dissolved oxygen, and oxygen-reduction potential (MicroPurge® Flow Cell Model FC4000 or equivalent in-line flow cell which allows for interchanging of sensor probes).
- Pump controller (MicroPurge® Smart Controller Model 400 or equivalent)
- 12 volt DC air compressor, 0.21 SFM @ 100 psi; maximum lift of 75 feet
- Oilless Air Compressor, 4.3 SCFM @ 100 psi; maximum lift of 200 feet
- Turbidity meter (LaMotte Turbidity Meter Model 2008 or equivalent)
- Photoionization detector (MicroTip Model HL-2000 or equivalent)
- Combustible gas indicator (Cannonball Biosystems. Inc. or equivalent)
- Electric water level measurement meter
- Standards and gasses for calibration (e.g., pH, conductivity, turbidity, PID, CGI)

- Pyrex measuring cup
- Stop watch
- Calculator
- Temperature and trip blanks, as specified in the SAP
- Sample preservation(e.g., deionized water, acids, pipettes, pH paper)
- Sample containers(e.g., glass or polyethylene of specific volumes)
- Sample shipment ice chest coolers
- Cold packs or ice for sample preservation in shipment coolers
- Plastic freezer bags to contain ice
- Bubble wrap plastic bags for sample containers
- Packing material to prevent sample containers from breakage during shipment
- Fiber and clear tape
- Chain-of-custody labels, record forms, custody seals, and ground water purging and sampling log sheets. Ground water purging and sampling log sheet is attached.
- Measuring tape
- Log book and indelible ink pen
- Decontamination equipment(e.g., tap and distilled water, non-phosphate soap, buckets, sponges, brushes)
- Camera and film
- Tool box
- D.O.T. approved gasoline storage container for air compressor
- Paper towels and/or rags
- Plastic sheeting (Visqueen)

- Distilled water sprayer used for decontamination
- Scissors and/or razor knife
- Trash bags
- Extra batteries and/or battery packs
- Express mail air bills

Once all the equipment is gathered and checked to determine that it is clean, properly packaged and in working order, the actual procedures for obtaining the samples must be selected. Well sampling is discussed in the next eleven sections in the order that it is performed:

1) Sample Preservation
2) Trip Blanks
3) Equipment Calibration
4) Well Condition Check and Contamination Prevention
5) Air Monitoring
6) Water Level Measurement and Monitoring
7) Initial Pump Installation
8) Low-Flow Purging
9) Sample Collection
10) After Completion of Sampling
11) Decontamination

4.3 Sample Preservation

The appropriate sample containers will be prepared in advance of actual sample collection for analytes of interest and include sample preservative where necessary. Preservatives will be added to the sample containers in a controlled setting prior to entering the field in order to reduce introducing field contaminants into the sample container while adding the preservatives. The preservatives will be transferred from the chemical bottle to the sample container using a disposable pipette. The pipette will be used for only one preservative type and then discarded after adding the specific preservative in the required group of sample containers. The pH of VOA samples will be checked by filling an extra vial with sample water and checking the pH with pH paper once per sampling event.

4.4 Trip Blanks

Trip blanks are used to assess the potential induction of contaminants from sample containers or during the transportation and storage procedures. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed for VOC analytes. Trip blanks will be prepared in the USACE Seattle District laboratory by filling 40 ml volatile organic analyses (VOA) vials with reagent grade water prior to commencement of field work.

Trip blanks will be preserved following the same procedure as investigative samples. One trip blank will accompany each cooler containing VOC samples sent to the laboratory for analysis.

4.5 Equipment Calibration

Prior to and following each day of sampling, all sampling device and monitoring equipment will be calibrated according to manufacturer's recommendations. Calibration documentation including date, time, and the initials of the person that performed the calibration will be recorded in the logbook.

A MicroPurge® Flow Cell Model FC4000 or equivalent will be used to simultaneously measure the pH, conductivity, water temperature, dissolved oxygen (DO), and oxidation reduction potential (Eh) of the water and aqueous solutions. The pH sensor will be calibrated at 2 points. One at neutral point (pH 7 buffer) and the second at pH 4 if the sample is expected to be acidic or pH 10 if the sample is expected to be basic. The conductivity sensor should be calibrated with a standard close to the conductivity range as the water to be sampled and performed at a temperature close to 25 degrees centigrade. This will minimize temperature compensation errors. Before calibrating the DO sensor, check condition of the membrane and change it if bubbles are visible under the membrane, if significant deposits of dried KCL electrolyte are visible on the membrane or O-ring, and/or if the probe shows unstable readings or other malfunction. For DO sensor calibration follow the detailed calibration procedure found in the MicroPurge® Flow Cell Model FC4000 User Guide manual or equivalent.

A dissolved oxygen Hach limnology kit or equivalent will be used on a site-specific basis as a quality control check on the DO sensor. The temperature and Eh sensors are factory calibrated, but should be checked on a regular basis. The temperature sensor should be checked by immersing it in water at a known temperature value. The Eh sensor should be checked by immersing it in a solution with a known oxidation reduction potential value, “Zobell” solution is recommended. Temperature and Eh sensors that cannot be factory recalibrated should be replaced if readings vary more than ±10 percent.

A MicroTIP, Model HL-2000, or equivalent hand held air monitor/photoionization detector(PID) will be used to measure the total concentration of airborne photoionizable gases and vapors released from the wells. The PID will first be calibrated to zero air followed by isobutylene span gas at 100 ppm +/- 5%.

A LaMotte Turbidity Meter, Model 2008, or equivalent will be used to measure the turbidity of the ground water. Turbidity standards, AMCO Turbidity Standard 0.5 NTU or 5.0 NTU, will be used to calibrate the meter.

A combustible gas indicator(CGI), Biosystems,Inc. Cannonball, or equivalent that will respond to all combustible gases and vapors will be used when specified in the Project Sampling and Analysis Plan. The CGI will first be calibrated to zero air followed by LFL propane span gas at 52.4 %.

4.6 Well Condition Check and Contamination Prevention

Check and record the condition of the well for any damage or evidence of tampering. To prevent contamination of the surface soils and the equipment, lay out a plastic sheeting around the wellhead and place the monitoring, purging and sampling equipment on the sheeting.

4.7 Air Monitoring

Measure total organic vapors upwind from the well to obtain a background reading using a PID equipped with a 10.6 eV lamp. Unlock well and remove well cap. Measure head space with the PID. For wells installed on a landfill or sites where combustible gas may be present, also measure head space with a CGI. If measurements indicate it is not safe, take necessary precautions noted in Health and Safety Plan.

4.8 Water Level Measurement and Monitoring

An electric water level meter will be used to measure the water level in the wells before purging, during purging, and after sampling. The water level probe should be carefully lowered down the well to minimize disturbance. Check water level periodically to monitor draw down as a guide to flow rate adjustment. The goal is minimal draw down, less than 4 inches during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval and may require adjustment based on site-specific conditions.

Measure the water level to the nearest 0.01 foot. Water level will be measured from the notch located at the top of the well casing. If well casing is not notched, measurement will be taken from the north edge of the top of the well casing, and a notch will be made using a decontaminated metal file.

Well depth should be obtained from well logs prior to entering the field. If well depth measurement is required, measure depth after sampling is complete.

4.9 Initial Pump Installation

The pump intake shall be positioned in the middle of the screened interval for wells with screen lengths less than or equal to 5-feet. For wells with longer screens, the pump intake shall be placed within the most productive zone. Therefore, the geologic log for each well shall first be consulted to determine the most productive zone. If at all possible, the pump intake shall not be placed within 2-feet of the well bottom or low water level.

4.10 Low-Flow Purging

Set up air compressor, pump controller, and in-line low flow cell to manufacturer specifications.

Begin purging at rate of 0.1 to 0.5 liters/minute. The appropriate and final purge rate will be determined by monitoring ground water draw down controlled by site specific conditions. If in-line flow meters are not used, pumping rates should be determined by collecting a measured

aliquot of purge water over a period of at least one minute. The discharge during purging and sampling must produce a non-pulsating flow. The water level should stabilize and ideally the pump rate should be sufficiently low to allow an equal or greater amount of water to recharge the well so little or no water level draw down is observed.

Measure and record ground water levels at least every 2 to 5 minutes until stabilization occurs. After stabilization, measure water levels at regular intervals. If significant draw down occurs, more than 4 inches, lower the speed of the pump and repeat discharge and water level measurements. Repeat until the water level stabilizes to closely match the recharge rate. Record pumping rate and any adjustments and depths to water on the purging and sampling log sheet.

Prior to and during purging, historic water quality parameter data shall be used to assist with evaluating stabilization. Any significant deviations will be recorded in the field sampling log book.

During purging, water chemistry indicator parameters will be measured continuously, every 2 to 5 minutes, until the parameters have stabilized. The water chemistry indicator parameters monitored shall include pH, temperature, conductivity, redox potential (Eh) and dissolved oxygen (DO). Turbidity shall be measured, but shall not used as a stabilizer indicator. The required indicator parameters to be monitored will be specified in the Project Sampling and Analysis Plan. As a guideline for stabilization, all indicator parameters should have stabilized for three successive readings. The 3 successive readings should be within +/- 0.1 for pH, +/- 3% for conductivity, +/- 10% for temperature, DO, and Eh. Eh and DO usually require the longest time for stabilization. A turbidity reading of 10 NTU's or less is desirable.[1] The above stabilization guidelines are provided as estimates and will not be appropriate for use in all circumstances. The purge stabilized indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable parameter values during purging. Purging will continue until the indicator parameters have stabilized to within the specified tolerance for each parameter and graph out asymptotically. It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter particularly with respect to draw down, flow rate, and sampling device. Fifteen to 30 minutes of purging at a rate of 0.1 to 0.5 liter/minute may be required to reach stabilization. If the indicator parameters do not stabilize, purging will cease after 60 minutes have elapsed.

The ground water should not be exposed to the atmosphere prior to measurement of the parameters because turbulence, degassing, aeration, heating, and depressurization can all cause significant changes in Eh, conductivity, and DO concentrations. Therefore, an in-line multi-parameter flow-through cell will be utilized when monitoring the indicator parameters.

All water produced during purging will be containerized and stored pending evaluation of acceptability for discharge or treatment.

Unless absolutely necessary, the pump will not be turned off between the purging and sampling process.

Wells installed in very low permeability formations(<0.1 L/min recharge) will require alternative purging and sampling methods. Use of the usual low flow techniques may be impractical in this type of environment, because devices to pump at such low flow rates are not readily available. The primary consideration is to avoid de-watering of the well screen and exposing the filter pack or formation in the saturated zone to atmospheric conditions. This may entail acquiring the sample with no or very little purging(volume of the tubing and pump chamber) and repeated recovery of the water. This may require that the water chemistry parameters be measured more frequently(every 1 to 2 minutes). Satisfying the usual sample volume requirements may also be a problem and some latitude will be needed on the part of the end-users. To ensure that the appropriate technique and methodology for purging and sampling collection is used, information on well construction and development is needed prior to the start of field activities. The decision on the purging and sampling collection technique and methodology to employ will be dictated by site specific conditions and objectives covered in the Project Sampling and Analysis Plan.

4.11 Sample Collection

Sampling can be initiated after the water chemistry indicator parameters have stabilized. Before collecting samples, sampling personnel will don clean, Nitrile or equivalent protective gloves. Sampling should occur in progression from least to most contaminated well if this is known. Samples will be collected directly from the end of the discharge tubing maintaining the established low flow purge rate. The sequence in which the different types of samples are collected is immaterial.

While filling the sample vial for VOC analysis, formation of air bubbles, aeration, and turbulence should be minimized by using the established low flow rate. A meniscus should be formed over the mouth of the vial to eliminate formation of air bubbles and head space prior to capping.

When pouring the sample from the discharge tubing into the sample bottle, the sample water will be poured gently down the inside of the bottle with minimal turbulence. After filling the sample container, the Teflon-lined cap will be screwed tightly to prevent the container from leaking. A sample label will be filled out and placed on the sample container as specified in the Project Sampling and Analysis Plan. The samples will be stored and shipped at 4°C. All samples will be shipped to the laboratory within 48 hours of collection.

The intent of low flow purging and sampling is to minimize disturbance in the well and thus eliminate the need for filtering samples for inorganic analyses. The unfiltered sample is meant to represent the total mobile contaminant load. However, filtering of samples collected for inorganic analyses may be recommended in some instances. The decision to filter samples will be dictated by site specific sampling objectives covered in the Project Sampling and Analysis Plan.

If filtering is performed, in-line filters will be used. The filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of one liter of ground water following purging and prior to sampling.

4.12 After Completion of Sampling

The air inlet and discharge lines shall be carefully removed from their respective well cap fittings Place protective cap on the air inlet and discharge fittings. Close and lock the well. Between all sampling locations, all sampling equipment that comes in contact with the well water(eg. water level meter, turbidity vials) will require decontamination**.** All non-dedicated supplies and equipment will be gathered and disposed of properly.

4.13 Decontamination

The water level meter and water chemistry parameter indicator sensors will be decontaminated according to the following procedures:

1. The water level meter will be hand washed with phosphate free detergent with a scrubber or sponge, then thoroughly rinsed with distilled water.

2. The parameter indicator meter probes will be rinsed with clean tap water after each measurement. No other decontamination procedures are necessary or recommended for these instrument probes and vials since they are very sensitive, and they do not contact in-situ well and sample water. After the sampling event, the flow cell chamber and sensors will be cleaned and maintained as necessary according to the care and maintenance procedures found in the MicroPurge® Flow Cell Model FC4000 User Guide manual or equivalent.

End of Standard Operating Procedures

Footnotes:
[1]Removed maximum allowed turbidity value of 10 NTU's.

LOW-FLOW GROUND WATER PURGING AND SAMPLING USING DEDICATED BLADDER PUMP SYSTEM

SEATTLE DISTRICT HTRW DESIGN CENTER
STANDARD OPERATING PROCEDURES

22 March 1999

US Army Corps
of Engineers
Seattle District

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LOW FLOW GROUND WATER PURGING AND SAMPLING USING NON-DEDICATED SUBMERSIBLE PUMPS

STANDARD OPERATING PROCEDURES

1.0 PURPOSE

This Standard Operating Procedure provides general information on low flow minimal draw down ground water purging and sample acquisition from HTRW monitoring wells with non-dedicated submersible pumps. This SOP is intended to provide field personnel with a uniform approach to routine ground water sampling tasks using the low flow method.

2.0 SCOPE

This guideline describes equipment and method for the low flow purging and collection of ground water sample from the saturated zone. Review of these guidelines will also assist in the development and execution of a low flow purging and sampling plan that will provide meaningful and representative data.

3.0 DEFINITION

Low flow purging and sampling is an EPA recommended method and is an acceptable method to use for USACE projects. The low flow purging and sampling technique induces laminar (non turbulent) flow in the immediate vicinity of the sampling pump intake, thus drawing ground water directly from the aquifer, horizontally through the well screen and into the sampling device. Low flow pumping rates are typically in the range of 0.1 to 0.5 liter/minute, however, this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations can be sampled successfully at flow rates of 0.5 to1.0 liters/minute. These low flow rates minimize disturbance in the aquifer, resulting in: (1)minimal production of artificial turbidity and oxidation; (2)minimal mixing of chemically distinct zones; (3)minimal loss of volatile organic compounds; and (4)collection of representative samples while minimizing purge volume.

4.0 GUIDELINES

4.1 General

Efficiency and cost-effectiveness of a sampling program will be increased by planning before starting the sampling operation. Well construction must be reviewed in order to specify the equipment and procedures to be used during purging and sampling. A table of well specifications that includes at least the well depths, casing diameters, screened intervals,

recovery rates, and water level measurements is to be provided in the Project Sampling and Analysis Plan. Mobilization of equipment will be faster if accessibility of each well location is verified, the wells are accurately plotted on a site map, and the sampling order is determined in advance.

4.2 Purging,Sampling,and Monitoring Supplies and Equipment

The following is a general list of supplies and equipment that will be required when sampling monitoring wells.

- Accident Prevention Plan
- Project Sampling and Analysis Plan
- Personal protective equipment(e.g., gloves, rain gear or Tyvex suits, steel toe boots, safety glasses)
- First aid kit
- Keys for well locks
- Purge and sample equipment(e.g., electrical submersible pumps or bladder pumps, generator, oilless air compressor, filters, tubing)
- In-line flow cell with multi-parameter meter that allows for interchanging of sensor probes.
- Meters, probes and standards for field measurements (e.g., turbidity, water level, PID, calibration gas)
- Pyrex measuring cup
- Graduated beaker
- Stop watch
- Calculator
- Temperature and trip blanks, as specified in the SAP
- Sample preservation(e.g., deionized water, acids, pipettes, pH paper)
- Sample containers(e.g., glass or polyethylene of specific volumes)

- Sample shipment ice chest coolers
- Cold packs or ice for sample preservation in shipment coolers
- Plastic freezer bags to contain ice
- Bubble wrap plastic bags for sample containers
- Packing material to prevent sample containers from breakage during shipment
- Fiber and clear tape
- Chain-of-custody labels, record forms, custody seals, and ground water purging and sampling log sheets. Ground water purging and sampling log sheet is attached.
- Measuring tape
- Log book and indelible ink pen
- Decontamination equipment(e.g.,tap and distilled water, non-phosphate soap,buckets,sponges,brushes)
- Camera and film
- Tool box
- D.O.T. approved gasoline storage container for generator or oilless air compressor
- Paper towels and/or rags
- Plastic sheeting(Visqueen)
- Decon sprayer
- Scissors and/or razor knife
- Trash bags
- Extra batteries and/or battery packs
- Express mail air bills

Once all the equipment is gathered and checked to determine that it is clean, properly packaged and in working order, the actual procedures for obtaining the samples must be selected. Well sampling is discussed in the next eleven sections in the order that it is performed:

1) Sample Preservation
2) Trip Blanks
3) Equipment Calibration
4) Equipment Blanks
5) Well Condition Check and Contamination Prevention
6) Air Monitoring
7) Water Level Measurement and Monitoring
8) Low-Flow Purging
9) Sample Collection
10) After Completion of Sampling
11) Decontamination

4.3 Sample Preservation

The appropriate sample containers will be prepared in advance of actual sample collection for analytes of interest and include sample preservative where necessary. Preservatives will be added to the sample containers in a controlled setting prior to entering the field in order to reduce introducing field contaminants into the sample container while adding the preservatives. The preservatives will be transferred from the chemical bottle to the sample container using a disposable pipette. The pipette will be used for only one preservative type and then discarded after adding the specific preservative in the required group of sample containers. The pH of VOA samples will be checked by filling an extra vial with sample water and checking the pH with pH paper once per sampling event.

4.4 Trip Blanks

Trip blanks are used to assess the potential induction of contaminants from sample containers or during the transportation and storage procedures. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed for VOC analytes. Trip blanks will be prepared in the USACE Seattle District laboratory by filling 40 ml volatile organic analyses (VOA) vials with reagent grade water prior to commencement of field work. Trip blanks will be preserved following the same procedure as investigative samples. One trip blank will accompany each cooler containing VOC samples sent to the laboratory for analysis.

4.5 Equipment Calibration

Prior to and following each day of sampling, all sampling device and monitoring equipment will be calibrated according to manufacturer's recommendations. Calibration documentation including date, time, and the initials of the person that performed the calibration will be recorded in the logbook.

A MicroPurge® Flow Cell Model FC4000 or equivalent will be used to simultaneously measure the pH, conductivity, water temperature, dissolved oxygen (DO), and oxidation reduction potential (Eh) of the water and aqueous solutions. The pH sensor will be calibrated at 2 points. One at neutral point (pH 7 buffer) and the second at pH 4 if the sample is expected to be acidic or pH 10 if the sample is expected to be basic. The conductivity sensor should be calibrated with a standard close to the conductivity range as the water to be sampled and performed at a temperature close to 25 degrees centigrade. This will minimize temperature compensation errors. Before calibrating the DO sensor, check condition of the membrane and change it if bubbles are visible under the membrane, if significant deposits of dried KCL electrolyte are visible on the membrane or O-ring, and/or if the probe shows unstable readings or other malfunction. For DO sensor calibration follow the detailed calibration procedure found in the MicroPurge® Flow Cell Model FC4000 User Guide manual or equivalent.

A MicroTIP, Model HL-2000, or equivalent hand held air monitor/photoionization detector(PID) will be used to measure the total concentration of airborne photoionizable gases and vapors released from the wells. The PID will first be calibrated to zero air followed by isobutylene span gas at 100 ppm +/- 5%.

A LaMotte Turbidity Meter, Model 2008, or equivalent will be used to measure the turbidity of the ground water. Turbidity standards, AMCO Turbidity Standard 0.5 NTU or 5.0 NTU, will be used to calibrate the meter.

A combustible gas indicator(CGI), Biosystems,Inc. Cannonball, or equivalent that will respond to all combustible gases and vapors will be used when specified in the Project Sampling and Analysis Plan. The CGI will first be calibrated to zero air followed by LFL propane span gas at 52.4 %.

4.6 Equipment Blanks

Equipment blank samples will be collected at a frequency of once per day to assess the effectiveness of the equipment decontamination procedures. The frequency of equipment blank collection will be specified in the Project Sampling and Analysis Plan. Equipment blanks will be collected in the field prior to purging and between sampling wells after proper equipment decontamination. Distilled or reagent grade water will be pumped through the system and will be collected in a sample container. All equipment blanks will be submitted blind to the laboratory with sample numbers that are indistinguishable from the investigative samples.

Equipment blanks will be preserved in the same manner as the investigative samples and will analyzed for the same parameters as the associated samples.

4.7 Well Condition Check and Contamination Prevention

Check and record the condition of the well for any damage or evidence of tampering. To prevent contamination of the surface soils and the equipment, lay out a plastic sheeting around the wellhead and place the monitoring, purging and sampling equipment on the sheeting.

4.8 Air Monitoring

Measure total organic vapors upwind from the well to obtain a background reading using a PID equipped with a 10.6 eV lamp. Unlock well and remove well cap. Measure head space with the PID. For wells installed on a landfill or sites where combustible gas may be present, also measure head space with a CGI. If measurements indicate it is not safe, take necessary precautions noted in Health and Safety Plan.

4.9 Water Level Measurement and Monitoring

An electric water level meter will be used to measure the water level in the wells before installing the pump. Water levels will also be measured before, during purging, and after sampling. The water level probe should be carefully lowered down the well to minimize disturbance. Check water level periodically to monitor draw down as a guide to flow rate adjustment. The goal is minimal draw down, less than 4 inches during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval and may require adjustment based on site-specific conditions.

Measure the water level to the nearest 0.01 foot. Water level will be measured from the notch located at the top of the well casing. If well casing is not notched, measurement will be taken from the north edge of the top of the well casing, and a notch will be made using a decontaminated metal file.

Well depth should be obtained from well logs prior to entering the field. If, well depth measurement is required, measure depth after sampling is complete.

4.10 Low-Flow Purging

Set up non-dedicated submersible pump, control, and power source components according to manufacturer specifications. Measure and mark desired pump intake placement depth on dedicated tubing and assemble to pump.

Slowly and carefully lower pump down to the desired sample depth where contaminants and representative ground water flow are expected. Be careful not to place the pump intake less than 2-feet above the bottom of the well as this may cause the mobilization of bottom sediments. There should be at least 2-feet of water above the pump intake to prevent pump suction from being broken or entrainment of air in the sample. The pump intake should be positioned in the middle of the screened interval for wells with screen lengths less than or equal to 5-feet. For wells with longer screens, the pump intake should be placed within the most productive zone. Therefore, the geologic log for each well shall be first consulted to determine the most productive zone. The pump intake depth will be recorded on the purging and sampling log sheet.

The water level in the well will rise due to displacement by the pump. Wait for water to equilibrate to its original level before purging.

After the well has equilibrated, begin purging at rate that minimizes stress(draw down) to the system. The appropriate and final purge rate will be determined by monitoring ground water draw down controlled by site specific conditions. The discharge during purging and sampling must produce a non-pulsating flow. The water level should stabilize and the pump rate should be sufficiently low to allow an equal or greater amount of water to recharge the well so little or no water level draw down is observed.

Measure and record ground water levels at least every 2 to 5 minutes until stabilization occurs. After stabilization, measure water levels at regular intervals. If significant draw down occurs, more than 4 inches, lower the speed of the pump and repeat discharge and water level measurements. Repeat until the water level stabilizes to closely match the recharge rate. Record pumping rate and any adjustments and depths to water on the purging and sampling log sheet.

During purging, water chemistry indicator parameters will be measured continuously, every 2 to 5 minutes, until the parameters have stabilized. The water chemistry indicator parameters monitored shall include pH, temperature, conductivity, redox potential (Eh) and dissolved oxygen (DO). Turbidity shall also be measured, but shall not used as a stabilizer indicator. However, turbidity values should not exceed 10 NTU's. The required indicator parameters to be monitored will be specified in the Project Sampling and Analysis Plan. As a guideline for stabilization, all indicator parameters should have stabilized for three successive readings. The 3 successive readings should be within +/- 0.1 for pH, +/- 3% for conductivity, +/- 10% for temperature, DO, and Eh. Eh and DO usually require the longest time for stabilization. A turbidity reading of 10 NTU's or less is desirable.[1] The above stabilization guidelines are provided as estimates and will not be appropriate for use in all circumstances. The purge stabilized indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable parameter values during purging. Purging will continue until the indicator parameters have stabilized to within the specified tolerance for each parameter and graph out asymptotically. It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter particularly with respect to draw down, flow rate, and sampling device. Purging will cease if the indicator parameters do not stabilize within 60 minutes of elapsed purging time.

The ground water should not be exposed to the atmosphere prior to measurement of the parameters because turbulence, degassing, aeration, heating, and depressurization can all cause significant changes in Eh, conductivity, and DO concentrations. Therefore, an in-line multi-parameter flow-through cell will be utilized when monitoring the indicator parameters.

All water produced during purging will be containerized and stored pending evaluation of acceptability for discharge or treatment.

Unless absolutely necessary, the pump will not be turned off between the purging and sampling process.

Wells installed in very low permeability formations(<0.1 L/min recharge) will require alternative purging and sampling methods. Use of the usual low flow techniques may be impractical in this type of environment, because devices to pump at such low flow rates are not readily available. The primary consideration is to avoid dewatering of the well screen and exposing the filter pack or formation in the saturated zone to atmospheric conditions. This may entail acquiring the sample with no or very little purging(volume of the tubing and pump chamber) and repeated recovery of the water. This may require that the water quality parameters be measured more frequently(every 1 to 2 minutes). Satisfying the usual sample volume requirements may also be a problem and some latitude will be needed on the part of the end-users. To ensure that the appropriate technique and methodology for purging and sampling collection is used, information on well construction and development is needed prior to the start of field activities. The decision on the purging and sampling collection technique and methodology to employ will be dictated by site specific conditions and objectives covered in the Project Sampling and Analysis Plan.

4.11 Sample Collection

Sampling can be initiated after the water quality indicator parameters have stabilized. Before collecting samples, sampling personnel will don clean, nitrile or equivalent protective gloves. Sampling should occur in progression from least to most contaminated well if this is known. Samples will be collected directly from the end of the discharge tubing maintaining the established low flow purge rate. The sequence in which the different types of samples are collected is immaterial.

While filling the sample vial for VOC analysis, formation of air bubbles, aeration, and turbulence should be minimized by using the established low flow rate. A meniscus should be formed over the mouth of the vial to eliminate formation of air bubbles and head space prior to capping.

When pouring the sample from the discharge tubing into the sample bottle, the sample water will be poured gently down the inside of the bottle with minimal turbulence. After filling the sample container, the Teflon-lined cap will be screwed tightly to prevent the container from

leaking. A sample label will be filled out and placed on the sample container as specified in the Project Sampling and Analysis Plan. The samples will be stored and shipped at 4°C. All samples will be shipped to the laboratory within 48 hours of collection.

The intent of low flow purging and sampling is to minimize disturbance in the well and thus eliminate the need for filtering samples for inorganic analyses. The unfiltered sample is meant to represent the total mobile contaminant load. However, filtering of samples collected for inorganic analyses may be recommended in some instances. The decision to filter samples will be dictated by site specific sampling objectives covered in the Project Sampling and Analysis Plan.

If filtering is performed, in-line filters will be used. The filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of one liter of ground water following purging and prior to sampling.

4.12 After Completion of Sampling

Unless the pump has been dedicated to the well, the pump assembly should be carefully removed from the well. Close and lock the well. Between all sampling locations, all sampling equipment that comes in contact with the well water will require decontamination. All non-dedicated supplies and equipment will be gathered and disposed of properly.

4.13 Decontamination

The non-dedicated ground water pump system (e.g., pump, power source cable, tubing) that will be used in multiple wells will be decontaminated according to the following procedures:

1. The outside surfaces of the pump and other components that contacts the ground water will be hand washed with phosphate free detergent and warm water, up to 100°F maximum, with a scrubber sponge; thoroughly rinsed with warm water, then rinsed with distilled water.

2. The inside and outside surfaces of the pump will be flushed with phosphate free detergent and warm water, up to 100 °F maximum, then thoroughly flushed with warm water followed with distilled water. It is recommended that the Teflon lined tubing used to draw the ground water be dedicated to each well sampled.

3. The sampling crew will be required to clean the pump system using procedures 1 and 2 between well sampling. For rental pumps, the rental company shall be required to decontaminate the equipment following above procedures 1 and 2. In addition, the pump shall be disassembled, all internal parts shall be cleaned, and all Teflon parts shall be replaced.

The water level meter and water quality parameter indicator probes will be decontaminated according to the following procedures:

1. The water level meter will be hand washed with phosphate free detergent with a scrubber or sponge, then thoroughly rinsed with distilled water.

2. The parameter indicator meter probes will be rinsed with distilled water after each measurement. No other decontamination procedures are necessary or recommended for these instrument probes and vials since they are very sensitive, and they do not contact in-situ well and sample water. After the sampling event, the meter probes will be decontaminated again by hand washing with phosphate free detergent and warm water with a scrubber sponge and then thoroughly rinsed with deionized water in the USACE Seattle District laboratory or equivalent.

End of Standard Operating Procedures

LOW-FLOW GROUND WATER PURGING AND SAMPLING USING NON-DEDICATED SUBMERSIBLE PUMPS

SEATTLE DISTRICT HTRW DESIGN CENTER
STANDARD OPERATING PROCEDURES

23 March 1999

US Army Corps
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ABBREVIATIONS AND ACRONYMS

AA	atomic absorption
ASTM	American Society for Testing and Materials
COC	chain of custody
CLP	Contract Laboratory Program
COPC	chemical of potential concern
CVAA	cold vapor atomic absorption spectophotometry
DQO	data quality objective
ECD	electron capture detector
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
FPD	flame photometric detector
FSP	field sampling plan
GB	sarin
GC/MS	gas chromatograph/mass spectrometry
HD	mustard gas
HPLC	high-performance liquid chromatography
HTRW	hazardous, toxic, and radiological waste
ICP	inductively coupled plasma
ICP/MS	inductively coupled plasma/mass spectrometry
LC/MS	liquid chromatograph/mass spectrometry
LCS	laboratory control sample
LIMS	laboratory information management system
MB	method blank
MCL	maximum contaminant level
MDL	method detection limit
mL	milliliter
MRL	method reporting limit
MS/MSD	matrix spike/matrix spike duplicate
NIST	National Institute of Standards and Technology
NPD	North Pacific Division
NWTPH-Dx	Northwest total petroleum hydrocarbons – diesel extended
ODEQ	Oregon Department of Environmental Quality
ORP	oxidation-reduction potential
PCBs	polychlorinated biphenyls
PID	photoionization detector
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goal
QA/QC	quality assurance/quality control

ABBREVIATIONS AND ACRONYMS (Continued)

QAM	quality assurance manager
QAPP	quality assurance project plan
RPD	relative percent difference
SAP	sampling analysis plan
SAS	Sound Analytical Services
SI	site investigation
SOP	standard operating procedure
SOW	Statement of Work
SPE	solid-phase extraction
SVOCs	semivolatile organic compounds
SWRI	Southwest Research Institute
TAL	Target Analyte List
TCL	Target Compound List
TIC	tentatively identified compound
TPH-Dx	total petroleum hydrocarbons–diesel range extended
URS	URS Corporation and subsidiaries
USACE	U.S. Army Corps of Engineers
UV	ultraviolet
VOCs	volatile organic compounds

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP), in conjunction with the Field Sampling Plan (FSP), make up the Sampling and Analysis Plan (SAP), which is an integral part of the Management Plan for the former North Pacific Division (NPD) laboratory site investigation (SI) in Troutdale, Oregon. The purpose of the SAP is to ensure production of high quality data that meet project objectives and requirements and accurately characterize measurement parameters. The SAP provides protocols for collecting samples, measuring and controlling data, and documenting field and laboratory methods so that the data are technically and legally defensible. The SAP was prepared in accordance with guidelines set forth by the U.S. Army Corps of Engineers requirements (USACE 1994).

The SAP has two major components: Part I - the FSP and Part II - this QAPP. The FSP presents the detailed scope of work associated with field activities (e.g., sample types, sample locations) and specifies the procedures to be used for sampling and other field operations. The QAPP describes the analytical data quality objectives, field and laboratory analytical procedures, quality assurance/quality control (QA/QC) procedures, and data quality evaluation criteria.

Sampling and analysis procedures for the field exploration are designed to be sufficient to satisfy the data quality objectives (DQOs) identified in Section 6.0 of the Work Plan. This plan presents the analytical methods and associated QA/QC procedures selected to meet the project DQOs.

2.0 ANALYTICAL DATA QUALITY OBJECTIVES

The purpose of the SI at the NPD laboratory site is to complete a consistent sampling and analysis scope that can be used to fill the data gaps left following previous investigations. Soil, sediment, groundwater, and concrete samples will be collected for the following purposes:

- To collect the data required to better define the type and extent of groundwater, soil, sediment, groundwater, and concrete contamination
- To determine if previous removal of contaminated soil was complete
- To determine if pole-mounted transformers have adversely impacted the soil around the existing transformer pad
- To evaluate any adverse impacts to the environment from past laboratory activities
- To determine the concentration of any contamination in the Umatilla Army Depot Borrow Site (borrow site) soils

2.1 CHEMICALS OF POTENTIAL CONCERN

Soil, sediment, groundwater, and concrete samples will be collected and analyzed for chemicals of potential concern (COPCs). For this site, the COPCs include the following:

- U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) Target Compound List (TCL) volatile and semivolatile organic compounds (VOCs and SVOCs), chlorinated pesticides, and polychlorinated biphenyls (PCBs)
- EPA CLP Target Analyte List (TAL) metals and cyanide
- Northwest Total Petroleum Hydrocarbons-diesel range extended (NWTPH-Dx)

In addition to these analytes, samples of the Umatilla borrow site materials will be analyzed for the following:

- EPA SW-846 Method 8330 list explosives

- Breakdown compounds from the chemical agents HD (mustard gas), VX, and GB (sarin).

Concentrations of COPCs detected during analysis will be compared to EPA maximum contaminant levels (MCLs), Oregon Department of Environmental Quality (ODEQ) Groundwater Quality Protection Standards, ODEQ Soil Cleanup Levels, and EPA Region 9 Preliminary Remedial Goals (PRGs). For some analytes, the laboratories will be unable to achieve reporting limits that are as low as the screening criteria for those analytes. Screening criteria that are lower than the laboratory reporting limits are highlighted in the table provided in Appendix A. When sample data cannot be compared to low-concentration screening criteria (because reporting limits exceed screen criteria), the data will be evaluated qualitatively by the Project Chemist. For example, the data will be evaluated for the presence or absence of the compound and for the presence of other collocated contaminants.

2.2 DATA QUALITY LEVELS

The sampling and analysis program was developed to generate data to meet project objectives and support the conclusions made by the technical staff. A more detailed description of the sampling rationale and project DQOs can be found in Section 6.2 of the Work Plan. The following section describes the approach to be used for data generation in the field and at off-site laboratories, and describes sources of uncertainty and how uncertainty will be managed. The quality control program associated with this approach and documented in this QAPP has been developed to address these uncertainties.

Two levels of data quality and analysis are applicable for this project:

- Screening-level data
- Definitive data

2.2.1 Screening-Level Data

Groundwater parameters will be measured during monitoring well development and sampling to evaluate conditions prior to sampling. These parameters include turbidity, temperature, pH, oxidation-reduction potential (ORP), specific conductance, and dissolved oxygen. A photoionization detector (PID) will be used to perform headspace screening. A discussion of field measurement quality assurance is presented in Section 3.

2.2.2 Definitive Level Data

Definitive data will be generated to determine the presence and concentration of COPCs at the site and to compare the detected concentrations to regulatory screening criteria. To generate data of sufficient quality for these uses, the following approach will be followed:

- The laboratories will be validated by the U.S. Army Corps of Engineers (USACE).
- Methods approved by the EPA will be used. Quality control samples and procedures will be used by the laboratories for analysis, as specified in Sections 4 through 6 and Appendix B.
- The laboratories will provide EPA CLP-like data reports for all analyses requiring definitive data. The complete data report and documentation must be sufficient to perform data validation if required.
- Documents will be retained in the project files for a minimum of 10 years from the time of receipt from the laboratories.
- Data quality review and validation will be performed on the analytical data according to the procedures specified in Section 10.

2.3 ANALYTICAL METHODS

Samples collected for the NPD laboratory SI will be analyzed according to EPA-approved methods. Analytical methods to be performed for the SI are presented in Section 5. The laboratories' standard operating procedures (SOPs) must be in compliance with the USACE *Engineer Manual EM 200-1-3*, Appendix I (USACE 2001) with modifications where appropriate. All method modifications must be documented and approved by the USACE.

Southwest Research Institute (SWRI) located in San Antonio, Texas, will conduct the analyses for the breakdown products of chemical agents, and Sound Analytical Services (SAS), Inc., located in Fife, Washington, will conduct all other analyses.

2.4 ANALYTICAL METHOD DETECTION LIMITS AND METHOD REPORTING LIMITS

Sensitivity requirements for all methods and matrices are driven by the DQOs. Laboratory data for the COPCs will be compared to applicable screening criteria as listed in Appendix A; therefore, method reporting limits (MRLs) should be less than the applicable matrix-specific screening criteria whenever possible. Method detection limits (MDLs) and MRLs are defined below.

The sensitivity of some of the analytical methods identified for this project is insufficient to allow comparison of all the target analytes to the screening criteria. Screening criteria concentrations that are lower than the analyte MRLs are highlighted in Appendix A. Values reported below the MRL but above the MDL and flagged as estimated (J) may be used as semiquantitative data points. However, when there are no analytes reported below the MRL, the data value used for comparison will be the MRL.

2.4.1 Method Detection Limit

The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDLs are determined from analysis of a sample in a given matrix containing the analyte (Appendix B of 40 CFR 136).

2.4.2 Method Reporting Limit

The Method Reporting Limit (also called the Practical Quantitation Limit [PQL] by SAS) is a threshold value below which the laboratory reports a result as non-detected. It may be based on project-specific criteria, regulatory action levels, or sensitivity capability of method and instrument. MRLs are adjusted based on the sample matrix and any necessary sample dilutions. The MRL represents the value for which the laboratory has demonstrated the ability to reliably quantitate target analytes within prescribed performance criteria for the method performed. Analytes whose concentrations fall below the MRL will be considered estimated.

3.0 METHODS AND QUALITY CONTROL FOR FIELD ACTIVITIES

This section describes field measurement procedures, sample handling, and coordination procedures between the sampling team and analytical laboratories. Detailed sampling procedures are presented in the FSP.

3.1 FIELD MEASUREMENT METHODS

Groundwater will be monitored during sampling for specific conductance, pH, turbidity, dissolved oxygen, temperature, and ORP using a water quality meter with flow-through chamber. A PID will be used to perform headspace screening. Both instruments will be used and calibrated daily according to the manufacturer's instructions.

3.2 FIELD MEASUREMENT INSTRUMENT CALIBRATION PROCEDURES

Field instruments used for this investigation will be rented; however, the calibration and general maintenance of field instruments will be the responsibility of the Field Investigation Manager. All calibration procedures and measurements will be made in accordance with manufacturers' specifications and the USACE SOP for low-flow purging and sampling (Appendix B to the FSP). Field instruments will be checked and calibrated before their use on site, and batteries will be charged and checked daily.

Instrument calibration will be conducted at the beginning of each workday, at midday, and if necessary through the course of the day in accordance with URS SOPs "Equipment Calibration, Operation, and Maintenance" and "Water Quality Monitoring Equipment." A final calibration will be conducted at the end of the day after the last field sample has been analyzed. Special attention will be given to instruments that may drift with change in ambient temperature or humidity. A three-point initial calibration will be conducted if applicable to the instrument being used. One-point calibrations will be conducted thereafter. If an instrument is found to be out of compliance during a calibration, sampling personnel may be required to reanalyze samples collected subsequent to the failed recalibration.

Equipment that fails calibration and/or becomes otherwise inoperable during the field investigation will be removed from service and segregated to prevent inadvertent use. Such equipment will be properly tagged to indicate that it should not be used until repaired. Equipment that cannot be repaired or recalibrated will be replaced.

All documentation pertinent to the calibration and/or maintenance of field equipment will be maintained in an active field logbook. Logbook entries regarding the status of field equipment will contain, but will not necessarily be limited to, the following information:

- Date and time of calibration
- Name of person conducting calibration
- Type of equipment being used or serviced and identification (make and model)
- Reference standard used for calibration (such as pH of buffer solutions)
- Calibration and/or maintenance procedure used
- Adjustments made based on calibration results
- Other pertinent information (e.g., operational problems such as drift)

3.3 SAMPLE HANDLING, CONTAINERS, PRESERVATION, AND HOLDING TIMES

Sample containers, preservation, and holding times are summarized in Tables 3-2 and 3-3 in the FSP. Samples will be collected in glass or plastic containers. The containers will have screw-type lids to ensure adequate sealing of the bottles. Lids of the glass containers will have Teflon inserts to prevent sample reaction with the lid and to improve the quality of the seal.

Commercially available precleaned jars will be used. The bottle shipment documentation will record batch numbers for the bottles. With this documentation, bottles can be traced to the supplier and bottle wash analysis results can be reviewed. The bottle wash certificate documentation will be archived in the permanent project file.

Before making shipment to the field, the project laboratories will add the required preservatives to the sample bottles. Sample preservation procedures are used to maintain the character of analytes as sampled (i.e., representative concentrations and/or speciation in situ) during storage and shipment. Regardless of the nature of the sample, absolute stability for all constituents cannot be achieved. Preservation techniques, such as pH control and refrigeration, may retard physiochemical and biochemical changes. As a general rule, analyzing the sample as soon as possible is the best way to minimize physicochemical and biochemical changes.

Samples will be placed in the appropriate sample container and refrigerated (on ice in a cooler) immediately upon sample collection. The samples will be transferred to the project laboratories as soon as possible using chain of custody (COC) procedures, as described in the FSP. Based on the potential levels of contaminants, samples for all analyses will be hand-delivered or shipped as environmental samples. Upon receipt at the project laboratories, a cooler receipt form will be filled out to document sample condition. The laboratories must fax the COC and cooler receipt

forms to the contractor within 8 hours of sample receipt. The laboratories will make every effort to meet all specified holding times.

3.4 COORDINATION WITH ANALYTICAL LABORATORIES

Team members will work closely with the project laboratories to ensure that samples are handled and analyzed following procedures described in this QAPP. A schedule of fieldwork and sampling will be established approximately 2 weeks before commencement of fieldwork. Each day that samples are shipped to the laboratories, a designated team member will contact the laboratories to confirm that samples have been received.

The project laboratories will contact the Project Chemist after it is suspected that reanalysis of a sample by the laboratory is unsuccessful due to matrix interference. The Project Chemist will immediately notify the URS Project Manager, who will notify the USACE Project Manager and the USACE Project Chemist, if necessary.

4.0 QUALITY CONTROL SAMPLES

Field QC and laboratory QC samples will be employed to evaluate data quality. QC samples are controlled samples introduced into the analysis stream, whose results are used to assess data quality and to calculate the accuracy and precision of the chemical analysis program. The purpose of each type of QC sample, collection and analysis frequency, and evaluation criteria are described in this section. Collection frequency for field QC samples is summarized in Table 4-1. Laboratory reporting limits and regulatory screening criteria are presented in Appendix A. Required QC criteria (including frequency and corrective action) and laboratory performance-based QC limits are listed in Appendix B and C, respectively.

QC procedures for the project laboratories will be consistent with the requirements described in this QAPP. This document defines and adds procedures and QC elements that an analytical method may leave ambiguous. The laboratories will be required to conduct all QC measurements for this project on samples from and within batches of samples from this project alone; in other words, no “other project” samples will be used with samples from this project for assessment of data quality.

4.1 FIELD QUALITY CONTROL SAMPLES

Field QC is accomplished through the analysis of controlled samples that are introduced to the laboratories from the field. Rinsate blanks, reagent blanks (preservatives), trip blanks, field duplicates, and temperature blanks will be collected and submitted to the project laboratories to provide a means of assessing the quality of data resulting from the field sampling program.

4.1.1 Rinsate Blanks

Rinsate blanks are collected to determine the potential for cross-contamination of samples during collection when improperly cleaned field equipment are used. Rinsate blanks are used to assess the quality of the decontamination process and to quantify COPCs that might have been transferred. If non-dedicated sampling equipment is used, rinsate blanks will be collected and analyzed at the rate of 5 percent of all groundwater, soil, sediment, and concrete samples submitted to the fixed laboratories. If dedicated or disposable sampling equipment is used, no rinsate blank is required.

Rinsate blanks will consist of laboratory-provided, analyte (COPCs)-free, deionized water collected from the final rinse of the sampling equipment after completion of the decontamination procedures described in Section 2 of the FSP. Blank sample collection frequency is listed in Table 4-1.

All rinsate blanks will be submitted blind to the laboratories with sample numbers that are indistinguishable from primary samples. Blank samples will be analyzed for the same parameters as associated field samples. The concentrations of analytes detected in the blanks will not be subtracted from the sample concentrations.

4.1.2 Trip Blanks

Trip blanks will be used to check for procedural contamination, cross-contamination, and contamination during shipment and storage of solid and aqueous samples collected for VOC analysis. One trip blank (40-milliliter [mL] vial with preserved contaminant-free water provided by the laboratory) will be submitted to the project laboratory for each cooler containing aqueous samples for VOC analysis. One trip blank (4-ounce glass container with methanol or sodium bisulfate provided by the laboratory) will be submitted to the project laboratory for each cooler containing soil, sediment, or concrete samples for analysis of VOCs. At no time after their preparation are the sample containers to be opened until they return to the laboratories. Each trip blank will be inspected for bubbles and overall condition, which will be noted in the field notebook. Each trip blank will be assigned a number to identify the cooler it accompanies, which will be recorded in the field logbook and on the COC. Trip blanks will be placed in the cooler with the first environmental sample collected. The self-sealing bag containing the trip blanks will be left open in the cooler throughout the sampling day.

The trip blanks will be indistinguishable from the other samples to the extent possible and will be prepared using sample containers and labels identical to those used for the primary samples. The concentrations of analytes detected in the trip blanks will not be subtracted from the sample concentrations.

4.1.3 Field Duplicates

Field duplicate samples are used to check for sampling and analysis reproducibility. Field duplicates will be submitted to the project laboratories at a frequency of 10 percent of the field samples for every matrix and analytical method. Field duplicate samples should be collected from areas most likely to be contaminated. Field duplicate samples will be collected in conjunction with and analyzed by the same methods as the primary samples. Control limits for field duplicate precision are 30 percent relative percent difference (RPD) for aqueous samples and 50 percent RPD for soil, sediment, and concrete samples.

Field duplicates will be submitted blind to the laboratories, with sample numbers that are indistinguishable from primary samples. Calculation and reporting of the RPD for field duplicates are described in Section 7.1.

4.1.4 Temperature Blanks

Temperature blanks are used to measure cooler temperatures upon receipt of the coolers at the laboratories. One temperature blank will be prepared and submitted to the project laboratory with each cooler. The temperature blank will consist of a sample jar containing water, which will be packed on ice in the cooler in the same manner as the rest of the samples and labeled "temperature blank."

4.2 LABORATORY QUALITY CONTROL SAMPLES

Laboratory QC is accomplished by analyzing initial and continuing calibration samples, method blanks, surrogate spikes, matrix spike (MS)/matrix spike duplicate (MSD) pairs, laboratory control samples (LCS), and laboratory duplicate samples. Project-specific QC criteria (including frequency, QC limits, and corrective actions) are presented in Appendix B. The criteria presented in Appendix B are derived from USACE guidance and the referenced methods. The laboratory analysts will process the data, and the laboratory QA manager will review data for overall reasonableness and transcription or calculation errors in compliance with the QC criteria presented in these tables.

4.2.1 Initial and Continuing Calibration Standards

Laboratory instrument calibration and maintenance requirements are discussed in Section 6.

4.2.2 Method Blanks

Method blanks are used to check for laboratory and reagent contamination, instrument bias, and accuracy. Laboratory method blanks will be analyzed at a minimum frequency of 5 percent or one per analytical batch for all chemical parameter groups.

QC criteria require that minimum contamination be detected in the blank(s). If a chemical is detected, the action taken will follow the criteria established by this QAPP. Blank samples will be analyzed for the same parameters as the associated field samples. The concentrations of analytes detected in the method blanks will not be subtracted from the sample concentrations.

4.2.3 Surrogate Spikes

The accuracy of an analytical measurement may be evaluated by using surrogate spikes. Surrogate compounds are compounds not expected to be found in environmental samples; however, they are chemically similar to several compounds analyzed in the methods and behave similarly in extracting solvents. Samples for organic compound analysis will be spiked with

surrogate compounds consistent with the requirements described in the analytical methods and in the laboratory SOPs.

Percent recovery of surrogates is calculated concurrently with the analytes of interest. Because sample characteristics will affect the percent recovery, the percent recovery is a measure of accuracy of the overall analytical method on each individual sample.

4.2.4 Laboratory Control Samples

LCSs are used to monitor the laboratories' day-to-day performance of routine analytical methods, independent of matrix effects. LCSs are prepared by spiking reagent water with standard solutions that contain the same compounds used in establishing instrument calibration. Spiking levels will be between the low and mid-level calibration standards used for the primary samples. LCSs are extracted and analyzed with each batch of samples. Results are compared on a per-batch basis and are used to evaluate the laboratories' performance for accuracy. LCSs may also be used to identify any background contamination of the analytical system that may lead to the reporting of elevated concentration levels or false-positive measurements.

4.2.5 Matrix Spike/Matrix Spike Duplicates

MS/MSD sample pairs are used to assess sample matrix interferences and analytical errors, as well as to measure the accuracy and precision of the analysis. For MS or MSD samples, known concentrations of analytes are added to environmental samples; the samples are then processed through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery of the known spiked amount (and RPD for MS/MSD).

Spiked samples will contain all the target compound required by the CLP. Spiking concentrations for all MS/MSD samples analyses will be at concentrations in the middle of the calibration range that is used to analyze the primary sample.

Because MS/MSD samples are used to measure the matrix interference of a specific matrix, only samples from this investigation will be analyzed as MS/MSD. The MS/MSD samples will be analyzed for the same parameters as the associated field samples in the same QC analytical batch. Poor MS/MSD recoveries may not be attributed to matrix interference until the laboratories reprepare the samples, with accompanying cleanup procedures and reanalysis, and the results indicate similarly poor recoveries.

Generally, a specific sampling location will be used to collect field QC samples; however, it may not be possible to collect MS/MSD samples for all analyses at the same sampling locations because of the limited volume of material available. In those instances, MS/MSD samples for various analyses will be collected from different locations. Additionally, samples for MS/MSD

analyses will be designated in the field but will not be collected from locations with potentially high concentrations of target analytes that may mask the added spike compounds. Required laboratory QC criteria and corrective actions for MS/MSD samples are presented in Appendix B.

4.2.6 Laboratory Duplicate Samples

Precision of the analytical system is evaluated by analyzing MS/MSD pairs and laboratory duplicates. Laboratory duplicates are two portions of a single homogeneous sample analyzed for the same parameter. Laboratory duplicates will be prepared and analyzed with project samples being analyzed for metals and other inorganic analytes. If a sample contains high native concentrations of organic compounds, a laboratory duplicate (instead of MSD) should be analyzed.

Table 4-1
Field Quality Control Sample Collection Summary

Sample Type	Frequency
Rinsate blanks	5 percent
Temperature blanks	1/cooler
Water trip blanks	1 per cooler for VOC analyses (per matrix)
Reagent trip blanks (preservatives)	1 per cooler for VOC analyses (per matrix)
Field duplicates	10 percent

5.0 METHODS AND QUALITY CONTROL FOR LABORATORY ACTIVITIES

This section describes the analytical procedures to be used for project laboratory measurements. The analytical methods and associated QA/QC procedures were selected based on consideration of the project DQOs.

5.1 ANALYTICAL METHODS

The analytical methods, calibration procedures, and QC measurements and criteria are based on current analytical protocols in the following documents:

- EPA SW-846 *Test Methods for Evaluation of Solid Waste* (SW-846) (USEPA 1998)
- USACE *Engineer Manual EM 200-1-3, Appendix I* (USACE 2001)
- Washington State Department of Ecology, Analytical Methods for Petroleum Hydrocarbons, ECY 97-602 (June 1997)
- SWRI Standard Operating Procedures (proprietary)

Samples will be analyzed using the following methods described in Sections 5.1.1 through 5.1.7 below. Tables 3-2 and 3-3 in the FSP provide requirements for sample containers, preservation, holding times, and analytical methods. Refer to Appendix B for a complete description of required QC criteria for each method.

Samples collected for dissolved metals will be filtered and preserved in the field. Concrete samples will be sent to the laboratory as collected in small chips (less than 1 inch in diameter), and the laboratory will analyze the samples in chip form. To prevent volatilization of any VOCs that may be present in the chip sample, the laboratory will not pulverize, grind, or sift the sample. The contracted laboratory has stated that it does not modify its methods for concrete chips.

5.1.1 Volatile Organic Compounds

CLP TCL VOCs will be analyzed by SW-846 methods including Method 8260B for analysis, Method 5030B for preparation of aqueous samples, and Method 5035 for preparation of solid samples. These methods are used to determine low-level concentrations of VOCs in soil and water. Soil samples will be preserved in the field with methanol or sodium bisulfate. Water

samples will be preserved in the field with hydrochloric acid. A purge-and-trap system is used to concentrate the volatile compounds prior to analysis by gas chromatography/mass spectrometry (GC/MS) with an ion trap (Table B-1 in Appendix B).

5.1.2 Semivolatile Organic Compounds

CLP TCL SVOCs will be analyzed by SW-846 methods including Method 8270C for analysis, Method 3510C for preparation of aqueous samples, and Method 3550B for preparation of solid samples. These methods are used to determine low-level concentrations of SVOCs in extracts prepared from all types of matrices. Water samples are extracted with methylene chloride and analyzed by GC/MS-ion trap. Soil samples are extracted with methylene chloride and acetone using a heated ultrasonic bath for extraction and a GC/MS-ion trap for analysis (Table B-2 in Appendix B).

5.1.3 Chlorinated Pesticides and PCBs

CLP TCL chlorinated pesticides and CLP TCL PCBs will be analyzed by SW-846 methods including Method 8081A for chlorinated pesticides, and Method 8082 for PCBs. Method 3510C will be used to prepare aqueous samples and Method 3550B will be used to prepare solid samples. These methods provide procedures for determining low-level concentrations of certain chlorinated pesticides and PCBs. Samples are extracted and then analyzed by GC equipped with a duel electron capture detector (ECD) (Tables B-3 and B-4 in Appendix B).

5.1.4 Metals and Mercury

CLP TAL total and dissolved metals, including strontium and uranium, will be analyzed by SW-846 methods including Method 6010B (inductively coupled plasma [ICP]) and Method 6020 (inductively coupled plasma/mass spectrometry [ICP/MS]). Method 3010A will be used for preparation of aqueous samples, and Method 3051 will be used for preparation of solid samples.

Aqueous samples will be analyzed for mercury by Method 7470A (cold vapor atomic absorption spectrophotometry [CVAA]) and solid samples will be analyzed by Method 7471A (CVAA).

These methods provide procedures for the preparation, operation, tuning, optimization, and analysis of samples for metals and mercury in solids and groundwater (Tables B-5 and B-6 in Appendix B).

5.1.5 Total Cyanide

Total cyanide in solid and aqueous samples will be analyzed by SW-846 Method 9012A. Method 9013 will be used for preparation of solid samples. These methods provide the

procedure for the analysis of total cyanide in most aqueous and solid matrices. The analysis uses a strong acid distillation and pyridine-barbituric acid colorimetric titration (Table B-7 in Appendix B).

5.1.6 Petroleum

Petroleum will be analyzed by NWTPH-Dx. This method provides a procedure for the quantitative and qualitative analyses of semivolatile petroleum products in soil and water. The samples are extracted with methanol and a portion of the extract is injected directly into a GC with flame ionization detector (FID) (Table B-8 in Appendix B).

5.1.7 Ordnance (Explosive) Compounds

Ordnance (explosive) compounds will be analyzed by SW-846 Method 8330A. Method 3535 will be used for preparation of aqueous samples, and Method 3550B will be used for preparation of solid samples. This method is used for the trace analysis of explosives residues. Water samples (rinsate blank) are extracted using solid-phase extraction (SPE) and are analyzed by high-performance liquid chromatography (HPLC) with an ultraviolet (UV) detector (Table B-9 in Appendix B).

5.2 MODIFICATION OF STANDARD METHODS

SAS uses a modification of Method 3550B to extract semivolatile organic analytes from soils and solids. The modification includes the use of a heated ultrasonic bath. SAS is validated for semivolatile soil extractions by the USACE based on this modified procedure.

Chemical agent breakdown products (HD [mustard], VX, and GB [sarin]) will be analyzed by SWRI SOPs. These SOPs are proprietary modifications of standard HPLC, ion chromatography, and GC/MS methods. QC criteria for these methods are provided in Tables B-10 through B-13 in Appendix B. SWRI performance-based QC limits are presented in Appendix C. A summary of the methods follows.

- HD (mustard gas) degrades to thiodiglycol and hydrochloric acid and oxidizes (e.g., by incineration) to dithiane and oxathiane. Thiodiglycol is determined by leaching the compound from soil with methanol and analyzing the extract using liquid chromatography/mass spectrometery (LC/MS) or HPLC with a UV detector. Dithiane and oxathiane are determined by extraction from soil at a slightly basic pH and injection of the concentrated extract into a gas chromatograph with a flame photometric (FPD) detector.

- The nerve agent GB (sarin) degrades to methylphosphonic and hydrofluoric acid. GB is determined by leaching the compound from soil and analyzing the leachate by ion chromatography with a UV detector.

- The nerve agent VX degrades to a number of decomposition products called VX thiols. VX is analyzed using EPA SW-846 modified Method 8270. The samples are extracted, and the extract is analyzed by GC/MS. Results are reported as tentatively identified compounds (TICs) because external standards are not commercially available.

5.3 LABORATORY PERFORMANCE

Laboratories selected for this project are USACE validated (see Appendix D). The laboratories' in-house statistical control limits, based on historical data, demonstrate their ability to meet project-specific control limits on a routine basis. Laboratory procedures will be implemented according to the laboratories' QA plans and SOPs. In addition, laboratories will be required to meet the QA/QC standards established in this QAPP.

The laboratories will ensure the quality of results by maintaining an integrated quality assurance system of activities involving the planning, implementation, assessment, reporting, and quality improvement of data. These activities will be performed or facilitated by the Laboratory QA officer and include the (1) performance of periodic audits (system and technical); (2) participation in proficiency testing programs/interlaboratory comparisons, (3) routine analysis of certified reference materials or second source reference materials, and (4) monitoring method performance (sensitivity, precision and bias) through an evaluation of the MDL study or MDL check sample, and batch QC sample (method blank [MB], LCS) control ranges/charts. Refer to *ISO/IEC Guide 25, General Requirements for the Competence of Calibration and Testing Laboratories* and *ANSI/ASQC E4, Specification and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* for additional information.

The selected laboratories must ensure that all possible procedures for achieving minimum reporting limits are applied. These procedures will include sample cleanup, increased aliquot size, and concentration of extracts. In addition, the laboratories will report (as estimated) all detected compounds whose concentrations are below the MRL but above the MDL. If dilutions are necessary to bring individual target analytes within the calibration range, these analytes will be reported from the dilution while the remaining analyte results will be reported from the nondiluted analytical run.

The laboratories will demonstrate that they tried cleanup procedures or method of standard additions, as recommended in the methods, to deal with suspected matrix effects. Sample dilution may be used to deal with matrix interferences only after extensive cleanups have been tried and have been unsuccessful.

If target analytes in LCS samples are out of control limits, corrective action will be taken. Initially, the effect the QC failure has on the samples will be evaluated. Regardless of the results of this assessment, the laboratory will take steps to find the source of the problem and correct it. Typically, the laboratory will reanalyze the LCS for the failed analytes only. If the second analysis fails, the LCS, method blank, and all associated samples of the batch will be reprepared and reanalyzed for the failed analytes only. When there are multiple target analytes (more than five), sporadic marginal failures of a few target analytes included in the LCS may be acceptable without requiring reanalysis of the entire batch.

USACE guidance states that the method blank is acceptable if "the concentration of all target analytes is below one-half the MRL for each target analyte, or less than 5 percent of the regulatory limit associated with that analyte, or less than 5 percent of the sample result for the same analyte, whichever is greater." The laboratories will be required to comply with the USACE guidance for analysis of the method blank as follows:

- If an analyte is found only in the method blank, but not in the batch samples, no further corrective action is necessary. Steps should be taken to find and reduce or eliminate the source of this contamination in the method blank.

- If an analyte is found in the method blank at concentrations that exceed criteria, and in some or all of the other batch samples, the laboratory shall reanalyze (within the holding times) the method blank and any samples containing the same contaminant.

- If the contamination remains at concentrations that exceed criteria, the laboratory shall re-prepare and reanalyze (within the holding times) the contaminated samples, a new method blank, and batch-specific QC samples.

- If holding times are exceeded before reanalysis occurs, the laboratory must notify the URS Project Chemist immediately. The URS Project Manager will decide if reanalysis or re-extraction outside of holding times should be undertaken.

Laboratory requirements for compound identification are prescribed within the SW-846 analytical methods used. In some organic methods, the information is included directly within the method used (e.g., GC/MS Methods 8260B, 8270C), or this information is referenced to a general EPA SW-846 method (such as 8000B) that outlines procedures applicable to several

chromatographic methods (GC, HPLC, etc.). Laboratory SOPs present procedures required to establish retention time windows (window width and location) for each target analyte for each chromatographic column employed in the analysis.

Laboratory requirements for compound confirmation are prescribed within the EPA SW-846 analytical methods employed. For GC/MS methods, compound confirmation is obtained from the mass spectrum following specified procedures included within the methods, and no additional measures are needed. For GC and HPLC methods, EPA SW-846 procedural options are presented in Method 8000B, Section 7.9. The USACE guidance recommends in preferential order the use of the GC/MS or other analytical technique (if applicable), a dissimilar column (if available), or a second detector as a means for confirmation. When using a secondary column, Method 8000B Section 7.9 states that the analysis should meet the QC criteria (for example, for calibration or retention time). The USACE guidance further recommends that if quantitative results are to be reported from the secondary column (i.e., when interferences are noted on the primary column), additional documentation must be furnished. This documentation must show that the same procedures for calibration and batch QC that are applied to the primary column are applied and successful on the secondary column.

When confirmed, the agreement between the primary and secondary columns (or detectors) is compared to evaluate method performance and decide the value to report (if applicable). The difference between the results is calculated as the RPD for comparability purposes only. These RPD values are generally not used to determine presence/absence of the target analyte. Presence/absence is determined by the signal being present on both columns. When disparity in the results occurs, the laboratory must review the chromatograms to evaluate potential sources of error (such as overlapping peaks or matrix interference). When no evidence of interference is found, the larger of the values should be reported to ensure that any decisions made based on the data are conservative with regard to the environment.

For HPLC analyses, the laboratories are required to analyze each sample on the primary column and again on the secondary column (as opposed to split column confirmation on a GC that allows the sample to be analyzed on two columns simultaneously). Therefore, the usual QC protocol for the HPLC secondary column is to analyze only one calibration standard whose concentration is within 50 percent of the sample concentration.

The selected methods and QC requirements listed in this section are sufficient to meet the project objectives. While a best effort will be made to achieve the project objectives, there may be cases in which it is not possible to meet the specified goals. Any significant limitation to data quality caused by analyses that fail to meet the data quality indicators specified in this QAPP will be identified and brought to the attention of the USACE Technical Lead as described in Section 5.4.

5.4 QUALITY CONTROL

The following procedures will be instituted to ensure that data to be used in decision making comply with QC criteria presented in this QAPP. The following procedures will be part of the overall project QA/QC activities:

- Data review will be performed on 100% of all analytical data. Data validation will be performed on 10% of all the analytical data.

- A laboratory monitoring program will be employed to institute corrective actions in laboratory procedures, as necessary, to provide defensible, quality data.

The laboratories will receive copies of the final Management Plan, including the QAPP. Approximately 1 week prior to the commencement of fieldwork, a telephone conference call will be conducted that will include participation by key project personnel such as laboratory representatives, the URS Project Manager, and URS Project Chemist. The USACE Project Manager and USACE Project Chemist may also choose to participate. The purpose of the telephone conference call will be to ensure that the field sampling program and required analytical procedures are clear to the laboratories, that the laboratories are prepared to receive and analyze the project samples, and that all personnel involved understand how data acquisition will be accomplished.

The laboratories will be required to prepare briefing reports that will be forwarded to URS. The briefings will include numbers of samples received, conditions of samples, requested analytical methods, and any other pertinent information regarding sample receipt. In addition, the briefings will provide information related to laboratory QC issues, such as matrix effects or surrogate recoveries. The purpose of these briefings is to institute corrective actions as soon as they arise to ensure that the final data packages provide reliable, accurate, and defensible data.

6.0 LABORATORY INSTRUMENT CALIBRATION

Instrument calibration will be in compliance with EPA-approved methods, this QAPP, and the manufacturer's instructions. General requirements are discussed below.

6.1 STANDARD SOLUTIONS

A critical element in the generation of quality data is the purity/quality and ability to trace the standard solutions and reagents used in the analytical operations. To ensure the highest purity possible, the laboratories will obtain all primary reference standards and standard solutions from the National Bureau of Standards, the EPA repository, or other reliable commercial source. The laboratories will maintain a written record of the supplier, lot number, purity/concentration, receipt/preparation date, name of the analyst , method of preparation, expiration date, and all other pertinent information for all standards, standard solutions, and individual standard preparation logs.

Standard solutions will be validated prior to use. Validation procedures can range from a check for chromatographic purity to verification of the concentration of the standard solution using another standard solution prepared at a different time or obtained from a different source. Stock and working standard solutions will be checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change of concentration. Care will be exercised in the proper storage and handling of standard solutions, and all containers will be labeled as to compound, concentration, solvent, expiration date, and preparation data (initials of preparer/date of preparation). Reagents will be examined for purity by subjecting an aliquot or subsample to the corresponding analytical method as well.

6.2 BALANCES

The laboratories will calibrate analytical balances annually according to manufacturer's instructions and have a calibration check before each daily use by laboratory personnel. All balance calibrations will use Class 1 or S weights and will be within a range appropriate to the sample mass. Acceptance criteria are 1 percent for top-loading balances and 0.1 percent for analytical balances. Annual calibrations and calibration checks will be documented in appropriate hardbound logbooks with prenumbered pages.

6.3 REFRIGERATORS

The laboratories will monitor all refrigerators for proper temperature by measuring and recording internal temperatures on a daily basis using National Institute of Standards and Technology (NIST)-certified or NIST-traceable thermometers. At a minimum, thermometers used for these measurements will be calibrated annually according to manufacturer's instructions. Refrigerators will be maintained at 4°C ± 2°C and freezers at -10°C to -20°C. Refrigerator and freezer temperatures will be documented in appropriate hardbound logbooks with prenumbered pages.

6.4 VOLUMETRIC MEASUREMENTS

Before use, volumetric glassware or other laboratory ware will be inspected for cracks or damages. Eppendorf-type pipettes will be verified (weekly, at a minimum) at the volume to be used or at two different volumes that bracket the range of use. Fixed volume Eppendorf-type pipettes will be verified monthly. All non-standard laboratory ware used to measure the initial sample volume or the final volume of the extracts/digestates will be verified to be accurate within 3 percent. Each calibration check will be documented in appropriate hardbound logbooks with prenumbered pages.

6.5 WATER SUPPLY SYSTEM

The project laboratories will maintain an appropriate water supply system that is capable of furnishing American Society for Testing and Materials (ASTM) Type II polished water to the various analytical areas. ASTM Type I or equivalent water should be used for trace metal analysis.

Initial calibration blanks and continuing calibration blanks will be used to document that the laboratory water supply system produces water that is free of the analytes of concern at the level of concern for the project. Method blanks will be used to ensure that none of the reagents used for the requested analyses are contaminated with the analytes of concern.

6.6 LABORATORY INSTRUMENTS

As stated in laboratory SOPs, calibration of all analytical instrumentation is required to ensure that the analytical system is operating correctly and functioning at the sensitivity required to meet project-specific objectives. Each instrument will be calibrated with standard solutions appropriate to the instrument and analytical method, in accordance with the methodology specified, and at the QC frequency specified in the laboratory SOPs.

The calibration history of the fixed laboratory instrumentation is an important aspect of the project's overall QA/QC program. As such, all initial and continuing calibration procedures will be implemented by trained personnel following the manufacturer's instructions and in accordance with applicable EPA protocols to ensure the equipment is functioning within the tolerances established by the manufacturer and the method-specific analytical requirements.

7.0 ANALYTICAL DATA QUALITY INDICATORS

The methods for the NPD laboratory SI are selected to ensure that the accuracy and precision of the data will be sufficient and that the data will be useful for identifying and quantifying COPCs at the site.

The data quality indicators presented in this section are precision, accuracy (bias), representativeness, comparability, completeness, and sensitivity. Table 7-1 presents a summary of QC samples and parameters that will be used to evaluate data quality. Project-specific QC criteria for laboratory analyses are summarized in Appendix B.

7.1 PRECISION

Precision is defined as the degree of agreement between or among independent, similar, or repeated measures. Precision is expressed in terms of analytical variability. For this project, analytical variability will be measured as the RPD or coefficient of variation between analytical laboratory duplicates and between the MS and MSD analyses. Monitoring variability will be measured by analysis of blind field duplicate samples.

Precision will be calculated as the RPD as follows:

$$\text{RPD (\%)} = 100 \times \frac{|S - D|}{(S + D)/2}$$

where:

S	=	Analyte concentration in a sample
D	=	Analyte concentration in a duplicate sample

The resultant RPD will be compared to criteria established by this QAPP, and deviations from these criteria will be reported. If the QAPP criteria are not met, the laboratories will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. The RPD will be evaluated during data review and validation. The data reviewer will note deviations from the specified limits and will comment on the effect of the deviations on reported data.

7.2 ACCURACY

Accuracy is the amount of agreement between a measured value and the true value. It will be measured as the percent recoveries of MS and MSD, organic surrogate compounds, and the LCS. Additional potential bias will be quantitated by the analysis of calibration standards and blank samples (e.g., method, rinsate, and trip blanks).

In cases where accuracy is determined from spiked samples, accuracy will be expressed as the percent recovery. The closer these values are to 100, the more accurate the data. Surrogate recovery will be calculated as follows:

$$\text{Recovery (\%)} = \frac{\text{MC}}{\text{SC}} \times 100$$

where:

SC	=	Spiked concentration
MC	=	Measured concentration

Matrix spike percent recovery will be calculated as follows:

$$\text{Recovery (\%)} = \frac{\text{MC} - \text{USC}}{\text{SC}} \times 100$$

where:

SC	=	Spiked concentration
MC	=	Measured concentration
USC	=	Unspiked sample concentration

The resultant percent recoveries will be compared to criteria established by this QAPP, and deviations from these criteria will be reported. If the objective criteria are not met, the laboratories will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. Percent recoveries will be evaluated during data review and validation and the data reviewer will comment on the effect of the deviations on the reported data.

7.3 REPRESENTATIVENESS

Representativeness is the degree to which sample results represent the system under study. This component is generally considered during the design phase of a program. This program will use the results of all analyses to evaluate the data in terms of its intended use. Site sampling locations for this project are placed using a biased approach to maximize the likelihood of locating and identifying site contamination, if present. Areas of apparent contamination have been selected to be representative of potential impacts from past activities. Representativeness will also be determined by evaluating hold time, sample preservation, and blank contamination. Samples with expired hold times, improper preservation, or contamination may not be representative.

7.4 COMPARABILITY

Comparability is the degree to which data from one study can be compared with data from historical studies at the site, other similar studies, reference values (such as background), reference materials, and screening values. This goal will be achieved through using standard techniques to collect samples, EPA-approved methods to analyze samples, and consistent units to report analytical results. Data comparability also depends on data quality. Data of unknown quality cannot be compared.

7.5 COMPLETENESS

Completeness for usable data is defined as the percentage of the total data set minus the rejected or missing data compared to the total data set generated. Specifically, the basis for calculation of completeness is the total number of planned data results (number of samples × number of analyses × number of analytes) relative to the total number of valid results generated. Data are considered valid if they fulfill the DQO requirements established in the QAPP. When feasible, the amount of sample collected will be sufficient to reanalyze the sample, should the initial results not meet QC requirements. Because the number of sample aliquots that will be collected to measure each parameter exceeds that required for the analysis, thus allowing for reanalysis, 100 percent completeness is anticipated. Less than 100 percent completeness could result if sufficient chemical contamination exists to require sample dilutions, resulting in an increase in the project-required detection/quantitation limits for some parameters. Highly contaminated environments can also be sufficiently heterogeneous to prevent the achievement of specified precision and accuracy criteria. Therefore, the overall project target goal for completeness will be 98 percent for laboratory analyses. Quality data are data obtained in a sample batch for which all QC criteria were met. Completeness will be calculated as follows:

$$Completeness\ (\%) = \frac{V}{P} \times 100$$

where:

V	=	Number of valid measurements
P	=	Number of planned measurements

Valid and nonvalid data (i.e., data qualified as "R" rejected) will be identified during data review and validation (Section 10.2).

7.6 SENSITIVITY

Sensitivity will be determined by reviewing MDLs, and MRLs. The sensitivity of some of the analytical methods identified for this project is insufficient to allow comparison of all the target analytes to all the screening criteria presented in the table in Appendix A. Screening criteria concentrations that are lower than the laboratory MRLs are highlighted in Appendix A .

The laboratories will be directed to report compounds detected below the MRL and above the MDL as detected estimated (J flag). These estimated compound concentrations will be used, in addition to the fully quantitated concentrations, for comparison to screening criteria.

Table 7-1
Parameters Used to Evaluate Data Quality

Data Quality Indicator	QA Parameter
Precision	Field duplicate Blank spike duplicate Laboratory duplicate Matrix spike duplicate
Accuracy	Matrix spike Surrogate spike Initial calibration standards and blanks Continuing calibration standards and blanks Laboratory control sample Trip blank Rinse blank Method blank
Representativeness	Trip blank Rinse blank Method blank Chain of custody Holding times and preservation status
Comparability	Method detection limits Method reporting limits Sample collection methods Laboratory analytical methods
Completeness	Data qualifiers Laboratory deliverables Requested/reported valid results
Sensitivity	Method detection limits Method reporting limits

8.0 PREVENTIVE MAINTENANCE

8.1 PREVENTIVE MAINTENANCE

Manufacturers have established guidelines for preventive maintenance of their instruments and equipment. Preventive maintenance is implemented on a schedule based on the type and stability of the instruments and equipment, project-required accuracy, intended use, and environmental factors. Preventive maintenance minimizes down time and ensures the accuracy, precision, sensitivity, and traceability of data collected while using the instruments and equipment. Maintenance is conducted by trained technicians, using service manuals or through service agreements with qualified maintenance contractors. Instruments and equipment that are identified to be out of calibration or malfunctioning are removed from operation until they are recalibrated or repaired. In addition, backup for instruments/equipment and critical spare parts are maintained to quickly correct malfunctions. Examples of typical equipment maintenance spare parts may include but not be limited to filters, tubing, and fittings.

8.2 FIELD INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Calibration of equipment and instrumentation ensures that accurate and reliable measurements are obtained. All instruments and equipment used on the project are calibrated and adjusted to operate within manufacturers' specifications and with a frequency stipulated by the maintenance schedule or by analytical method. Instrument calibration will be conducted at the beginning of each workday and at midday in accordance with URS SOPs “Equipment Calibration, Operation, and Maintenance” and “Water Quality Monitoring Equipment.” A final calibration will be conducted at the end of the day after the last field sample has been analyzed. The initial calibration will include three calibration standards if appropriate to the instrument being used. One-point calibrations will be conducted thereafter. In addition, one-point calibrations will be made when sampling conditions change, when sample matrices change, and/or if the instrument readings become unstable.

The water quality meter and PID used during the collection of groundwater samples will be factory serviced and calibrated before the project is initiated and will be field-checked daily in accordance with the manufacturer’s instructions.

8.3 LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION

The procedures for maintenance and calibration used by the analytical laboratories are included in their laboratory QA plans and analytical methods. The laboratories supplied information regarding their preventive maintenance programs and their inventory of backup instrumentation

for review by URS during the procurement process. Laboratories selected for this project have demonstrated their ability to analyze project samples within holding time by having well-maintained instruments and adequate backup instrumentation.

All laboratory calibration standards must be traceable to the NIST or other primary standards. Methods and intervals of calibration are based on the type of equipment, stability characteristics, required accuracy, intended use, and environmental conditions. Section 6 provides detailed requirements for laboratory instruments. The tables in Appendix B provide additional QC criteria required for laboratory instrument calibration.

8.4 CALIBRATION AND MAINTENANCE RECORDS

Calibration and maintenance schedules and records are maintained for laboratories' instruments and URS-owned field equipment. Both equipment and equipment records are located in a controlled-access facility when not in use. This is done to minimize equipment damage, theft, and tampering that may jeopardize either field or laboratory measurements and, ultimately, data quality.

9.0 CORRECTIVE ACTIONS

The project plans, SOPs, and training establish the baseline for field quality control. The ultimate responsibility for maintaining quality throughout the NPD laboratory SI rests with the URS Project Manager. The day-to-day responsibility for ensuring the quality of field and laboratory data rests with the Field Investigation Manager, Project Chemist, Project Quality Assurance Manager (QAM) or QA/QC Designee, and the laboratory program administrator.

Results of QA reviews and audits typically identify the requirement for a corrective action. The Project QAM/Designee is responsible for reviewing all audit and nonconformance reports to determine areas of poor quality or failure to adhere to established procedures. Nonconformances are reported formally by the Project QAM/Designee to the URS Project Manager. The URS Project Manager is responsible for evaluating all reported nonconformances, determining the root cause, conferring with the Project QAM/Designee on the steps to be taken for correction, and ensuring that the corrective action is developed and scheduled. Corrective action measures are selected to prevent or reduce the likelihood of future occurrences and address the root causes to the extent identifiable. Selected measures are appropriate to the seriousness of the nonconformance and are realistic in terms of the resources required for implementation.

Any nonconformance with the established QC procedures will be expeditiously identified, corrected, and controlled. Where procedures are not in compliance with the established protocol, corrective actions will be taken immediately. Subsequent work that depends on the nonconforming activity will not be performed until the identified nonconformance is corrected.

In summary, corrective action involves the following steps:

- Discovery of a nonconformance
- Identification of the responsible party
- Determination of root causes
- Planning and scheduling of corrective/preventive action
- Review of the corrective action taken
- Confirmation that the desired results were produced

9.1 FIELD CORRECTIVE ACTION

The Field Investigation Manager will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, and other procedures will be checked for completeness. Where procedures are not in compliance with the

established protocol, the deviations will be field documented and reported to the Project QAM/Designee.

Examples of field nonconformances include, but are not limited to, the following:

- Items provided by a subcontractor supplier that do not meet the contractual requirements
- Errors made in following work instruction or improper work instruction
- Unforeseen or unplanned circumstances that result in services that do not meet quality/contractual/technical requirements
- Unapproved or unwarranted deviations from established procedures
- Nonvalidated or nonverified computer programs
- Sample chain-of-custody missing or deficient
- Data falling outside established objective criteria

Corrective actions will be defined by the Field Investigation Manager and Project Manager and documented. Problems that require corrective action are documented by the use of a corrective action report. Upon implementation of the corrective action, the Field Investigation Manager will provide the Project QAM/Designee with a written memo documenting field implementation. The memo will become part of the SI project file.

9.2 LABORATORY CORRECTIVE ACTION

The laboratory QA managers will review the data generated to ensure that all samples have been analyzed as specified in this QAPP (Appendices A and B). Percent recoveries of surrogates and spiked analytes from LCS samples and MS samples will be evaluated for accuracy. RPDs for laboratory duplicate or MSD samples will be evaluated for precision. Corrective action requirements for noncompliant data are presented in Appendix B and in laboratory SOPs.

The laboratory project manager will fax the COCs and cooler receipt forms to URS within 8 hours of sample receipt. URS will be notified immediately if discrepancies occur between the contracted analyses and the analyses listed on the COCs. The laboratory project manager will contact the URS Project Chemist to discuss noncompliant data sets within 72 hours of first discovering that any analysis failed to meet the required data quality criteria. If the analyses

cannot produce data sets that are within control limits, the USACE Technical Lead will be notified. At a minimum, corrective actions are necessary if any of the following occur:

- Initial calibration verification and continuing calibration verification do not meet QC criteria.
- Any changes in the MDL or MRL occur.
- Blanks contain contaminants at concentrations greater than one-half the MRL for any target analyte. Refer to Section 5.3.
- The QC data are outside the acceptance windows for precision and accuracy established for LCS.
- Undesirable trends are detected in surrogate, MS or LCS recoveries.
- Undesirable trends are detected in RPD for MS/MSD or laboratory duplicates.
- The laboratory QA manager detects deficiencies during internal or external audits.

If laboratory personnel identify any nonconformance in analytical methodologies or QC sample results, corrective actions will be implemented immediately. Corrective action procedures will be handled initially at the bench level by the analyst, who will review the preparation or extraction procedure for possible errors and perform various checks such as the instrument calibration, spike, calibration mixes, and instrument sensitivity. The analyst will immediately notify his/her supervisor of the identified problem and the investigation that is being conducted. If the problem persists or the cause cannot be identified, the matter will be referred to the laboratory supervisor and laboratory QA manager for further investigation. When the problem has been resolved, the laboratory QA manager will file full documentation of the corrective action procedure, and if data are affected, the URS Project Chemist will be provided a corrective action memo for inclusion into the project file.

Corrective action may include, but will not be limited to, the following:

- Recalibrating analytical instruments
- Reanalyzing suspect samples if holding time criteria permit. The need for reanalysis is dependent on the number of analytes that are out of compliance, the importance of the outlier to the decisionmaking process, and the magnitude of the

outlying data. For example, an LCS sample with one analyte recovery at 125%, representing a sample batch where the average sample concentration was 10 parts per million (ppm), would not necessarily require reanalysis of the LCS or the entire sample batch.

- Resampling and analyzing newly collected samples
- Evaluating and amending sampling and/or analytical procedures (with USACE concurrence)
- Accepting data with an acknowledged level of uncertainty (with USACE concurrence)
- Evaluating and attempting to identify limitations of the data

Following the implementation of the required corrective action measures, data still deemed unacceptable will not be accepted by the Laboratory Project Manager and followup corrective actions will be explored.

9.3 CORRECTIVE ACTIONS FOLLOWING DATA REVIEW

The URS Project Chemist or qualified subcontractor will review the field and laboratory data generated for this project to ensure that all project QA objectives are met. If any nonconformances in the data have resulted from the field procedures, sample collection procedures, field documentation procedures, or laboratory analytical and documentation procedures, the impact of those nonconformances on the overall project QA objectives will be assessed. Appropriate actions, including resampling and reanalysis may be recommended to the URS Project Manager so that the project objectives can be accomplished.

10.0 LABORATORY DATA REDUCTION, DELIVERABLES, VALIDATION, AND REPORTING

This section describes the processes of data generation, reduction, reporting, review, and validation. First, the laboratories will generate and reduce the raw data and prepare data reports. Then, the laboratory QA manager will review and finalize the data report. When URS receives the completed data report, the Project Chemist, or a qualified subcontractor, will review one hundred percent of the data. Ten percent of the data will be validated by an independent third party. Based on the results of the reviews and validations, additional validation may be undertaken. The Project QAM will prepare a final QC summary report. Data quality review responsibilities are summarized in Table 10-1.

10.1 LABORATORY DATA REDUCTION, REVIEW, AND DELIVERABLES

Data generated by the analytical laboratories will undergo generation, reduction, and verification procedures described in the laboratories' QA plans and SOPs.

10.1.1 Data Reduction Procedures

The laboratories will perform in-house analytical data reduction under the direction of the laboratory QA manager. Laboratory data reduction procedures will be those specified in EPA-approved methods and those described in the laboratory SOPs. The data reduction steps will be documented, signed, and dated by the analyst. Data reduction will be conducted as follows:

- Raw data produced by the analyst will be processed and reviewed for compliance with QC criteria established in this QAPP. The analyst will also review the raw data for overall reasonableness and for transcription or calculation errors.

- After the data have been entered into the laboratory information management system (LIMS), a computerized report will be generated and sent to the laboratory supervisor or senior chemist.

- The laboratory supervisor will decide whether any sample reanalysis is required. The laboratory Project Manager will contact the URS Project Chemist to discuss noncompliant data sets upon discovering that any analysis fails to meet the required data quality criteria. If corrective actions have been taken and data still do not meet project QA requirements, the USACE Technical Lead will be notified.

- Upon acceptance of the preliminary reports by the laboratory QA manager, final reports will be generated. Final data reports will be available within approximately 30 calendar days of sample submittal.

The laboratory analyst will assign QC qualifiers, as described and defined in the laboratory QA plans, if any of the following occurs:

- The concentration of the chemical is below required reporting limit or above calibration limit.
- The concentration of the chemical is below required reporting limit but above the MDL.
- The chemical is also found in the laboratory blank.
- Spiking analyte recoveries (bias) are outside project-specified control limits (inorganic analyses only).
- Laboratory duplicate precision is outside project-specified control limits (inorganic analyses only).

Other sample-specific qualifiers will be added, as necessary, to describe QC conditions.

The laboratories will maintain detailed procedures for laboratory recordkeeping to support the validity of all analytical work. Each data report package submitted will contain the laboratories' written certification that the requested analytical method was run and that all QA/QC checks were performed. The laboratory program administrators will provide copies of applicable independent third party external audits, which will become part of the central project files.

10.1.2 Data Review Procedures

The laboratory analysts have the initial responsibility for verifying the correctness and completeness of the data based on an established set of guidelines and on the project QC criteria. The analysts will ensure that the following QC elements have been satisfactorily completed:

- Documentation of sampling receipt and handling is complete.
- Sample preparation information is correct and complete.
- Analysis information is correct and complete.

- Raw data, including manual integrations, have been correctly interpreted.
- Appropriate preparation and analysis procedures have been followed.
- Site specific special sample preparation and analytical requirements have been met.
- Analytical results are correctly calculated and complete.
- QC sample results are within project QC limits.
- Laboratory blanks are within project QC limits.
- Documentation is complete. All anomalies in the preparation and analysis have been documented; holding times are documented; and all data (including data generated before and after corrective actions or cleanup are conducted) are included in the laboratory data report.

The laboratory supervisor or QA manager will provide an independent peer review of the analytical data package to ensure that the following QC elements are acceptable:

- Appropriate laboratory SOPs have been referenced.
- Calibration data are scientifically sound and appropriate to the method.
- QC sample data are within project-specific limits.
- Qualitative and quantitative results are correct.
- Raw data, including manual interpretations, have been correctly interpreted.
- Documentation is complete and correct.

10.1.3 Data Deliverables

To ensure that project chemical data are sufficient to meet both qualitative and quantitative objectives, laboratory data deliverables that will permit a data quality assessment consistent with the requirements of this QAPP are required.

The laboratories will prepare and retain full analytical and associated QC documentation. The laboratories will report the data as analytical batches of 20 samples or less, along with associated QC reporting data. The analytical results will be submitted in both hard copy and electronic formats (see Appendix E) for review by URS. Data packages will be unbound and paginated.

Information provided will be sufficient to review the data with respect to:

- Holding times and conditions
- Calibrations and instrument tunes
- Detection/quantitation limits
- Spike and surrogate recoveries
- Duplicate analyses (laboratory duplicates and MS/MSDs)
- Laboratory control samples
- Blank contamination
- Precision and accuracy
- Representativeness
- Comparability
- Completeness

The analytical data will be provided in a complete CLP-type deliverable data format including the following hard copy information for each analytical data package:

- Cover sheet listing the samples included in the report

- Narrative comments describing problems encountered in analysis, identification of any analyses not meeting quality control criteria, including holding times, and cautions regarding nonquantitative use or unusability due to out-of-control-limit QC results

- Chain-of-custody forms and cooler receipt forms

- Tabulated results of inorganic and organic compounds identified and quantified, with analyte-specific MRL as presented in Appendix A. All analytes will be reported for each sample as a detected concentration or as not detected above the specific limits of quantitation, which must be stated. The laboratories will also report MDLs, dilution factors, date of extraction, extraction batch number, cleanup procedures used, date of analysis, surrogate percent recoveries, batch run logs, and analytical batch number for each sample, with corresponding sample results.

- Analytical results for QC sample spikes, laboratory duplicates, initial and continuing calibration, verifications of standards and laboratory blanks, standard procedural blanks, LCSs, laboratory reference materials, ICP interference check samples, and detection limit check samples

- Documentation of rationale for the use of method of standard addition if required

- Documentation of any cleanup procedures used

- Raw data system printouts (or legible photocopies) identifying date of reported analysis, analyst, parameters analyzed, calibration curves, calibration verifications, second column confirmations, method blanks, any reported sample dilutions, cleanup logs, laboratory duplicates, spikes, control samples, sample spiking levels, preparation/extraction logs, run logs, and chromatograms

- Chromatograms labeled with analyte peaks, internal standards, and surrogate standards where applicable

- Mass calibration and mass spectral tuning data for GC and GC/MS analyses

Data reduction and QC review steps will be documented, signed, and dated by an authorized representative.

10.2 INDEPENDENT DATA REVIEW

One hundred percent of all field and laboratory data will receive an independent data review. Ten percent of the data will be validated.

Independent data review involves three steps:

- Assessment of the reliability of data based on quality control sample results

- Verification that requirements contained in the project planning documents have been met

- Assessment of the data usability

The data quality review will include evaluation of laboratory summary forms for precision, accuracy, representativeness, comparability, completeness, and a summary of qualified data, but will not include review of raw data or recalculation of reported results. The review report

provides a list of all samples being reviewed, a narrative summarizing each review topic (e.g., calibration or hold times), qualified results, worksheets, and any data resubmitted by the laboratories at the request of the reviewer.

The data review process for this project will follow the procedures in EPA's Functional Guidelines (USEPA 1994, 1999, and 2001) modified for the methods used and project-specific criteria . The review will include verification of the following:

- Compliance with the QAPP
- Proper sample preservation and handling procedures
- Holding times
- Initial and continuing calibrations
- MDL and MRL
- QC results (for example, surrogate, MS/MSD and LCS recoveries; MS/MSD and laboratory duplicate RPDs; serial dilutions)
- Laboratory blank and trip blank analyses
- Data completeness and format
- Data qualifiers assigned by the laboratories

Qualifiers will be added to data during review as necessary. Qualifiers applied to the data as a result of the independent review will be limited to:

U The analyte was analyzed for but was not detected above the sample-specific reporting limit.

J The analyte was positively identified; the associated numerical value is an estimate of the concentration of the analyte in the sample.

UJ The analyte was not detected above the sample reporting limit. However, the reporting limit is approximate and may or may not represent the actual limit of quantitation.

B The analyte was also detected in the method blank (organic analyses only)

R The analyte's results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Data validation will include all the elements of the data review, but will also include evaluation of raw data and recalculation of 10% of the data results.

Results of the QA review will be included in a data quality review report that will provide a basis for meaningful interpretation of the data quality and evaluate the need for corrective actions and/or comprehensive data validation. This report will be used to generate the quality control summary report.

10.3 QUALITY CONTROL SUMMARY REPORT

After the fieldwork and the final analytical data have been completed and reviewed, a final QC summary report will be prepared by the project QAM. The report will summarize QA and audit information, including the results of the data review; evaluate field QC sample data, such as field duplicates and trip blanks; indicate any corrective actions taken; and describe overall compliance with the SAP and the project DQOs. The report will also list the number of field QC samples collected and the number of laboratory QC analyses conducted. When control limits are exceeded, the result will be listed along with the applicable control limit.

Proposed topics to be included in the Quality Control Summary Report are:

- Project scope
- Project description
- Sampling procedures
- Quality control activities
- Analytical procedures
- Chemical data quality assessment (field duplicate results, detected analyte table, total results table(s), and rejected or qualified results table)
- Conclusions and recommendations

The QC summary report will be included in the central project file and incorporated as part of the final SI report, will provide a basis for meaningful interpretation of the data quality, and evaluate the need for further corrective actions.

Table 10-1
Data Quality Review Responsibilities

Task	Project Laboratories	URS
Laboratory data quality review and data reduction	X	
Independent data review/validation		X
Quality control summary report		X

11.0 PERFORMANCE AND SYSTEM AUDITS

Performance and systems audits may be conducted to determine whether:

- The QA program has been conducted and documented in accordance with specified requirements
- The documented program has been implemented
- Any nonconformances were identified and corrective actions were implemented

The URS Project Manager will be responsible for seeing that the project performance satisfies the QA objectives as set forth in this SAP. The Project QAM will be responsible for initiating audits, selecting the audit team, and overseeing audit implementation.

The Field Investigation Manager will be responsible for supervising and ensuring that samples are collected and handled in accordance with this Management Plan and that documentation of work is adequate and complete. Field performance will be evaluated using field blanks, trip blanks, equipment decontamination rinsates, and field duplicates.

Reports and technical correspondence will be peer reviewed by qualified individuals before being finalized.

11.1 SYSTEMS AUDITS

Technical systems audits are used to confirm the adequacy of the data collection (field operation) and data generation (laboratory operation) systems. The on-site audits are conducted to determine whether the project-specific plans and field and laboratory SOPs are being properly implemented. Systems audits of the field and laboratory procedures are not expected during this project. However, in the event that an on-site field audit is required, the audit procedures described in this section will be followed.

Internal systems audits of the laboratories will be performed when the laboratory QA manager identifies the need, which may be throughout this project. An additional laboratory systems audit may be requested by the Project QAM, if warranted. The frequency of on-site audits will depend on the type of interaction and communications the Project QAM experiences with the laboratory staff, and on the frequency of observations of noncompliance with QC criteria and SOPs.

The laboratory QA manager will regularly conduct the following internal audits:

- Technical audit, including reviews of calibration and equipment monitoring records, laboratory logbooks, maintenance records, and instrument control charts
- Data quality audit reviews, including all aspects of data collection, reporting, and review
- Management system audits, verifying that management and supervisory staff are effectively implementing and monitoring all QC activities necessary to support the laboratories' QA program

Various government agencies and programs, such as the EPA CLP, the ODEQ, and the USACE frequently conduct external laboratory systems audits.

11.2 AUDIT PROCEDURE

This subsection provides requirements and guidance for performing internal and external audits to verify compliance with the elements of the SAP.

The URS Project Manager and, if appropriate, other audited entity (e.g., Field Investigation Manager, Subcontractor Manager) will be notified by the Project QAM of an audit a reasonable time before the audit is performed. This notification will be in writing and include information such as the general scope and schedule of the audit, and the name of the audit team leader.

A pre-audit conference will be conducted at the audit site with the appropriate manager or designated representative (e.g., Field Investigation Manager, laboratory project manager). The purpose of the conference will be to confirm the audit scope, present the audit plan, discuss the audit sequence, and plan for the post-audit conference.

The audit team will then implement the audit. Selected elements of the SAP will be audited to the depth necessary to evaluate the effectiveness of implementation. Checklists prepared by the audit team and approved by the Project QAM will be sufficiently detailed to document major audit components. Conditions requiring immediate corrective action will be reported immediately to the Project QAM.

At the conclusion of the audit, a post-audit conference will be held with the audited entities, or their designated representatives. The audit team leader will concisely state the audit findings and clarify any misunderstandings. The findings will be acknowledged by signature of the Project Manager or designated representative upon completion of the post-audit conference.

An audit report will be prepared by the audit team leader and signed by the Project QAM. The report will include the following:

- Description of the audit scope
- Identification of the audit team
- Persons contacted during pre-audit, audit, and post-audit activities
- A summary of audit results, including an evaluation statement regarding the effectiveness of the SAP elements that were audited
- Details of findings and program deficiencies
- Recommendations for corrective actions to the Project QAM, with a copy to the URS Project Manager and others as appropriate

11.3 AUDIT RESPONSE

The URS Project Manager and audited entities, or their designated representatives, will respond to an audit report within 7 days of receipt. The response will clearly state the corrective action for each finding, including action to prevent recurrence and the date the corrective action will be completed.

The Project QAM, upon receipt of the response, will take the following actions:

11.4 FOLLOWUP ACTION

Follow-up action will be performed by the Project QAM or designated representative to:

- Evaluate the adequacy of the URS Project Manager's or other audited entity's response
- Determine that corrective action is appropriate and scheduled for each finding
- Confirm that corrective action has been accomplished as scheduled

Follow-up action may be accomplished through written communications, re-audit, or other appropriate means. When all corrective actions have been verified, the Project QAM will send a

memo to the URS Project Manager or other audited entity signifying the satisfactory closeout of the audit.

11.5 AUDIT RECORDS

Original records generated for all audits will be retained in the central project files. Records will include audit reports, written responses, the record of completion of corrective actions, and documents associated with the conduct of audits that support audit findings and corrective actions as appropriate.

12.0 REFERENCES

U.S. Army Corps of Engineers (USACE). 2001. *Engineer Manual–200-1-3, Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans. Appendix I, Shell for Analytical Chemistry Requirements.* February 1, 2001.

U.S. Environmental Protection Agency (USEPA). 2001. *USEPA Contract Laboratory Program National Functional Guidelines for Low-Concentration Organic Data Review.* EPA-540-R-00-006. June 2001.

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APPENDIX A

Laboratory Reporting Limits and Regulatory Screening Criteria

Laboratory Reporting Limits and Regulatory Screening Criteria

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
Volatile Organic Compounds									
Dichlorodifluoromethane	0.4	—	—	11,000[g]	—	—	0.4	310 nc	—
Chloromethane	0.4	—	—	11,000[g]	—	—	0.4	2.7 ca	—
Vinyl chloride	0.4	2	2	—	—	—	0.4	0.83 ca	0.008
Bromomethane	0.4	—	—	11,000[g]	—	—	0.4	13 nc	60
Chloroethane	0.4	—	—	—	—	—	0.4	6.5 ca	—
Trichlorofluoromethane	0.4	—	—	11,000[g]	—	—	0.4	2,000 sat	1,000
1,1-Dichloroethene	0.4	7	7	11,600	—	—	0.4	0.12 ca	0.01
1,1,2-Trichloro-1,2,2-trifluoroethane	0.4	—	—	—	—	—	0.4	5,600 sat	—
Acetone	2	—	—	—	—	—	0.4	6,200 nc	—
Carbon disulfide	0.4	—	—	—	—	—	0.4	720 sat	—
Methyl acetate	2	—	—	—	—	—	2	96,000 nc	—
Methylene chloride	0.4	—	—	—	—	—	0.4	21 ca	0.1
trans-1,2-Dichloroethene	0.4	100	—	11,600	—	—	0.4	210 nc	5
Methyl tert butyl ether (MTBE)	0.4	—	—	—	—	—	0.4	37 ca	—
1,1-Dichloroethane	0.4	—	—	—	—	—	0.4	7.1 ca	—
cis-1,2-Dichloroethene	0.4	70	—	11,600	—	—	0.4	150 nc	4
2-Butanone (MEK)	2	—	—	—	—	—	0.4	28,000 nc	—
Chloroform	0.4	See trihalo-methanes	See trihalo-methanes	28,900	1,240	—	0.4	0.52 ca	0.4
1,1,1-Trichloroethane	0.4	200	200	—	—	—	0.4	1,400 sat	9
Cyclohexane	0.4	—	—	—	—	—	0.4	140 sat	—
Carbon tetrachloride	0.4	5	5	35,200	—	—	0.4	0.53 ca	0.2
Benzene	0.4	5	5	5,300		—	0.4	1.5 ca	0.1

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
1,2-Dichloroethane (Ethylene dichloride)	0.4	5	5	118,000	20,000	—	0.4	0.76 ca	0.008
Trichloroethene	0.4	5	5	45,000	21,900	—	0.4	6.1 ca	0.4
Methylcyclohexane	0.4	—	—	—	—	—	0.4	8,800 nc	—
1,2-Dichloropropane	0.4	5	—	23,000	5,700	—	0.4	0.77 ca	—
Bromodichloromethane	0.4	See trihalo-methanes	See trihalo-methanes	11,000	—	—	0.4	2.4 ca	0.01
1,3-Dichloropropene (DCP), total	0.8	—	—	6,060	244	—	0.8	1.6 ca	—
cis-1,3-Dichloropropene (see 1,3-DCP, total)	0.4	—	—	6,060	244	—	0.4	—	—
4-Methyl-2-pentanone (Methyl isobutyl ketone)	2	—	—	—	—	—	0.4	2,900 nc	—
Toluene	0.4	1,000	—	17,500	—	—	0.4	520 sat	80
trans-1,3-Dichloropropene (see 1,3-DCP, total)	0.4	—	—	6,060	244	—	0.4	—	—
1,1,2-Trichloroethane	0.4	5		—	9,400	—	0.4	1.9 ca	0.08
Tetrachloroethene	0.4	5	—	5,280	840	—	0.4	19 ca	0.3
2-Hexanone	2	—	—	—	—	—	0.4	—	—
Dibromochloromethane	0.4	See trihalo-methanes	See trihalo-methanes	11,000	—	—	0.4	2.7 ca	10
1,2-Dibromoethane (Ethylene dibromide [EDB])	0.4	0.05	—	—	—	—	0.4	0.048 ca	—
Chlorobenzene	0.4	100	—	250	50	—	0.4	540 nc	50
Ethylbenzene	0.4	700	—	32,000	—	—	0.4	230 sat	100
Xylenes (total)	1.2	10,000	—	—	—	—	1.2	210 sat	800
Styrene	0.4	100	—	—	—	—	0.4	1,700 sat	—

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
Bromoform	0.4	See trihalo-methanes	See trihalo-methanes	—	—	—	0.4	310 ca	0.3
Isopropylbenzene (cumene)	0.4	—	—	—	—	—	0.4	520 nc	—
1,1,2,2-Tetrachloroethane	0.4	—	—	—	2,400	—	0.4	0.9 ca	—
1,3-Dichlorobenzene	0.4	600	—	1,120	763	—	0.4	52 nc	—
1,4-Dichlorobenzene	0.4	75	75	1,120	763	—	0.4	8.1 ca	—
1,2-Dichlorobenzene	0.4	—	—	1,120	763	—	0.4	370 sat	—
1,2-Dibromo-3-chloropropane	0.4	0.2	—	—	—	—	0.4	4.0 ca	—
1,2,4-Trichlorobenzene	0.4	70	—	250[h]	50[h]	—	0.4	3,000 sat	—
Total trihalomethanes	1.6	100	100	11,000	—	—	1.6	—	—
Semivolatile Organic Compounds									
Benzaldehyde	0.1	—	—	—	—	—	100	88,000 nc	—
Phenol	0.05	—	—	10,200	2,560	—	50	100,000 max	—
bis(2-Chloroethyl) ether	0.05	—	—	—	—	—	50	0.62 ca	0.0002
2-Chlorophenol	0.05	—	—	4,380	2,000	—	50	240 nc	—
2-Methylphenol	0.05	—	—	—	—	—	50	44,000 nc	—
2,2'-Oxybis(1-chloropropane)=[bis (2-chloroisopropyl) ether]	0.05	—	—	—	—	—	50	0.62 ca	—
Acetophenone	0.1	—	—	—	—	—	100	1.6 nc	—
4-Methylphenol	0.05	—	—	—	—	—	50	4,400 nc	—
n-Nitroso-di-n-propylamine	0.05	—	—	—	—	—	50	0.35 ca	0.00003
Hexachloroethane	0.05	—	—	980	540	—	50	180 ca	100
Nitrobenzene	0.05	—	—	27,000	—	—	50	110 nc	—
Isophorone	0.05	—	—	117,000	—	—	50	2,600 ca	—
2-Nitrophenol	0.05	—	—	230	150	—	50	—	—
2,4-Dimethylphenol	0.05	—	—	2,120	—	—	50	1,800 nc	—

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
bis(2-Chloroethoxy)methane	0.05	—	—	—	—	—	50	—	—
2,4-Dichlorophenol	0.05	—	—	2,020	365	—	50	2,600 nc	—
Naphthalene	0.01	—	—	2,300	620	—	10	190 nc	30
4-Chloroaniline	0.05	—	—	—	—	—	50	3500 nc	—
Hexachlorobutadiene	0.05	—	—	90	9.3	—	50	32 ca	—
Caprolactam	0.1	—	—	—	—	—	100	100,000 max	—
4-Chloro-3-methylphenol	0.05	—	—	30	—	—	50	—	—
2-Methylnaphthalene	0.01	—	—	—	—	—	10	—	—
Hexachlorocyclopentadiene	0.05	50	—	7	5.2	—	50	5,900 nc	—
2,4,6-Trichlorophenol	0.05	—	—	—	970	—	50	220 ca	2
2,4,5-Trichlorophenol	0.05	—	—	—	—	—	50	88,000 nc	—
1,1'-Biphenyl	0.1	—	—	—	—	—	50	350 sat	—
2-Chloronaphthalene	0.01	—	—	1,600	—	—	10	27,000 nc	—
2-Nitroaniline	0.05	—	—	—	—	—	50	50 nc	—
Dimethylphthalate	0.05	—	—	—	—	—	50	100,000 max	—
2,6-Dinitrotoluene	0.05	—	—	330	230	—	50	880 nc	0.002
Acenaphthylene	0.01	—	—	—	—	—	10	—	—
3-Nitroaniline	0.05	—	—	—	—	—	50	—	—
Acenaphthene	0.01	—	—	1,700	520	—	10	38,000 nc	2,000
2,4-Dinitrophenol	0.05	—	—	—	—	—	50	1,800 nc	—
4-Nitrophenol	0.05	—	—	230	150	—	50	7,000 nc	—
Dibenzofuran	0.05	—	—	—	—	—	50	5,100 nc	—
2,4-Dinitrotoluene	0.05	—	—	330	230	—	50	1,800 nc	—
Fluorene	0.01	—	—	—	—	—	10	33,000 nc	2,000
Diethylphthalate	0.05	—	—	—	—	—	50	100,000 max	—
4-Chlorophenyl-phenyl-ether	0.05	—	—	—	—	—	50	—	—
4-Nitroaniline	0.05	—	—	—	—	—	50	—	—
4,6-Dinitro-2-methylphenol	0.05	—	—	—	—	—	50	—	—

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
n-Nitrosodiphenylamine	0.01	—	—	—	—	—	50	500 ca	2
4-Bromophenyl-phenyl ether	0.05	—	—	—	—	—	50	—	—
Hexachlorobenzene	0.05	1	—	—	—	—	50	1.5 ca	—
Atrazine	0.1	3	—	—	—	—	50	11 ca	—
Pentachlorophenol	0.05	1	—	20[l]	13[l]	—	50	11 ca	5
Phenanthrene	0.01	—	—	—	—	—	10	—	—
Anthracene	0.01	—	—	—	—	—	10	100,000 max	20,000
Carbazole	0.05	—	—	—	—	—	50	120 ca	—
Di-n-butylphthalate	0.05	—	—	—	—	—	50	88,000 nc	—
Fluoranthene	0.01	—	—	3,980	—	—	10	30,000 nc	8,000
Pyrene	0.01	—	—	—	—	—	10	54,000 nc	6,000
Butylbenzylphthalate	1	—	—	—	—	—	50	100,000 max	—
3,3'-Dichlorobenzidine	0.5	—	—	—	—	—	50	5.5 ca	0.05
Benzo(a)anthracene	0.01	—	—	—	—	—	10	2.9 ca	0.1
Chrysene	0.01	—	—	—	—	—	10	290 ca	0.1
bis-(2-Ethylhexyl) phthalate	1	6	—	—	—	—	50	180 ca	4
Di-n-octylphthalate	0.05	—	—	—	—	—	50	10,000 sat	—
Benzo(b)fluoranthene	0.01	—	—	—	—	—	10	2.9 ca	0.1
Benzo(k)fluoranthene	0.01	—	—	—	—	—	10	29 ca	0.1
Benzo(a)pyrene	0.01	0.2	—	—	—	—	10	0.29 ca	0.1
Indeno(1,2,3-c,d)pyrene	0.01	—	—	—	—	—	10	2.9 ca	0.1
Dibenzo(a,h)anthracene	0.01	—	—	—	—	—	10	0.29 ca	—
Benzo(g,h,i)perylene	0.01	—	—	—	—	—	10	—	—
Pesticides and PCBs									
Aldrin	0.01	—	—	3	—	—	1	0.15 ca	0.04
α-BHC	0.01	—	—	—	—	—	1	0.59 ca	0.008
β-BHC	0.01	—	—	—	—	—	1	2.1 ca	—
χ-BHC (Lindane)	0.01	0.2	4	2	0.08	4	1	2.9ca	0.03

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
δ-BHC	0.01	—	—	—	—	—	1	—	—
Chlordane, technical	0.1	2	—	2.4	0.0043	—	10	11 ca	0.5
α-Chlordane	0.01	—	—	—	—	—	1	—	
χ-Chlordane	0.01	—	—	—	—	—	1	—	—
4,4'-DDD	0.02	—	—	—	—	—	2	17 ca	3
4,4'-DDE	0.02	—	—	1,050	—	—	2	12 ca	2
4,4'-DDT	0.02	—	—	1.1	0.001	—	2	12 ca	2
Dieldrin	0.02	—	—	2.5	0.0019	—	2	0.15 ca	0.001
Endosulfan	0.02	—	—	0.22	0.0056	—	2	53,000 nc	—
Endosulfan I	0.01	—	—	0.22[j]	0.056[j]	—	1	(see Endosulfan)	0.0006
Endosulfan II	0.02	—	—	0.22[j]	0.056[j]	—	2	(see Endosulfan)	0.0006
Endosulfan sulfate	0.02	—	—	0.22[j]	0.056[j]	—	2	—	—
Endrin	0.02	2	0.2	0.18	0.0023	0.2	2	260 nc	0.05
Endrin aldehyde	0.02	—	—	—	—	—	2	—	—
Endrin ketone	0.02	—	—	—	—	—	2	—	—
Heptachlor	0.01	0.4	—	0.52	0.0038	—	1	0.55 ca	0.0002
Heptachlor epoxide	0.01	0.2	—	—	—	—	1	0.27 ca	0.0003
Methoxychlor	0.1	40	100	—	0.03	100	10	4,400 nc	—
Toxaphene	1.0	3	5	0.73	0.0002	5	100	2.2 ca	0.01
Aroclor® 1016	0.1	0. 5	—	2[k]	0.014[k]	—	10	29 ca	0.08
Aroclor® 1221	0.2	0. 5	—	2[k]	0.014[k]	—	20	1.0 ca	0.08
Aroclor® 1232	0.1	0. 5	—	2[k]	0.014[k]	—	10	1.0 ca	0.08
Aroclor® 1242	0.1	0. 5	—	2[k]	0.014[k]	—	10	1.0 ca	0.08
Aroclor® 1248	0.1	0. 5	—	2[k]	0.014[k]	—	10	1.0 ca	0.08
Aroclor® 1254	0.1	0. 5	—	2[k]	0.014[k]	—	10	1.0 ca	0.08
Aroclor® 1260	0.1	0. 5	—	2[k]	0.014[k]	—	10	1.0 ca	0.08

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
Metals	**(mg/L)**	**(mg/L)**	**(mg/L)**			**(mg/L)**	**(mg/kg)[l]**	**(mg/kg)**	**(mg/kg)**
Aluminum	0.005	—	—	—	—	—	40	100,000 max	—
Antimony	0.003	0.006	—	9,000	1,600	—	100	820 nc	—
Arsenic (soil by 6020)	0.001	0.05	0.05	360[m]	190[m]	0.05	1	2.7 ca	0.004
Barium	0.001	2,000	1.0	—	—	1	1	100,000 max	100
Beryllium	0.0005	0.004	—	130	5.3	—	0.4	2,200 ca	0.002
Cadmium (soil by 6020)	0.0005	0.005	0.01	3.9[n]	1.1[n]	0.01	0.5	810 nc	0.5
Calcium	0.5	—	—	—	—	—	200	—	—
Chromium, total	0.001	0.1	0.05	16 (1,700[n])[o]	11 (210[n])[o]	0.05	2	450 ca	10
Cobalt	0.0005	—	—	—	—	—	2	100,000 max	—
Copper	0.001	1.3	1,000	18[n]	12[n]	—	4	76,000 nc	100
Iron	0.1	—	300	—	—	—	20	100,000 max	—
Lead (soil by 6020)	0.0005	0.015	0.05	82[n]	3.2[n]	0.05	0.5	750 nc	2
Magnesium	0.5	—	—	—	—	—	200	—	—
Manganese	0.0005	—	50	—	—	—	3	32,000 nc	400
Mercury	0.0002	0.002	0.002	2.4	0.012	0.002	0.1	610 nc	0.2
Nickel	0.001	—	—	1,400[n]	160[n]	—	8	41,000 nc	10
Potassium	1.0	—	—	—	—	—	400	—	—
Selenium	0.003	0.050	0.01	260	35	0.01	80	10,000 nc	—
Silver (soil by 6020)	0.0005	—	0.05	4.1[n]	0.12[n]	0.05	0.5	10,000 nc	5
Sodium	1.0	—	—	—	—	—	100	—	—
Strontium	0.0005	—	—	—	—	—	10	100,000 max	—
Thallium	0.0005	0.002	0.5	1,400	40	—	100	130 nc	—
Uranium (soil by 6020)	0.1	30	—	—	—	—	0.1	410 nc	—
Vanadium	0.001	—	—	—	—	—	10	14,000 nc	—
Zinc	0.004	—	5,000	120[n]	110[n]	—	4	100,000 max	—

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
Cyanide									
	0.01	0.2	—	2.2	5.2	—	0.2	35 nc	20
TPH-Diesel									
	NA	—	—	—	—	—	25	—	—
Explosives									
1,3,5-Trinitrobenzene	NA	NA	NA	—	—	—	0.05	26,000 nc	—
1,3-Dinitrobenzene	NA	NA	NA	—	—	—	0.05	88 nc	—
2,4,6-Trinitrotoluene	NA	NA	NA	—	—	—	0.05	82 ca	—
2,4-Dinitrotoluene	NA	NA	NA	—	—	—	0.05	1,800 nc	—
2-Aminodinitrotoluene	NA	NA	NA	—	—	—	0.05	—	—
2-Nitrotoluene	NA	NA	NA	—	—	—	0.1	1,000 sat	—
3-Nitrotoluene	NA	NA	NA	—	—	—	0.1	1,000 sat	—
4-Aminonitrotoluene	NA	NA	NA	—	—	—	0.05	—	—
4-Nitrotoluene	NA	NA	NA	—	—	—	0.1	1,000 sat	—
Nitrobenzene	NA	NA	NA	27,800	—	—	0.05	110 nc	—
HMX	NA	NA	NA	—	—	—	0.05	44,000 nc	—
Tetryl	NA	NA	NA	—	—	—	0.05	—	—
Chemical Agent Breakdown Products									
Thiodiglycol	NA	NA	NA	—	—	—	0.020	—	—
Dithiane	NA	NA	NA	—	—	—	0.020	8,800 nc	—
Oxathiane	NA	NA	NA	—	—	—	1	—	—
Methylphosphonic acid	NA	NA	NA	—	—	—	10	18,000 nc	—

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
VX thiols: Diisopropylaminoethane thiol, bis-(Diisopropylaminoethane) disulfide bis-Diisopropylaminosulfide, Other isopropylaminoethane compounds	NA	NA	NA	—	—	—	0.5	—	—

[a] **Screening criteria that are lower than the laboratory PQL (reporting limit) are highlighted**. Compounds listed for VOCs, SVOCs, pesticides and PCBs, and analytes listed for metals and cyanide are based on the EPA Contract Laboratory Program Target Compound Lists and Target Analyte Lists.
[b] Current drinking water standards, Http://www.epa.gov/safewater/mcl.html
[c] ODEQ Groundwater Quality Protection, OAR 340-040-0020, Tables 1 through 3.
[d] ODEQ Water Quality Standards and Beneficial Uses, OAR 340-041-0001 to 340-041-0975, Table 20. There were insufficient data to develop criteria for all compounds listed; value presented is the L.O.E.L. – Lower Observed Effect Level (does not apply to pesticides and PCBs except 4,4'-DDE and metals except beryllium and thallium).
[e] 1998 EPA Region 9 PRGs for industrial soils.
[f] ODEQ Soil Cleanup Levels, Hazardous Substance Remedial Action, OAR 340-122-045, soil cleanup table.
[g] These analytes are halomethanes
[h] This analyte is a chlorinated benzene
[i] pH dependent criteria (7.8 pH used)
[j] Criteria are for Endosulfan
[k] Based on total PCB results
[l] Lab metals analysis method for soil matrix, unless otherwise indicated, is SW-846 6010B.
[m] Criteria are for trivalent arsenic
[n] Hardness dependent criteria (100 mg/L used)
[o] Cr^{+6} (Cr^{+3})

Notes:
ca - cancer
GW - groundwater
max - maximum soil contamination level
MCL - maximum contaminant level
NA - not applicable
nc - noncancer
OAR - Oregon Administrative Rules
ODEQ - Oregon Department of Environmental Quality
PQL - practical quantitation limit equivalent to the method reporting limit (MRL)
PRG - preliminary remedial goal
sat - saturated soil
— - criteria not established

APPENDIX B

Quality Control Criteria for Laboratory Analyses

Table B-1
Summary of Method Quality Control Criteria for Volatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/ SURROGATES	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Instrument Tune	Check mass spectral ion intensities using BFB. (4-bromofluorobenzene)	Every 12 hours.	Refer to method narrative.	Not Applicable	1. Retune instrument. 2. Repeat BFB analysis.
Initial Calibration (ICal)	Five-point calibration to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria	Instrument Evaluation: SPCCs: minimum RF values per method requirements CCCs: verify %RSD = 30% Primary Evaluation : r = 0.995, %RSD = 15%; r^2 = 0.990 Alternative Evaluation: Mean %RSD for all target analytes = 15%; none > 30%	No allowance No allowance Alternative Evaluation: Maximum allowable %RSD for each target analyte = 30%	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A mid-level standard from an independent source other than that used for the instrument calibration, and analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the initial calibration prior to any sample analysie.	%Recovery = 80% - 120% of known concentration.	No allowance	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.

Table B-1 (Continued)
Summary of Method Quality Control Criteria for Volatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/ SURROGATES	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Continuing Calibration Verification (CCV)	A mid-level standard f analyzed in the exact same manner as the calibration standards.	Analyzed daily before sample analysis, every 12 hours and at the end of the analytical sequence.	Instrument Evaluation: SPCCs: minimum RF values per method requirements Primary Evaluation (CCCs): %Drift = 20%, %D = 20%	No Allowance No allowance	1. Evaluate system. 2. Reanalyze CCV. 3. Reanalyze samples subsequent to failed CCV. 4. Recalibrate
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Target Analytes: Less than one-half MRL.	Common Lab Contaminants: ≤ MRL	1. Check calculations. 2. Reanalyze MB. 3. Reprepare and reanalyze samples unless target compound concentrations are 5 x blank concentration. 4. If insufficient sample volume is available to reprepare samples, narrate outliers and discuss implications to data usability.

Table B-1 (Continued)
Summary of Method Quality Control Criteria for Volatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/ SURROGATES	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Internal Standards (IS)	Organic compounds with retention times similar to the target compounds.	Three internal standards added to every environmental sample, calibration standard, QC sample, and blank.	RT of the IS must be within 30 sec. of the RT in the last CCV (12 hour). [Area of the IS must be <2 x area in the daily CCV.]	No Allowance	1. Check calculations and sensitivity of instrument. 2. Reanalyze sample. 3. Narrate outliers and discuss implications to data usability.
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	3 surrogates added to every environmental sample, QC sample, calibration standard, and blank.	Interference-Free Matrix: Water: %Recovery = 80%-120% Solids: %Recovery = 75%-125% Project Sample Matrix: %Recovery = 70% - 130%	Not Applicable	1. Check calculations. 2. Reanalyze sample once. 3. If chromatographic interference is evident and LCS recovery is acceptable, flag data for matrix interference.
Laboratory Control Sample (LCS)	A certified standard that is processed using the same analytic preparations as the samples.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	Water: %Recovery = 80% - 120% of known concentration. Solids: %Recovery = 75% - 125% of known concentration	Sporadic Marginal Failures[a]: %Recovery = 60% - 140% of known concentration.	1. Check calculations. 2. Reanalyze LCS. 3. Reprepare and reanalyze samples. 4. If insufficient sample volume is available to reprepare samples, narrate outliers and discuss implications to data usability.

Table B-1 (Continued)
Summary of Method Quality Control Criteria for Volatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/ SURROGATES	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes or subset of the target analytes. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 70% - 130% of known concentration.	Sporadic Marginal Failures[a]: %Recovery = 60% - 140% of known concentration.	1. Check calculations. 2. Reanalyze once, unless the target compound concentrations in the native sample are > 4x the amount spiked. 3. Evaluate LCS. If it meets acceptable limits, flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	Water: RPD = 30% Solids: No RPD limits	Sporadic Marginal Failures[a]: Water: RPD = 40% Solids: No RPD limits	1. Check calculations. 2. Reanalyze once, unless the target compound concentrations in the native sample are > 4x the amount spiked. 3. Evaluate LCS and MS. If they meet QC limits, flag data for matrix interference.

Table B-1 (Continued)
Summary of Method Quality Control Criteria for Volatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/ SURROGATES	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Target Compound Identification	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT = ± 0.06 minutes compared to the ICal.(criteria used by SAS Laboratory)	No Allowance	1. Reanalyze standard 2. Recalculate RT windows 3. Verify that all target analytes fall within newly established RT windows
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 14 days if preserved with HCl to pH <2. Soil: methanol or sodium bisulfate; cool to 4°C ± 2ºC.	Holding time may not be exceeded.	Holding time may not be exceeded.	Recollect samples.

*The number of Sporadic Marginal Failure (SMF) allowances depend upon the number of target analytes reported from the analysis. For instance, if the full list of target compounds is reported, then five SMFs are allowed to exceed the expanded criteria presented for the ICV and LCS. If the MS includes only a subset of compounds, allow only one SMF.

Note:
Information presented is based on EPA SW-846 Method 8260B and the USACE Shell.

Table B-2
Summary of Method Quality Control Criteria for Semivolatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	QC CRITERIA FOR POOR PURGERS/GASES/ SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Instrument Tune	Check mass spectral ion intensities using DFTPP (decafluorotriphenylphosphine)	Every 12 hours.	Refer to method narrative.	Not applicable	1. Retune instrument 2. Repeat DFTPP analysis.
Initial Calibration (ICal)	5 Point calibration to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria.	Instrument Evaluation: SPCCs: minimum Response Factor (RF) values per method requirements CCCs: verify %RSD = 30% Primary Evaluation (all target analytes) : r = 0.995, %RSD = 15%; r^2 = 0.990 Alternative Evaluation: Mean %RSD for all target analytes = 15%; none > 40%	No allowance No allowance No allowance	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A mid-level standard from an independent source other than that used for the instrument calibration, analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the ICAL.	%Recovery (Rec)= 70% - 130% of known concentration.	No allowance	1. Evaluate system. 2. Reanalyze ICV. 3. Recalibrate.
	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed daily before analysis, every 12 hours, and at the end of the analytical sequence.	Instrument Evaluation: SPCCs: minimum RF values per method requirements Primary Evaluation (CCCs): %Drift = 20%, %Difference = 20%	No allowance No allowance	1. Evaluate system. 2. Reanalyze CCV. 3. Reanalyze sample subsequent to failed 4. Recalibrate

Table B-2 (Continued)
Summary of Method Quality Control Criteria for Semivolatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	QC CRITERIA FOR POOR PURGERS/GASES/ SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, calibration standard, QC sample, and blank.	Recovery Interference-Free Matrix Water/Solids[b]: = 60%-120% B/N analytes = 45%-135% A analytes %Recovery Project Sample Matrix Water/Solids: = 45%-135% B/N analytes = 35% - 140% A analytes	%Recovery Sporadic Marginal Failures[a]: Water: %Recovery = 15% - 150% of known concentration. Solids: %Recovery = 20% - 150% of known concentration.	1. Check calculations 2. Reanalyze sample 3. Reextract if 2- (or 1 fraction) are outside limits; if %Rec = <10 4. If surrogate recove still outside limits, na outliers and discuss implications to data usability.
Internal Standards (IS)	Organic compounds with retention times similar to the target compounds.	Every environmental sample, calibration standard, QC sample, and blank.	Retention time of the IS must be within 30 sec. of the RT in the last CCV (12 hours). Area of the IS must be <2x area of the IS in the daily CCV.	No allowance	1. Check calculations instrument sensitivity 2. Reanalyze sample 3. If three surrogates out reprepare and reanalyze samples. 4. If one or two intern standards are out, fla data and comment in narrative.

Table B-2 (Continued)
Summary of Method Quality Control Criteria for Semivolatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	QC CRITERIA FOR POOR PURGERS/GASES/ SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Target Analytes: Less than one-half MRL.	Common Lab Contaminants: Analytes < MRL	1. Check calculations 2. Reanalyze MB. 3. Reprepare and reanalyze samples u target compound concentrations are 5 blank concentration. 4. If insufficient samp volume is available t reprepare samples, narrate outliers and discuss implications t data usability.
Laboratory Control Sample (LCS)	A certified standard that is processed using the same analytic preparations as the samples.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	%Recovery of known analyte concentration. Water: = 60% - 120% (~15 analytes = 45% - 135% (~30 analytes) = 20% - 150% (~15 analytes) Solids: = 60% - 120% (~20 analytes = 45% - 135% (~25 analytes) = 30% - 150% (~15 analytes)	%Recovery Sporadic Marginal Failures[a]: Water: 15% - 150% Solids: 25% - 150%	1. Check calculations 2. Reanalyze LCS. 3. Reprepare and reanalyze samples u recoveries are high a target compound are undetected in the samples. 4. If insufficient samp volume is available t reprepare samples, narrate outliers and discuss implications t data usability.

Table B-2 (Continued)
Summary of Method Quality Control Criteria for Semivolatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	QC CRITERIA FOR POOR PURGERS/GASES/ SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes or subset of the target analytes. Documents method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery Water/Solids = 45% - 135% of known concentration.	%Recovery Sporadic Marginal Failures[a]: Water: 15% - 150% of known concentration. Solids: 20% - 150% of known concentration.	1. Check calculations 2. Reanalyze once 3. Evaluate LCS. If L meets acceptable lim flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	% Recovery same as MS Relative Percent Difference (RPD) Water: = 50% Solids: = 60%	% Recovery same as MS RPD Sporadic Marginal Failures[a]: Water/Solids: = 60%	1. Check calculations 2. Reanalyze once. 3. Evaluate LCS. If it meets acceptable lim flag data for matrix interference.
Target Compound Identifica-tion	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period. All succeeding standards in an analysis sequence should fall within the daily RT window established by the first standard of the sequence.	No Allowance	1. Reanalyze standar 2. Recalculate RT windows 3. Verify that all targe analytes fall within ne established RT windc

Table B-2 (Continued)
Summary of Method Quality Control Criteria for Semivolatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	QC CRITERIA FOR POOR PURGERS/GASES/ SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Other	Holding time is the length of time allowable between sampling and analysis.	Cool to 4°C. Water: 7 days before extraction, 40 days from extraction to analysis. Soil: 14 days before extraction, 40 days from extraction to analysis.	Hold time may not be exceeded.	Hold time may not be exceeded.	Recollect samples

*The number of Sporadic Marginal Failure (SMF) allowances depend upon the number of target analytes reported from the analysis. For instance, if the full list of target compounds is reported, then five SMFs are allowed to exceed the expanded criteria presented for the ICV and LCS. If the MS includes only a subset of compounds and for surrogates, allow up to one SMF for each base/neutral (B/N) and acid (A) grouping.

Note:
Information presented is based on EPA SW-846 Method 8270C and the USACE Shell.

Table B-3
Summary of Method Quality Control Criteria for Pesticides (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Initial Calibration (Ical)	Standards analyzed to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria. Minimum of 5 standards.	Primary Evaluation: $r \geq 0.0095$; %RSD ≤20% $r^2 \geq 0.990$. Alternative Evaluation: Mean %RSD for all target analytes ≤20%.	No allowance Alternative Evaluation: Maximum allowable %RSD for each target analyte ≤40%.	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A standard from an independent source other than that used for the instrument calibration, but within the calibration range and analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the initial calibration.	%Recovery = ± 15% of known concentration.	No allowance	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed after every 10 samples, daily before sample analysis, and at the end of the analytical sequence.	Primary Evaluation: %Drift ≤ 15%; %Difference ≤ 15% Alternative Evaluation: Mean % Drift/%D for all target analytes ≤ 15%.	No allowance Alternative Evaluation: Maximum allowable %Drift/%D for each target analyte ≤30%.	1. Evaluate system. 2. If %D >15% and targe analytes are undetected (U), report results. 3. Reanalyze samples subsequent to failed CCV. 4. Recalibrate
DDT/Endrin Breakdown	Measures the extent of 4,4'-DDT and endrin breakdown during analysis.	Every 24 hours	4'4"-DDT and endrin breakdown = 15% each.	Not applicable	

Table B-3 (Continued)
Summary of Method Quality Control Criteria for Pesticides (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples	Target analytes: Less than one-half MRL	Not applicable	1. Check calculations. 2. Reanalyze MB. 3.If target analytes are undetected (U) or 20x blank concentration, no action. 4. If sample concentrations <20x blank, reextract and reanalyze samples analyzed before the last clean blank.
Laboratory Control Sample (LCS)	A standard that is processed using the same analytic preparations as the samples. Documents laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	%Recovery water/solid = 50% - 130% of known concentration.	Sporadic Marginal Failures: %Recovery = 30% - 150% of known concentration.	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze samples unless LCS recoveries are high and target analytes are undetected (U) in the samples. 4. If insufficient sample to reprepare, narrate outliers and discuss implications to data usability.

Table B-3 (Continued)
Summary of Method Quality Control Criteria for Pesticides (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes or a subset of the target analytes. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery water/solid = 40% - 140% of known concentration	Sporadic Marginal Failures: %Recovery = 30% - 150% of known concentration.	1. Check calculations. 2. Reanalyze once, unless the target analyte concentration is 4x the amount spiked. 3. If chromatographic interference is evident and LCS recovery is acceptable, flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	%Recovery = same as MS Relative Percent Difference (RPD) $\leq$ 50%	Sporadic Marginal Failures: RPD $\leq$ 60%	Same as MS
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, QC sample, calibration standard, and blank.	Interference-free Water/Solid Matrix: %Recovery = 50% - 130% of known concentration; Sample: %Recovery = 40% - 140% of known concentration.	Not applicable	1. Check calculations, standards, and the system. 2. Reanalyze once. 3. If chromatographic interference is evident in the samples and surrogate recovery is acceptable in the LCS and MB, flag data for matrix interference.

Table B-3 (Continued)
Summary of Method Quality Control Criteria for Pesticides (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Target Compound Identification	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate for each chromatographic column employed in the analysis.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period. All succeeding standards in an analysis sequence should fall within the daily RT window established by the first standard of the sequence.	No allowance	1. Reanalyze standard 2. Recalculate RT windows 3. Verify that all target analytes fall within newly established RT windows
Target Compound Confirmation	Qualitative confirmation of detected target compounds using a second column dissimilar to the primary column. Quantitative confirmation of detected target compounds is required when interferences are noted on the primary column.	All samples with detected target compounds.	For qualitative confirmation, the second column must meet QC criteria for calibration and retention times. For quantitative confirmation, the second column must meet criteria for calibration, retention times, and batch QC. RPD = ≤40%	RPD = ≤40%	Not Applicable
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 7 days to extraction, 40 days from extraction to analysis. Soil: 14 days to extraction, 40 days from extraction to analysis, 4°C ± 2°.	Hold time may not be exceeded.	Recollect samples.	

Table B-3 (Continued)
Summary of Method Quality Control Criteria for Pesticides (by Gas Chromatography)

*The number of Sporadic Marginal Failure (SMF) allowances depend upon the number of target analytes reported from the analysis. For instance, if the full list of target compounds is reported from the GC/ECD, then two SMFs are allowed to exceed the expanded criteria presented for the ICV and LCS. If the MS includes only a subset of compounds, allow only one SMF for that QC element.

Note:
Information presented is based on EPA SW-846 Method 8081A and the USACE Shell

Table B-4
Summary of Method Quality Control Criteria for PCBs (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Initial Calibration (Ical)	Standards analyzed to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria. Minimum of 5 standards.	Primary Evaluation: $r \geq 0.0095$; %RSD ≤20% $r^2 \geq 0.990$. Alternative Evaluation: Mean %RSD for all target analytes ≤20%.	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A standard from an independent source other than that used for the instrument calibration, but within the calibration range and analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the initial calibration.	%Recovery = ± 15% of known concentration.	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed after every 10 samples, daily before sample analysis, and at the end of the analytical sequence.	Primary Evaluation: %Drift ≤ 15%; %Difference ≤ 15% Alternative Evaluation: Mean % Drift/%D for all target analytes ≤ 15%.	1. Evaluate system. 2. If %D >15% and target analyte concentrations are undetected (U), report results. 3. Reanalyze samples subsequent to failed CCV. 4. Recalibrate
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Target analytes: Less than one-half MRL.	1. Check calculations. 2. Reanalyze MB. 3. If target analytes are undetected (U) or 20x blank concentration, no action. 4. If sample concentrations <20x blank, reextract and reanalyze samples analyzed before the last clean blank.

Table B-4 (Continued)
Summary of Method Quality Control Criteria for PCBs (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	A standard that is processed using the same analytic preparations as the samples. Documents laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	Water/Solid: %Recovery = 50% - 130% of known concentration.	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze samples unless LCS recoveries are high and target analytes are undetected (U) in the samples. 4. If insufficient sample to reprepare, narrate outliers and discuss implications to data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes or subset of the target analytes. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 40% - 140% of known concentration.	1. Check calculations. 2. Reanalyze once, unless the target analyte concentration is 4x the amount spiked. 3. If chromatographic interference is evident and LCS recovery is acceptable, flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	%Recovery same as MS. Relative Percent Difference (RPD) $\leq$ 50%	Same as MS

Table B-4 (Continued)
Summary of Method Quality Control Criteria for PCBs (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, QC sample, calibration standard, and blank.	Interference-free Water/Solid Matrix: %Recovery = 50% - 130% of known concentration; Sample: %Recovery = 40% - 140% of known concentration.	1. Check calculations, standards, and the system. 2. Reanalyze once. 3. If chromatographic interference is evident in the samples and surrogate recovery is acceptable in the LCS and MB, flag data for matrix interference.
Target Compound Identification	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate for each chromatographic column employed in the analysis.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period. All succeeding standards in an analysis sequence should fall within the daily RT window established by the first standard of the sequence.	1. Reanalyze standard 2. Recalculate RT windows 3. Verify that all target analytes fall within newly established RT windows
Target Compound Confirmation	Qualitative confirmation of detected target compounds using a second column dissimilar to the primary column. Quantitative confirmation of detected target compounds is required when interferences are noted on the primary column.	All samples with detected target compounds.	For qualitative confirmation, the second column must meet QC criteria for calibration and retention times. For quantitative confirmation, the second column must meet criteria for calibration, retention times, and batch QC. RPD = ≤40%	Not Applicable

Table B-4 (Continued)
Summary of Method Quality Control Criteria for PCBs (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 7 days to extraction, 40 days from extraction to analysis. Soil: 14 days to extraction, 40 days from extraction to analysis, 4°C ± 2°.	Hold time may not be exceeded.	

Note:
Information presented is based on EPA SW-846 Method 8082 and the USACE Shell

Table B-5
Summary of Method Quality Control Criteria for Metals (by ICP and ICP/MS)

QC ELEMENT	DESCRIPTION OF ELEMENT	FREQUENCY	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICal)	Option 1 - standard and blank, and a low-level check standard at the MRL. Option 2 - 3 standards and a blank	Daily	Option 1 - Low-level check standard ± 20% Option 2 - r ≥ 0.995	1. Recalibrate
Instrumental Precision	% RSD 3 integrations (exposures)	Each calibration and calibration verification standard (ICV/CCV).	%Relative Standard Deviation (RSD) < 5%	1. Recalibrate
Initial Calibration Verification (ICV)	Mid-level (2nd source) verification.	After initial calibration.	% Recovery ± 10%	1. Terminate analysis 2. Correct the problem 3. Recalibrate
Initial Calibration Blank (ICB)	Interference-free matrix to assess analysis contamination.	After initial calibration.	Analytes < Method Detection Limit (MDL)	1. Terminate analysis 2. Correct the problem 3. Recalibrate
Interelement Check Standards (ICS)	ICS-A: interferents only ICS-B: interferents and target analytes.	Beginning of analytical sequence.	% Recovery ± 20% for target analytes	1. Narrate the possibility of physical or chemical interference
Continuing Calibration Blank (CCB)	Interference-free matrix to assess analysis contamination.	Every 10 samples and at the end of analytical sequence.	Target analytes < MDL	1. Terminate analysis 2. Correct the problem 3. Recalibrate and rerun all samples not bracketed by acceptable CCB
Continuing Calibration Verification (CCV)	Mid-level verification.	Every 10 samples and at the end of analytical sequence.	% Recovery = ± 10% of known concentration.	1. Terminate analysis 2. Correct the problem 3. Recalibrate and rerun all samples not bracketed by acceptable CCV

Table B-5 (Continued)
Summary of Method Quality Control Criteria for Metals (by ICP and ICP/MS)

QC ELEMENT	DESCRIPTION OF ELEMENT	FREQUENCY	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Method Blank (MB)	Interference-free matrix to assess overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Target analytes Less than one-half the MRL	1. Redigest and reanalyze samples associated with the MB
Laboratory Control Sample (LCS)	Interference-free matrix containing all target analytes.	One LCS for each analytical batch or a minimum of one LCS per 20 samples.	% Recovery = 80% - 120% of known concentration. Sporadic Marginal Failures: * % Recovery = 60% - 140%.	1. Terminate analysis 2. Correct the problem 3. Redigest and reanalyze samples associated with the LCS
Matrix Spike (MS)	Sample matrix spiked with all/subset of target analytes prior to digestion.	One MS for each analytical batch or a minimum of one MS per 20 samples.	% Recovery = 75% - 125% of known concentration.	1. Flag the data; no flag required if the sample level is >4x the spike added
Matrix Duplicate (MD)	Environmental sample that is divided into two separate aliquots by the laboratory.	One MD for each analytical batch or a minimum of one MD per 20 samples.	RPD ≤ 25%	1. Flag the data; no flag required if the sample level is >4x the spike added
Post Digestion Spikes (PDS)	Sample digestate spiked with all/subset of target analytes.	One MD for each analytical batch or a minimum of one MD per 20 samples.	% Recovery = 75% -125% of known concentration.	1. Check calculations 2. Repeat PDS
Serial Dilution (SD)	1:4 dilution analyzed to assess matrix effects.	As needed to assess new and unusual matrix effects.	Agreement between undiluted and diluted results ± 10%	1. Narrate the possibility of physical or chemical interference
Method of Standard Additions	Method of quantitation.	As needed for samples with suspected or confirmed matrix effects.	r = 0.995	1. Check calculations 2. Repeat MSA
Other	Holding time is the length of time allowable between sampling and analysis.	6 months.	Hold time may not be exceeded.	Recollect samples.

Table B-5 (Continued)
Summary of Method Quality Control Criteria for Metals (by ICP and ICP/MS)

'he number of Sporadic Marginal Failure (SMF) allowances depends upon the number of target analytes reported from the analysis. For instance, if between 7 to 15 metals are eported from the ICP analysis, one (1) SMF is allowed to the expanded criteria presented. If greater than 15 metals are reported from the ICP analysis, two (2) SMFs are allowed.

lotes:

ıformation presented is based on EPA SW-846 Methods 6010B and 6020 and the USACE Shell.

CP – Inductively coupled plasma spectroscopy

CP/MS – Inductively coupled plasma spectroscopy/mass spectroscopy

Table B-6
Summary of Method Quality Control Criteria for Mercury (by CVAA)

QC ELEMENT	DESCRIPTION OF ELEMENT	FREQUENCY	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICal)	5 standards and blank.	Daily	$r \geq 0.995$	1. Check calculations 2. Recalibrate 3. Reprep standards as needed.
Initial Calibration Verification (ICV)	Mid-level (2nd source) verification.	After initial calibration.	% Recovery = ± 10% of known concentration.	1. Check calculations 2. Rerun ICV 3. Recalibrate as necessary
Initial Calibration Blank (ICB)	Interference-free matrix to assess analysis contamination.	After initial calibration.	Analytes < Method Detection Limit (MDL)	1. Check calculations 2. Clean system 3. Reanalyze samples analyzed after the last clean blank
Continuing Calibration Blank (CCB)	Interference-free matrix to assess analysis contamination.	Every 10 samples and at the end of analytical sequence.	Analytes < MDL	1. Check calculations 2. Clean system 3. Reanalyze samples analyzed after the last clean blank
Continuing Calibration Verification (CCV)	Mid-level verification.	Every 10 samples and at the end of analytical sequence.	% Recovery = ± 20% of known concentration.	1. Check calculations 2. Repeat CCV 3. Reanalyze samples back to last good CCV 4. Recalibrate if necessary
Method Blank (MB)	Interference-free matrix to assess overall method contamination.	1 per sample batch of 20 samples or less.	Analytes less than one-half the MRL	1. Check calculations 2. Reanalyze 3. Redigest samples if reanalysis fails unless sample results are >5x the blank result 4. If insufficient sample amount to reprep, narrate any outliers and discuss implications on data usability

Table B-6 (Continued)
Summary of Method Quality Control Criteria for Mercury (by CVAA)

QC ELEMENT	DESCRIPTION OF ELEMENT	FREQUENCY	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	Interference-free matrix containing all target analytes.	1 per sample batch of 20 samples or less.	% Recovery = 80% - 120% known concentration	1. Check calculations 2. Reanalyze 3. If still out, reprep samples unless recoveries were high and sample results were ND 4. If insufficient sample amount to reprep, narrate any outliers and discuss implications on data usability
Matrix Spike (MS)	Sample matrix spiked with all/subset of target analytes prior to digestion.	1 per sample batch of 20 samples or less.	% Recovery = 80% - 120% known concentration	1. Check calculations 2. Reanalyze once, unless the native sample concentration is >4x the amount spiked 3. If recoveries still out and sample concentration is <4x the spike amount, analyze by the Method of Standard Additions (MSA) 4. Evaluate LCS. If it meets acceptable limits, flag the data for matrix interference
Matrix Duplicate (MD)	Environmental sample that is divided into two separate aliquots by the laboratory.	1 per sample batch of 20 samples or less.	% RPD = ≤ 20%	1. Same as matrix spike
Method of Standard Additions (MSA)	Method of quantitation.	As needed for samples with suspected or confirmed matrix effects.	$r \geq 0.995$	1. Check calculations 2. Repeat MSA

Table B-6 (Continued)
Summary of Method Quality Control Criteria for Mercury (by CVAA)

QC ELEMENT	DESCRIPTION OF ELEMENT	FREQUENCY	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Other	Holding time is the length of time allowable between sampling and analysis.	28 days.	Hold time may not be exceeded.	Recollect samples.

Notes:
Information presented is based on EPA SW-846 Methods 7470A and 7471A and the USACE Shell
GFAA/CVAA – graphite furnace atomic absorption/cold vapor atomic absorption spectrophotometry

Table B-7
Summary of Method Quality Control Criteria for Total Cyanide (by Distillation)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICal)	Determine the linear range of the method using four standards and a blank. .	Once per analytical sequence	± 0.05 mg CN/ml. Regression coefficient for standard curve > 0.99 and all standards must be regressed within 10% of their known concentration.	1. Check calculations. 2. Recalibrate.
Initial Calibration Verification (ICV)	A mid-level standard from an independent source other than that used for the instrument calibration, analyzed in the exact same manner as the calibration standards.	Third in sequence after ICal and ICB .	% Recovery = ± 10% of known concentration.	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Initial and Continuing Calibration Blanks (ICB, CCB)	Laboratory reagent-grade water that is used for the preparation of the ICal (ICB), ICV (CCB) and CCV (CCB) and that has not gone through any preparation process.	After the ICV, CCV, and high concentration samples.	< ½ Method Reporting Limit (MRL)	1. Reanalyze. 2. Clean system. 3. Reanalyze samples analyzed after last c blank.
Method Blank (MB)	Interference-free laboratory reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	< ½ Method Reporting Limit (MRL)	1. Check calculations. 2. Reanalyze. 3. Redistill and reanalyze samples if reanal unless sample concentrations are >5x the l result. 4. If insufficient sample to redistill, narrate c and discuss implications to data usability.

Table B-7 (Continued)
Summary of Method Quality Control Criteria for Total Cyanide (by Distillation)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	A cyanide standard, that is processed using the same analytic preparations as the samples. Documents laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample volume exists for MSD.	% Recovery = 80% - 120% of known concentrations.	1. Check calculations. 2. Reanalyze. 3. Redistill and reanalyze samples unless recoveries are high and cyanide is undetec in the samples. 4. If insufficient sample to redistill, narrate and discuss implications to data usability.
Matrix Spike (MS)	A sample spiked with a known concentration cyanide prior to sample preparation and processed using the same analytic preparations as the samples. Used to document method bias in a given sample matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	% Recovery = 75% - 125% If the spike sample concentration is less than the unspiked sample value, rerun the spike.	1. Check calculations. 2. Reanalyze once, unless the native samp concentration is 4x the amount spiked. 3. If recoveries are still out and sample concentration is <4x the spike amount, ana the Method of Standard Additions (MSA). 4. Evaluate LCS. If LCS meets acceptable limits, flag data for matrix interference.
Laboratory Duplicate (LD)	An environmental sample that is divided into two aliquots by the laboratory and processed using the same analytical preparations as the samples. Used to document method precision.	One LD for each analytical batch or a minimum of one LD per 20 samples.	RPD = ≤ 20%	1. Check calculations. 2. Reanalyze once. 3. Evaluate LCS and MS. If they meet acc limits, flag data for matrix interference.
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 14 days if preserved with NaOH to pH >12. Pretreat samples containing residual chlorine or sulfide. Soil: 14 days.	Hold time may not be exceeded.	Recollect samples.

Notes:
Information presented is based on EPA SW-846 Method 9012A and Sound Analytical Services Laboratories SOP.

Table B-8
Summary of Method Quality Control Criteria for Petroleum Hydrocarbons (Diesel)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICal)	Standards analyzed to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria. Minimum of five standards.	Primary Evaluation: r ≥ 0.0095; r^2 ≥0.990. Alternative Evaluation: ± 15% of known concentration.	1. Evaluate system. 2. Recalibrate. 3. If motor or jet fuel is detected, a second ICAL will be analyzed and quantitated usin the second ICAL.
Initial Calibration Verification (ICV)	A mid-level standard from an independent source other than that used for the instrument calibration, analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the initial calibration.	± 15% of known concentration.	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed daily before sample analysis after every 10 samples, and at the end of the analytical sequence.	Primary Evaluation: %Drift ≤ 15%; %D ≤ 15% Alternative Evaluation: Mean % Drift/%D for all target analytes ≤ 15%.	1. Evaluate system. 2. Repeat CCV. 3. Reanalyze samples subsequent to failec CCV. 4. If %D is >15% for the CCV and the end CCV, and TPH is undetected (U) in the samples, then recalibration and reanalysis will not be performed. Narrate the anomaly 5. Recalibrate.
Method Blank (MB)	Interference-free reagent-grade water (or sodium sulfate for solid samples) treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	< ½ Method Reporting Limit (MRL).	1. Run a system blank. 2. Reanalyze MB. 3. Bake out system. 4. Perform instrument maintenance. 5. Rerun samples back to last clean blank.

Table B-8 (Continued)
Summary of Method Quality Control Criteria for Petroleum Hydrocarbons (Diesel)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	A standard that is processed using the same analytic preparations as the samples. Documents laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample volume exists for MS/MSD.	%Recovery = 60% - 140% of known concentration .	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze samples unles LCS recoveries are high and TPH is undetected (U) in the samples". 4. If insufficient sample to reprepare, narrat outliers and discuss implications to data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	% Recovery = 60% - 140% of known concentration	1. Check calculations. 2. Reanalyze once, unless the native sample concentration is 4x the amount spiked. 3. Evaluate LCS. If the LCS meets acceptable limits, flag the data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	% Recovery = 50% - 180% of known concentration RPD = ≤ 22%.	1. Check calculations. 2. Reanalyze once. 3. Evaluate LCS and MS. If they meet acceptable limits, flag as matrix interferenc
Surrogates	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, and QC sample.	%Recovery = 50% – 150% of known concentration	1. Check calculations. 2. Reanalyze once. 3. Assess the impact on the samples and narrate the outliers. 4. Reprepare and reanalyze the samples.

Table B-8 (Continued)
Summary of Method Quality Control Criteria for Petroleum Hydrocarbons (Diesel)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 7 days to extraction, 40 days to analysis. Soil: 14 days to extraction, 40 days from extraction to analysis. Cool to 4°C.	Hold time may not be exceeded.	Recollect samples.

Notes:
Information presented is derived from *Analytical Methods for the Analysis of Petroleum Hydrocarbons* (Washington State Department of Ecology, June 1997) and Sound Analytical SOP.

Table B-9
Summary of Method Quality Control Criteria for Nitroaromatics and Nitramines (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	TETRYL/SPORATIC MARGINAL FAILURES[b]	CORRECTIVE ACTION
Initial Calibration (ICal)	5 Point calibration to evaluate instrument performance with respect to analyte concentration.	At system startup, whenever ICV or CCV does not meet quality control criteria, and when major instrument maintenance is performed.	Primary Evaluation: r = 0.995; %Relative Standard Deviation (RSD) = 20%; r^2 = 0.990 Alternative Evaluation: Mean %RSD for all target analytes = 20%	No Allowance Alternative Evaluation: Maximum allowable %RSD for each target analyte = 40%	1. Evaluate system 2. Recalibrate
Initial Calibration Verification (ICV)	A mid-level second source standard analyzed in the exact same manner as the calibration standards, processed to verify that Retention Time (RT), calibration and calculations are correct.	Analyzed immediately after the ICAL.	%Recovery = 85% - 115%	No allowance	1. Evaluate system 2. Repeat ICV 3. Recalibrate if ICV fails to meet criteria
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards, processed to verify that RT, calibration and calculations are correct.	Analyzed daily before sample analysis, after every 10 samples and at the end of the analytical sequence.	Primary Evaluation: %Drift = 15%; %Difference (D) = 15% Alternative Evaluation: Mean %Drift/%D for all target analytes = 15%	No allowance Alternative Evaluation: Maximum allowable %Drift/%D for each target analyte = 30%	1. Evaluate system 2. Repeat CCV 3. Reanalyze samples subsequent to failed CCV 4. Recalibrate as needed
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the samples. Evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Less than one-half the MRL.	Not applicable	1. Check calculations 2. Reanalyze e. If reanalysis falls, reprepare and reanalyze samples unless sample results are >5x the blank

Table B-9 (Continued)
Summary of Method Quality Control Criteria for Nitroaromatics and Nitramines (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	TETRYL/SPORATIC MARGINAL FAILURES[b]	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	Second source standard in reagent-grade water matrix that is processed using the same analytic preparations as the samples. Used to document laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples.	%Recovery Water/Solids: 60% - 120% [b]	Sporadic Marginal Failures[b]: %Recovery = 40% - 150%	1. Check calculations 2. Reanalyze 3. Reprepare and reanalyze samples unless LCS recoveries are high and target compound concentrations are undetected (U) 4. If sample volume is insufficient to reprepare samples, narrate outliers and discuss implications on data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the each target analyte prior to sample preparation and processed using the same analytic preparations as the samples. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 50% - 140% [c] Spike must contain all target compounds.	Sporadic Marginal Failures[b]: %Recovery = 40% - 150%	1. Check calculations 2. Reanalyze once, unless the native sample concentration is >4x the amount spiked 3. Evaluate LCS. If LCS meets QC limits, flag data for matrix interference.
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	An environmental sample that is divided into two aliquots by the laboratory and processed using the same analytic preparations as the samples. Documents precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	Relative Percent Difference (RPD) = 50%	Sporadic Marginal Failures[b] RPD = 60%	1. Check calculations 2. Reanalyze once, unless the native sample concentration is >4x the amount spiked 3. Evaluate LCS . If LCS meets acceptable limits, flag data for matrix interference.

Table B-9 (Continued)
Summary of Method Quality Control Criteria for Nitroaromatics and Nitramines (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	TETRYL/SPORATIC MARGINAL FAILURES[b]	CORRECTIVE ACTION
Surrogate Spikes	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, QC sample and calibration standard.	%Recovery for Interference-Free Matrix: Water: 60%-140% Solids: 50%-150% %Recovery for Project Sample Matrix: Water/Solids: 50% - 150%	Not applicable	1. Check calculations; 2. Reanalyze once; 3. If chromatographic interference is evident in the samples and surrogate recovery is acceptable in the LCS and MB, flag the data for matrix interference
Target Compound Identification	Calculation of retention time (RT) windows for each target analyte and surrogate for each chromatographic column employed in the analysis.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period.	No Allowance	Not Applicable
Target Compound Confirmation	Qualitative confirmation of detected target compounds using a second column dissimilar to the primary column. Quantitative confirmation of detected target compounds is required when interferences are noted on the primary column.	All samples with detected target compounds.	For qualitative confirmation, the second column must meet QC criteria for calibration and retention times For quantitative confirmation, the second column must meet QC criteria for calibration, retention times, and batch QC (MS/MSD optional). RPD =40%	No Allowance No Allowance	Not Applicable
Other	Holding time: Time allowable between sampling and analysis.	Water: 7 days to extraction, 40 days to analysis. Soil: 14 days to extraction, 40 days from extraction to analysis. Dark, 4°C ± 2°C.	Holding time may not be exceeded.	Holding time may not be exceeded.	Not Applicable

Notes:
Information presented is based on EPA SW-846 Method 8330 and the USACE Shell.

Table B-10
Summary of Method Quality Control Criteria for Thiodiglycol in Soil (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	CORRECTIVE ACTION
Initial Calibration (ICal)	5 Point calibration to evaluate instrument performance with respect to analyte concentration.	At system startup, whenever ICV or CCV does not meet quality control criteria, and when major instrument maintenance is performed.	Primary Evaluation: r = 0.995; %Relative Standard Deviation (RSD) = 20%; r^2 = 0.990 Alternative Evaluation: Mean %RSD for all target analytes = 20%	1. Evaluate system 2. Recalibrate
Initial Calibration Verification (ICV)	A mid-level second source standard analyzed in the exact same manner as the calibration standards, processed to verify that Retention Time (RT), calibration and calculations are correct.	Analyzed immediately after the ICAL.	%Recovery = 85% - 115%	1. Evaluate system 2. Repeat ICV 3. Recalibrate if ICV fails to meet criteria
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards, processed to verify that RT, calibration and calculations are correct.	Analyzed daily before sample analysis, after every 10 samples and at the end of the analytical sequence.	Primary Evaluation: %Drift = 15%; %Difference (D) = 15% Alternative Evaluation: Mean %Drift/%D for all target analytes = 15%	1. Evaluate system 2. Repeat CCV 3. Reanalyze samples subsequent to failed CCV 4. Recalibrate as needed
Initial and Continuing Calibration Blanks (ICB, CCB)	Laboratory reagent-grade water that has not gone through any preparation process.	Analyzed after the ICV, CCV, and before analysis of samples.	< 1/2 method reporting limit (MRL)	1. Rerun 2. Clean system 3. Rerun samples analyzed after last clean blank
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the samples. Evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	< 1/2 MRL or < 5% of sample result for the same analyte, whichever is greater.	1. Check calculations 2. Reanalyze e. If reanalysis falls, reprepare and reanalyze samples unless sample results are >5x the blank

Table B-10 (Continued)
Summary of Method Quality Control Criteria for Thiodiglycol in Soil (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	Second source standard in reagent-grade water matrix that is processed using the same analytic preparations as the samples. Used to document laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples.	%Recovery 60% - 120% [b]	1. Check calculations 2. Reanalyze 3. Reprepare and reanalyze samples unless LCS recoveries are high and target compound concentrations are undetected (U) 4. If sample volume is insufficient to reprepare samples, narrate outliers and discuss implications on data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the each target analyte prior to sample preparation and processed using the same analytic preparations as the samples. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 50% - 140% [c] Spike must contain all target compounds.	1. Check calculations 2. Reanalyze once, unless the native sample concentration is >4x the amount spiked 3. Evaluate LCS. If LCS meets QC limits, flag data for matrix interference.
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	An environmental sample that is divided into two aliquots by the laboratory and processed using the same analytic preparations as the samples. Documents precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	Relative Percent Difference (RPD) = 50%	1. Check calculations 2. Reanalyze once, unless the native sample concentration is >4x the amount spiked 3. Evaluate LCS for the compound(s) that are not within control limits. If LCS meets acceptable limits, flag data for matrix interference.
Surrogate Spikes	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, QC sample and calibration standard.	Not Applicable	Not Applicable
Target Compound Identification	Calculation of retention time (RT) windows for each target analyte and surrogate for each chromatographic column employed in the analysis.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT $\pm$ 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period.	Not Applicable

Table B-10 (Continued)
Summary of Method Quality Control Criteria for Thiodiglycol in Soil (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	CORRECTIVE ACTION
Target Compound Confirmation	Qualitative confirmation of detected target compounds using a second column dissimilar to the primary column. Quantitative confirmation of detected target compounds is required when interferences are noted on the primary column.	All samples with detected target compounds.	For qualitative confirmation, an alternate instrument (liquid chromatography/mass spectrometry) must meet QC criteria for calibration and retention times For quantitative confirmation, an alternate instrument (liquid chromatography/mass spectrometry) must meet QC criteria for calibration, retention times, and batch QC (MS/MSD optional). RPD = <40%	Not Applicable
Other	Holding time: Time allowable between sampling and analysis.	Water: 14 days to extraction, 40 days to analysis; dark, 4°C ± 2°C.	Holding time may not be exceeded.	Not Applicable

Notes:
Information presented is based on EPA SW-846 modified Method 8330A, Southwest Research SOPs, and Southwest Research performance-based criteria.

Table B-11
Summary of Method Quality Control Criteria for Dithiane and Oxathiane in Soil (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Initial Calibration (Ical)	Standards analyzed to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria. Minimum of 5 standards.	Primary Evaluation: r ≥ 0.0095; %RSD ≤20% r^2 ≥0.990. Alternative Evaluation: Mean %RSD for all target analytes ≤20%.	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A standard from an independent source other than that used for the instrument calibration, but within the calibration range and analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the initial calibration.	%Recovery = ± 25% of known concentration.	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed after every 10 samples, daily before sample analysis, and at the end of the analytical sequence.	Primary Evaluation: %Drift ≤ 25%; %Difference ≤ 25% Alternative Evaluation: Mean % Drift/%D for all target analytes ≤ 25%.	1. Evaluate system. 2. If %D >15% and herbicide concentrations are undetected (U), report results. 3. Reanalyze samples subseque to failed CCV. 4. Recalibrate

Table B-11 (Continued)
Summary of Method Quality Control Criteria for Dithiane and Oxathiane in Soil (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Initial and Continuing Calibration Blanks (ICB, CCB)	Laboratory reagent water that is used for the preparation of the IC, ICV and CCV and that has not gone through any preparation process.	After the ICV, CCV, and high concentration samples.	< ½ Method Reporting Limit (MRL)	1. Check calculations. 2. Reanalyze ICB or CCB. 3. If herbicide concentrations are undetected (U) or 20x blank concentration, no action. 4. If sample concentrations <20x blank, reanalyze samples analyzed before the last clean blank.
DDT/Endrin Breakdown	Measures the extent of 4,4'-DDT and endrin breakdown during analysis.	Every 24 hours	4'4"-DDT and endrin breakdown < 15% each.	
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	< ½ Method Reporting Limit (MRL) or < 5% of sample result for the same analyte, whichever is greater.	1. Check calculations. 2. Reanalyze MB. 3. If herbicide concentrations are undetected (U) or 20x blank concentration, no action. 4. If sample concentrations <20x blank, reextract and reanalyze samples analyzed before the last clean blank.
Laboratory Control Sample (LCS)	A standard, prepared from the same certified standard as the ICV and CCV but at a different concentration, that is processed using the same analytic preparations as the samples. Documents laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	Water/Solid: %Recovery = 50% - 150% of known concentration.	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze samples unless LCS recoveries are high and herbicides are undetected (U) in the samples. 4. If insufficient sample to reprepare, narrate outliers and discuss implications to data usability.

Table B-11 (Continued)
Summary of Method Quality Control Criteria for Dithiane and Oxathiane in Soil (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 40% - 140% of known concentration.	1. Check calculations. 2. Reanalyze once, unless the sample herbicide concentration 4x the amount spiked. 3. If chromatographic interferenc is evident and LCS recovery is acceptable, flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	%Recovery = 40% - 140% of known concentration; Relative Percent Difference (RPD) ≤ 50%	Same as MS
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, QC sample, calibration standard, and blank.	Not Applicable	Not Applicable
Target Compound Identification	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate for each chromatographic column employed in the analysis.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period. All succeeding standards in an analysis sequence should fall within the daily RT window established by the first standard of the sequence.	1. Reanalyze standard 2. Recalculate RT windows 3. Verify that all target analytes within newly established RT windows

Table B-11 (Continued)
Summary of Method Quality Control Criteria for Dithiane and Oxathiane in Soil (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Target Compound Confirmation	Qualitative confirmation of detected target compounds using a second column dissimilar to the primary column. Quantitative confirmation of detected target compounds is required when interferences are noted on the primary column.	All samples with detected target compounds.	For qualitative confirmation, the second column must meet QC criteria for calibration and retention times. For quantitative confirmation, the second column must meet criteria for calibration, retention times, and batch QC. RPD = ≤40%	Not Applicable
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 14 days to extraction, 40 days to analysis. Soil: 14 days to extraction, 40 days to analysis, 4°C ± 2°C.	Hold time may not be exceeded.	

Notes:
Information presented is based on EPA SW-846 modified Method 8181A, Southwest Research SOPs, and Southwest Research performance-based criteria.

Table B-12
Summary of Method Quality Control Criteria for Methylphosphonic Acid in Soil (By Ion Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICal)	Standards analyzed to evaluate instrument performance with respect to analyte concentration. Minimum of three standards.	Daily or before each analytical sequence.	Linearity from 0.2 mg/L to 4.0 mg/L	1. Check calculations. 2. Recalibrate.
Initial Calibration Verification (ICV)	An independent, second source mid-level standard analyzed in the exact same manner as the calibration standards, processed to verify that the procedure and calculations are correct.	Analyzed immediately after the initial calibration.	% Recovery = 25% - 140% of known concentrations.	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards, processed to verify that the procedure and calculations are correct.	Analyzed after every 10 samples and at the end of the analytical sequence.	% Recovery = 25% - 140% of known concentrations.	1. Evaluate system. 2. Repeat CCV. 3. Reanalyze samples subsequent to failed CCV. 4. Recalibrate.
Initial and Continuing Calibration Blanks (ICB, CCB)	Laboratory reagent-grade water that is used for the preparation of the IC, ICV and CCV standards and that has not gone through any preparation process.	After the ICV, CCV, and high concentration samples.	< ½ Method Reporting Limit (MRL)	1. Reanalyze. 2. Clean system. 3. Reanalyze samples analyzed after the last clean blank.
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	< ½ Method Reporting Limit (MRL)	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze all samples associated with the unacceptable MB. 4. If insufficient sample to reprepare, narrate outliers and discuss implications to data usability.

Table B-12 (Continued)
Summary of Method Quality Control Criteria for Methylphosphonic Acid in Soil (By Ion Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	An independent standard in an interference-free matrix that is processed using the same analytic preparations as the samples. Used to document laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples.	% Recovery = 25% - 140% of known concentrations.	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze samples unless recoveries are high and analytes are undetected (U) in the samples. 4. If insufficient sample to reprepare, narrate outliers and discuss implications to data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the each analyte prior to sample preparation and processed using the same analytic preparations as the samples. Used to document method bias in a given sample matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	% Recovery = 25% - 140%. If the concentration is >4 times the spike level, recovery limits do not apply.	1. Check calculations. 2. Reanalyze once, unless the native sample concentration is 4x the amount spiked. 3. If recoveries are still out and sample concentration is <4x the spike amount, analyze by the Method of Standard Additions (MSA). 4. Evaluate LCS. If LCS meets acceptable limits, flag data for matrix interference.
Laboratory Duplicate (LD)	An environmental sample that is divided into two aliquots by the laboratory and processed using the same analytic preparations as the samples. Used to document precision.	One LD for each analytical batch or a minimum of one LD per 20 samples.	RPD = ≤ 50%. If either the sample concentration and/or duplicate concentration is less than the reporting limit concentration, the absolute difference between the two should be < MRL.	1. Check calculations. 2. Reanalyze once. 3. Evaluate LCS and MS. If they meet acceptable limits, flag data for matrix interference.

Table B-12 (Continued)
Summary of Method Quality Control Criteria for Methylphosphonic Acid in Soil (By Ion Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Other	Holding time: The length of time allowable between sampling and analysis.	14 days to extraction, 40 days to analysis. Store at 4°C ± 2ºC.	Hold time may not be exceeded.	Recollect samples.

Notes:
Information presented is based on Southwest Research SOPs and Southwest Research performance-based QC criteria.

Table B-13
Summary of Method Quality Control Criteria for VX Thiol Compounds* in Soil (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	CORRECTIVE ACTION
Instrument Tune	Check mass spectral ion intensities using DFTPP (decafluorotriphenylphosphine)	Every 12 hours.	Refer to method narrative.	1. Retune instrument. 2. Repeat DFTPP analysis.
Initial Calibration (ICal)	5 Point calibration to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria.	Instrument Evaluation: SPCCs: minimum Response Factor (RF) values per method requirements CCCs: verify %RSD = 30% Primary Evaluation (all target analytes) : r = 0.995, %RSD = 15%; r^2 = 0.990 Alternative Evaluation: Mean %RSD for all target analytes = 15%; none > 30%	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A mid-level standard from an independent source other than that used for the instrument calibration, analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the ICAL.	%Recovery (Rec)= 70% - 130% of known concentration.	1. Evaluate system. 2. Reanalyze ICV. 3. Recalibrate.

Table B-13 (Continued)
Summary of Method Quality Control Criteria for VX Thiol Compounds* in Soil (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	CORRECTIVE ACTION
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed daily before analysis, every 12 hours, and at the end of the analytical sequence.	Instrument Evaluation: SPCCs: minimum RF values per method requirements CCCs: verify %D = 30% Primary Evaluation (CCCs): %Drift = 20%, %Difference = 20%	1. Evaluate system. 2. Reanalyze CCV. 3. Reanalyze samples subsequent to failed CCV. 4. Recalibrate
Initial Calibration Blank (ICB)/ Continuing Calibration Blank (CCB)	Laboratory reagent-grade water that is used for the preparation of the IC, ICV and CCV and that has not gone through any preparation process.	After the ICV, CCV, and high concentration samples.	Target Analytes 1/2 Reporting limit	1. Reanalyze ICB or CCB. 2. Clean system. 3. Reanalyze samples analyzed after the last clean blank.
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, calibration standard, QC sample, and blank.	Recovery Interference-Free Matrix[b]: = 45%-135% %Recovery Project Sample Matrix: = 35% - 140%	1. Check calculations 2. Reanalyze sample. 3. Reextract if 2- (or 1 per fraction) are outside limits; if %Rec = <10%. 4. If surrogate recovery is still outside limits, narrate outliers and discuss implications to data usability.

Table B-13 (Continued)
Summary of Method Quality Control Criteria for VX Thiol Compounds* in Soil (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	CORRECTIVE ACTION
Internal Standards (IS)	Organic compounds with retention times similar to the target compounds.	Every environmental sample, calibration standard, QC sample, and blank.	Retention time of the IS must be within 30 sec. of the RT in the last CCV (12 hours). Area of the IS must be <2x area of the IS in the daily CCV.	1. Check calculations and instrument sensitivity. 2. Reanalyze sample. 3. If three surrogates are out reprepare and reanalyze samples. 4. If one or two internal standards are out, flag the data and comment in the narrative.
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Target Analytes: 1/2 Reporting limit < 5% of the sample result for the same analyte, whichever is greater.	1. Check calculations. 2. Reanalyze MB. 3. Reprepare and reanalyze samples unless target compound concentrations are 5 x blank concentration. 4. If insufficient sample volume is available to reprepare samples, narrate outliers and discuss implications to data usability.

Table B-13 (Continued)
Summary of Method Quality Control Criteria for VX Thiol Compounds* in Soil (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	A standard, prepared from the same certified standard as the ICV and CCV but at a different concentration, and processed using the same analytic preparations as the samples.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	%Recovery of known analyte concentration. = 30% - 160%	1. Check calculations. 2. Reanalyze LCS. 3. Reprepare and reanalyze samples unless recoveries are high and target compound are undetected in the samples. 4. If insufficient sample volume is available to reprepare samples, narrate outliers and discuss implications to data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes. Documents method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 30% - 160% of known concentration.	1. Check calculations. 2. Reanalyze once 3. Evaluate LCS. If LCS meets acceptable limits, flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	%Recovery = 45% - 135% of known concentration; Relative Percent Difference (RPD): = 60%	1. Check calculations. 2. Reanalyze once. 3. Evaluate LCS. If it meets acceptable limits, flag data for matrix interference.

Table B-13 (Continued)
Summary of Method Quality Control Criteria for VX Thiol Compounds* in Soil (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	CORRECTIVE ACTION
Target Compound Identifica-tion	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	VX thiol compounds are reported as Tentatively Identified Compounds (TICs). RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period. All succeeding standards in an analysis sequence should fall within the daily RT window established by the first standard of the sequence.	1. Reanalyze standard 2. Recalculate RT windows 3. Verify that all target analytes fall within newly established RT windows
Other	Holding time is the length of time allowable between sampling and analysis.	Cool to 4°C ± 2ºC. Water: 14 days before extraction, 40 days to analysis. Soil: 14 days before extraction, 40 days to analysis.	Hold time may not be exceeded.	Recollect samples

*VX thiol compounds to be analyzed are diisopropylaminoethane thiol, bis-(diisopropylaminoethane) disulfide, bis-diisopropylaminosulfide and other isopropylaminoethane compounds.

Notes:
Information presented is based on EPA SW-846 modified Method 8270C, Southwest Research SOPs, and Southwest Research performance-based criteria.

APPENDIX C

Laboratory Performance-Based Quality Control Limits

Information presented in Appendix C was provided by the laboratories to demonstrate their ability to meet project-specific control limits on a routine basis. However, project-required reporting limits (Appendix A) and QC criteria (Appendix B) take precedence over the laboratories' in-house criteria (Appendix C).

Sound Analytical Services, Inc. - Method QC Limits

Volatile Organics by USEPA Method 5035/8260B

Analysis Method: 8260B
Matrix : **Soil**
Preparation Method : SW5035
Low -ITS 40- Level
Expires: 07/04/2001

Blank Spike Recovery

1,1-Dichloroethene	75 - 125%	=<27% RPD
1,2-Dichloroethane	75 - 125%	=<32% RPD
1,4-Dichlorobenzene	75 - 125%	=<30% RPD
2-Butanone	60 - 140%	=<39% RPD
Benzene	75 - 125%	=<26% RPD
Carbon Tetrachloride	75 - 125%	=<26% RPD
Chlorobenzene	75 - 125%	=<27% RPD
Chloroform	75 - 124%	=<29% RPD
Ethylbenzene	75 - 125%	=<24% RPD
m,p-Xylene	75 - 125%	=<26% RPD
o-Xylene	75 - 125%	=<28% RPD
Tetrachloroethene	75 - 125%	=<25% RPD
Toluene	75 - 125%	=<30% RPD
Trichloroethene	75 - 125%	=<27% RPD
Vinyl chloride	75 - 125%	=<28% RPD

Matrix Spike Recovery

1,1-Dichloroethene	75 - 125%	=<27% RPD
1,2-Dichloroethane	75 - 125%	=<32% RPD
1,4-Dichlorobenzene	75 - 125%	=<30% RPD
2-Butanone	60 - 140%	=<39% RPD
Benzene	75 - 125%	=<26% RPD
Carbon Tetrachloride	75 - 125%	=<26% RPD
Chlorobenzene	75 - 125%	=<27% RPD
Chloroform	75 - 124%	=<29% RPD
Ethylbenzene	75 - 125%	=<24% RPD
m,p-Xylene	75 - 125%	=<26% RPD
o-Xylene	75 - 125%	=<28% RPD
Tetrachloroethene	75 - 125%	=<25% RPD
Toluene	75 - 125%	=<30% RPD
Trichloroethene	75 - 125%	=<27% RPD
Vinyl chloride	75 - 125%	=<28% RPD

Surrogate Recovery

Bromofluorobenzene	80 - 113%
Dibromofluoromethane	75 - 115%
Ethylbenzene-d10	90 - 106%
Fluorobenzene	85 - 115%
Toluene-d8	91 - 109%

Sound Analytical Services, Inc. - Method QC Limits

Volatile Organics by USEPA Method 5030B/8260B

Analysis Method : 8260B
Matrix : **Water**
Preparation Method : SW5030B
Low -ITS-40- Level
Expires: 07/04/2001

Blank Spike Recovery

1,1-Dichloroethene	80 - 120%	=<11% RPD
1,2-Dichloroethane	80 - 120%	=<16% RPD
1,4-Dichlorobenzene	80 - 120%	=<20% RPD
2-Butanone	60 - 140%	=<36% RPD
Benzene	80 - 119%	=<12% RPD
Carbon Tetrachloride	80 - 120%	=<12% RPD
Chlorobenzene	80 - 120%	=<12% RPD
Chloroform	80 - 120%	=<12% RPD
Ethylbenzene	80 - 120%	=<13% RPD
m,p-Xylene	80 - 120%	=<14% RPD
o-Xylene	80 - 120%	=<13% RPD
Tetrachloroethene	80 - 120%	=<12% RPD
Toluene	80 - 120%	=<12% RPD
Trichloroethene	80 - 118%	=<12% RPD
Vinyl chloride	80 - 120%	=<15% RPD

Matrix Spike Recovery

1,1-Dichloroethene	80 - 120%	=<11% RPD
1,2-Dichloroethane	80 - 120%	=<16% RPD
1,4-Dichlorobenzene	80 - 120%	=<20% RPD
2-Butanone	60 - 140%	=<36% RPD
Benzene	80 - 119%	=<12% RPD
Carbon Tetrachloride	80 - 120%	=<12% RPD
Chlorobenzene	80 - 120%	=<12% RPD
Chloroform	80 - 120%	=<12% RPD
Ethylbenzene	80 - 120%	=<13% RPD
m,p-Xylene	80 - 120%	=<14% RPD
o-Xylene	80 - 120%	=<13% RPD
Tetrachloroethene	80 - 120%	=<12% RPD
Toluene	80 - 120%	=<12% RPD
Trichloroethene	80 - 118%	=<12% RPD
Vinyl chloride	80 - 120%	=<15% RPD

Surrogate Recovery

Bromofluorobenzene	86 - 110%
Dibromofluoromethane	83 - 114%
Ethylbenzene-d10	87 - 108%
Fluorobenzene	84 - 114%
Toluene-D8	91 - 107%

Sound Analytical Services, Inc. - Method QC Limits

Semivolatile Organics by USEPA Method 8270C

Analysis Method : 8270C
Matrix : **Water**
Preparation Method : 3510C
Expires: 06/08/2001

Blank Spike Recovery

1,2,4-Trichlorobenzene	42 - 114%	=<30% RPD
1,4-Dichlorobenzene	39 - 114%	=<35% RPD
2,4-Dinitrotoluene	50 - 132%	=<31% RPD
2-Chlorophenol	44 - 119%	=<33% RPD
4-Chloro-3-methylphenol	45 - 141%	=<33% RPD
4-Nitrophenol	17 - 83%	=<39% RPD
Acenaphthene	48 - 114%	=<32% RPD
N-nitroso-di-n-propylamine	30 - 130%	=<28% RPD
Pentachlorophenol	24 - 154%	=<38% RPD
Phenol	15 - 82%	=<38% RPD
Pyrene	46 - 127%	=<32% RPD

Matrix Spike Recovery

1,2,4-Trichlorobenzene	42 - 114%	=<30% RPD
1,4-Dichlorobenzene	39 - 114%	=<35% RPD
2,4-Dinitrotoluene	50 - 132%	=<31% RPD
2-Chlorophenol	44 - 119%	=<33% RPD
4-Chloro-3-methylphenol	45 - 141%	=<33% RPD
4-Nitrophenol	17 - 83%	=<39% RPD
Acenaphthene	48 - 114%	=<32% RPD
N-nitroso-di-n-propylamine	30 - 130%	=<28% RPD
Pentachlorophenol	24 - 154%	=<38% RPD
Phenol	15 - 82%	=<38% RPD
Pyrene	46 - 127%	=<32% RPD

Surrogate Recovery

2 - Fluorobiphenyl	56 - 127%
2 - Fluorophenol	34 - 109%
2,4,6 - Tribromophenol	55 - 156%
Nitrobenzene - d5	52 - 149%
p - Terphenyl - d14	43 - 145%
Phenol - d5	19 - 105%

Sound Analytical Services, Inc. - Method QC Limits

Semivolatile Organics by USEPA Method 8270C

Analysis Method : 8270C
Matrix : **Soil**
Preparation Method : 3550B
Expires: 06/08/2001

Blank Spike Recovery

1,2,4-Trichlorobenzene	48 - 140%	=<30% RPD
1,4-Dichlorobenzene	53 - 131%	=<33% RPD
2,4-Dinitrotoluene	51 - 140%	=<33% RPD
2-Chlorophenol	58 - 123%	=<32% RPD
4-Chloro-3-methylphenol	50 - 150%	=<32% RPD
4-Nitrophenol	36 - 130%	=<41% RPD
Acenaphthene	54 - 128%	=<32% RPD
N-nitroso-di-n-propylamine	43 - 130%	=<35% RPD
Pentachlorophenol	21 - 144%	=<41% RPD
Phenol	45 - 128%	=<36% RPD
Pyrene	45 - 145%	=<34% RPD

Matrix Spike Recovery

1,2,4-Trichlorobenzene	48 - 140%	=<30% RPD
1,4-Dichlorobenzene	53 - 131%	=<33% RPD
2,4-Dinitrotoluene	51 - 140%	=<33% RPD
2-Chlorophenol	58 - 123%	=<32% RPD
4-Chloro-3-methylphenol	50 - 150%	=<32% RPD
4-Nitrophenol	36 - 130%	=<41% RPD
Acenaphthene	54 - 128%	=<32% RPD
N-nitroso-di-n-propylamine	43 - 130%	=<35% RPD
Pentachlorophenol	21 - 144%	=<41% RPD
Phenol	45 - 128%	=<36% RPD
Pyrene	45 - 145%	=<34% RPD

Surrogate Recovery

2 - Fluorobiphenyl	55 - 137%
2 - Fluorophenol	57 - 146%
2,4,6 - Tribromophenol	35 - 146%
Nitrobenzene - d5	56 - 145%
p - Terphenyl - d14	45 - 134%
Phenol - d5	54 - 140%

Sound Analytical Services, Inc. - Method QC Limits

Organochlorine Pesticides by USEPA Method 8081A

Analysis Method : 8081A
Matrix : **Soil**
Preparation Method : 3550B
Expires: 11/17/2001

Blank Spike Recovery

4,4'-DDT	47 - 135%	=<26% RPD
Aldrin	50 - 124%	=<23% RPD
Dieldrin	55 - 138%	=<21% RPD
Endrin	45 - 145%	=<22% RPD
gamma-BHC (Lindane)	52 - 121%	=<18% RPD
Heptachlor	50 - 133%	=<21% RPD

Surrogate Recovery

Decachlorobiphenyl	26 - 157%
TCMX	34 - 143%

Organochlorine Pesticides by USEPA Method 8081A

Analysis Method : 8081A
Matrix : Water
Preparation Method : 3510C
Expires: 11/17/2001

Blank Spike Recovery

4,4'-DDT	68 - 128%	=<20% RPD
Aldrin	55 - 117%	=<21% RPD
Dieldrin	72 - 133%	=<17% RPD
Endrin	54 - 150%	=<22% RPD
gamma-BHC (Lindane)	51 - 122%	=<19% RPD
Heptachlor	64 - 127%	=<21% RPD

Surrogate Recovery

Decachlorobiphenyl	42 - 163%
TCMX	44 - 137%

Sound Analytical Services, Inc. - Method QC Limits

PCBs by USEPA Method 8082

Analysis Method : 8082
Matrix : **Soil**
Preparation Method : SW3550B
Expires: 11/17/2001

Blank Spike Recovery

Aroclor-1260	59 - 138%	=<16% RPD

Surrogate Recovery

Decachlorobiphenyl	53 - 126%
TCMX	52 - 131%

PCBs by USEPA Method 8082

Analysis Method : 8082
Matrix : **Water**
Preparation Method : SW3510C
Expires: 11/17/2001

Blank Spike Recovery

Aroclor 1260	62 - 129%	=<25% RPD

Surrogate Recovery

Decachlorobiphenyl	49 - 132%
TCMX	43 - 129%

Sound Analytical Services, Inc. - Method QC Limits

Total and Dissolved Metals by ICP - USEPA Method 6010B

Analysis Method : 6010B
Matrix : **Soil**
Preparation Method : 3051

Blank Spike Recovery

Aluminum	80 - 120%
Antimony	80 - 120%
Arsenic	80 - 120%
Barium	80 - 120%
Beryllium	80 - 120%
Boron	80 - 120%
Cadmium	80 - 120%
Calcium	80 - 120%
Chromium	80 - 120%
Cobalt	80 - 120%
Copper	80 - 120%
Iron	80 - 120%
Lead	80 - 120%
Magnesium	80 - 120%
Manganese	80 - 120%
Molybdenum	80 - 120%
Nickel	80 - 120%
Potassium	80 - 120%
Selenium	80 - 120%
Silica	80 - 120%
Silver	80 - 120%
Sodium	80 - 120%
Strontium	80 - 120%
Thallium	80 - 120%
Tin	80 - 120%
Titanium	80 - 120%
Vanadium	80 - 120%
Zinc	80 - 120%

Duplicate RPD

Aluminum	=<35% RPD
Antimony	=<35% RPD
Arsenic	=<35% RPD
Barium	=<35% RPD
Beryllium	=<35% RPD
Boron	=<35% RPD
Cadmium	=<35% RPD
Calcium	=<35% RPD
Chromium	=<35% RPD
Cobalt	=<35% RPD
Copper	=<35% RPD
Iron	=<35% RPD
Lead	=<35% RPD
Magnesium	=<35% RPD

Sound Analytical Services, Inc. - Method QC Limits

Manganese	=<35% RPD
Molybdenum	=<35% RPD
Nickel	=<35% RPD
Potassium	=<35% RPD
Selenium	=<35% RPD
Silica	=<35% RPD
Silver	=<35% RPD
Sodium	=<35% RPD
Strontium	=<35% RPD
Thallium	=<35% RPD
Tin	=<35% RPD
Titanium	=<35% RPD
Vanadium	=<35% RPD
Zinc	=<35% RPD

Matrix Spike Recovery

Aluminum	75 - 125%
Antimony	75 - 125%
Arsenic	75 - 125%
Barium	75 - 125%
Beryllium	75 - 125%
Boron	75 - 125%
Cadmium	75 - 125%
Calcium	75 - 125%
Chromium	75 - 125%
Cobalt	75 - 125%
Copper	75 - 125%
Iron	75 - 125%
Lead	75 - 125%
Magnesium	75 - 125%
Manganese	75 - 125%
Molybdenum	75 - 125%
Nickel	75 - 125%
Potassium	75 - 125%
Selenium	75 - 125%
Silica	75 - 125%
Silver	75 - 125%
Sodium	75 - 125%
Strontium	75 - 125%
Thallium	75 - 125%
Tin	75 - 125%
Titanium	75 - 125%
Vanadium	75 - 125%
Zinc	75 - 125%

Sound Analytical Services, Inc. - Method QC Limits

Total and Dissolved Metals by ICP - USEPA Method 6010B

Analysis Method : 6010B
Matrix : **Water**
Preparation Method : 3010A

Blank Spike Recovery

Aluminum	80 - 120%	=<20% RPD
Antimony	80 - 120%	=<20% RPD
Arsenic	80 - 120%	=<20% RPD
Barium	80 - 120%	=<20% RPD
Beryllium	80 - 120%	=<20% RPD
Boron	80 - 120%	=<20% RPD
Cadmium	80 - 120%	=<20% RPD
Calcium	80 - 120%	=<20% RPD
Chromium	80 - 120%	=<20% RPD
Cobalt	80 - 120%	=<20% RPD
Copper	80 - 120%	=<20% RPD
Iron	80 - 120%	=<20% RPD
Lead	80 - 120%	=<20% RPD
Magnesium	80 - 120%	=<20% RPD
Manganese	80 - 120%	=<20% RPD
Molybdenum	80 - 120%	=<20% RPD
Nickel	80 - 120%	=<20% RPD
Potassium	80 - 120%	=<20% RPD
Selenium	80 - 120%	=<20% RPD
Silica	80 - 120%	=<20% RPD
Silver	80 - 120%	=<20% RPD
Sodium	80 - 120%	=<20% RPD
Strontium	80 - 120%	=<20% RPD
Thallium	80 - 120%	=<20% RPD
Tin	80 - 120%	=<20% RPD
Titanium	80 - 120%	=<20% RPD
Uranium	80 - 120%	=<20% RPD
Vanadium	80 - 120%	=<20% RPD
Zinc	80 - 120%	=<20% RPD

Duplicate RPD

Aluminum	=<20% RPD
Antimony	=<20% RPD
Arsenic	=<20% RPD
Barium	=<20% RPD
Beryllium	=<20% RPD
Boron	=<20% RPD
Cadmium	=<20% RPD
Calcium	=<20% RPD
Chromium	=<20% RPD
Cobalt	=<20% RPD
Copper	=<20% RPD
Iron	=<20% RPD
Lead	=<20% RPD

Sound Analytical Services, Inc. - Method QC Limits

Magnesium		=<20% RPD
Manganese		=<20% RPD
Molybdenum		=<20% RPD
Nickel		=<20% RPD
Potassium		=<20% RPD
Selenium		=<20% RPD
Silica		=<20% RPD
Silver		=<20% RPD
Sodium		=<20% RPD
Strontium		=<20% RPD
Thallium		=<20% RPD
Tin		=<20% RPD
Titanium		=<20% RPD
Uranium		=<20% RPD
Vanadium		=<20% RPD
Zinc		=<20% RPD

Matrix Spike Recovery

Aluminum	75 - 125%	=<20% RPD
Antimony	75 - 125%	=<20% RPD
Arsenic	75 - 125%	=<20% RPD
Barium	75 - 125%	=<20% RPD
Beryllium	75 - 125%	=<20% RPD
Boron	75 - 125%	=<20% RPD
Cadmium	75 - 125%	=<20% RPD
Calcium	75 - 125%	=<20% RPD
Chromium	75 - 125%	=<20% RPD
Cobalt	75 - 125%	=<20% RPD
Copper	75 - 125%	=<20% RPD
Iron	75 - 125%	=<20% RPD
Lead	75 - 125%	=<20% RPD
Magnesium	75 - 125%	=<20% RPD
Manganese	75 - 125%	=<20% RPD
Molybdenum	75 - 125%	=<20% RPD
Nickel	75 - 125%	=<20% RPD
Potassium	75 - 125%	=<20% RPD
Selenium	75 - 125%	=<20% RPD
Silica	75 - 125%	=<20% RPD
Silver	75 - 125%	=<20% RPD
Sodium	75 - 125%	=<20% RPD
Strontium	75 - 125%	=<20% RPD
Thallium	75 - 125%	=<20% RPD
Tin	75 - 125%	=<20% RPD
Titanium	75 - 125%	=<20% RPD
Uranium	75 - 125%	=<20% RPD
Vanadium	75 - 125%	=<20% RPD
Zinc	75 - 125%	=<20% RPD

Sound Analytical Services, Inc. - Method QC Limits

Total and Dissolved Metals by ICP-MS - USEPA Method 6020

Analysis Method : 6020
Matrix : **Soil**
Preparation Method : 3051

Blank Spike Recovery

Antimony	80 - 120%
Arsenic	80 - 120%
Barium	80 - 120%
Beryllium	80 - 120%
Boron	80 - 120%
Cadmium	80 - 120%
Chromium	80 - 120%
Cobalt	80 - 120%
Copper	80 - 120%
Lead	80 - 120%
Manganese	80 - 120%
Molybdenum	80 - 120%
Nickel	80 - 120%
Selenium	80 - 120%
Silver	80 - 120%
Strontium	80 - 120%
Thallium	80 - 120%
Tin	80 - 120%
Titanium	80 - 120%
Uranium	80 – 120%
Vanadium	80 - 120%
Zinc	80 - 120%

Duplicate RPD

Antimony	=<35% RPD
Arsenic	=<35% RPD
Barium	=<35% RPD
Beryllium	=<35% RPD
Boron	=<35% RPD
Cadmium	=<35% RPD
Chromium	=<35% RPD
Cobalt	=<35% RPD
Copper	=<35% RPD
Lead	=<35% RPD
Manganese	=<35% RPD
Molybdenum	=<35% RPD
Nickel	=<35% RPD
Selenium	=<35% RPD
Silver	=<35% RPD
Strontium	=<35% RPD
Thallium	=<35% RPD
Tin	=<35% RPD
Titanium	=<35% RPD
Uranium	=<35% RPD

Sound Analytical Services, Inc. - Method QC Limits

Vanadium	=<35% RPD
Zinc	=<35% RPD

Matrix Spike Recovery

Antimony	75 - 125%
Arsenic	75 - 125%
Barium	75 - 125%
Beryllium	75 - 125%
Boron	75 - 125%
Cadmium	75 - 125%
Chromium	75 - 125%
Cobalt	75 - 125%
Copper	75 - 125%
Lead	75 - 125%
Manganese	75 - 125%
Molybdenum	75 - 125%
Nickel	75 - 125%
Selenium	75 - 125%
Silver	75 - 125%
Strontium	75 - 125%
Thallium	75 - 125%
Tin	75 - 125%
Titanium	75 - 125%
Uranium	75 - 125%
Vanadium	75 - 125%
Zinc	75 - 125%

Sound Analytical Services, Inc. - Method QC Limits

Total and Dissolved Metals by ICP-MS - USEPA Method 6020B

Analysis Method : 6020B
Matrix : **Water**
Preparation Method : 3010A

Blank Spike Recovery

Antimony	80 - 120%
Arsenic	80 - 120%
Barium	80 - 120%
Beryllium	80 - 120%
Boron	80 - 120%
Cadmium	80 - 120%
Chromium	80 - 120%
Cobalt	80 - 120%
Copper	80 - 120%
Lead	80 - 120%
Manganese	80 - 120%
Molybdenum	80 - 120%
Nickel	80 - 120%
Selenium	80 - 120%
Silver	80 - 120%
Strontium	80 - 120%
Thallium	80 - 120%
Tin	80 - 120%
Titanium	80 - 120%
Uranium	80 - 120%
Vanadium	80 - 120%
Zinc	80 - 120%

Duplicate RPD

Antimony	=<20% RPD
Arsenic	=<20% RPD
Barium	=<20% RPD
Beryllium	=<20% RPD
Boron	=<20% RPD
Cadmium	=<20% RPD
Chromium	=<20% RPD
Cobalt	=<20% RPD
Copper	=<20% RPD
Lead	=<20% RPD
Manganese	=<20% RPD
Molybdenum	=<20% RPD
Nickel	=<20% RPD
Selenium	=<20% RPD
Silver	=<20% RPD
Strontium	=<20% RPD
Thallium	=<20% RPD
Tin	=<20% RPD
Titanium	=<20% RPD
Uranium	=<20% RPD

Sound Analytical Services, Inc. - Method QC Limits

Vanadium		=<20% RPD
Zinc		=<20% RPD

Matrix Spike Recovery

Antimony	75 - 125%
Arsenic	75 - 125%
Barium	75 - 125%
Beryllium	75 - 125%
Boron	75 - 125%
Cadmium	75 - 125%
Chromium	75 - 125%
Cobalt	75 - 125%
Copper	75 - 125%
Lead	75 - 125%
Manganese	75 - 125%
Molybdenum	75 - 125%
Nickel	75 - 125%
Selenium	75 - 125%
Silver	75 - 125%
Strontium	75 - 125%
Thallium	75 - 125%
Tin	75 - 125%
Titanium	75 - 125%
Uranium	75 - 125%
Vanadium	75 - 125%
Zinc	75 - 125%

Mercury by CVAA - USEPA Method 7470A

Analysis Method : 7470A
Matrix : **Water**

Blank Spike Recovery

Mercury	75 - 125%

Duplicate RPD

Mercury	=<20% RPD

Matrix Spike Recovery

Mercury	75 - 125%

Sound Analytical Services, Inc. - Method QC Limits

Mercury by CVAA - USEPA Method 7471A

Analysis Method : 7471A
Matrix : **Soil**

Blank Spike Recovery

Mercury	75 - 125%	=<25% RPD

Duplicate RPD

Mercury		=<35% RPD

Matrix Spike Recovery

Mercury	75 - 125%

Sound Analytical Services, Inc. - Method QC Limits

Total Cyanide by USEPA Method 9012A

Analysis Method : 9012A
Matrix : Soil
Preparation Method: 9013
Expires: 09/30/2001

Blank Spike Recovery

Cyanide	80 - 120%	=<22% RPD

Matrix Spike Recovery

Cyanide	80 - 120%	=<22% RPD

Total Cyanide by USEPA Method 9012A

Analysis Method : 9012A
Matrix : **Water**
Preparation Method 9012A
Expires: 09/30/2001

Blank Spike Recovery

Cyanide	80 - 120%	=<20% RPD

Matrix Spike Recovery

Cyanide	80 - 120%	=<20% RPD

Sound Analytical Services, Inc. - Method QC Limits

Diesel and Motor Oil by NWTPH-Dx Modified

Analysis Method : NWTPH-Dx
Matrix : **Soil**
Expires: 08/05/2001

Blank Spike Recovery

#2 Diesel	67 - 139%	=<22% RPD
Motor Oil	62 - 120%	=<25% RPD

Duplicate RPD

#2 Diesel		=<35% RPD

Matrix Spike Recovery

#2 Diesel	50 - 150%	=<35% RPD
Motor Oil	50 - 150%	=<35% RPD

Surrogate Recovery

o-terphenyl	50 - 150%

Sound Analytical Services, Inc. - Method QC Limits

Nitroamine & Nitroaromatic Compounds by USEPA Method 8330

Analysis Method : 8330
Matrix : **Soil**
Preparation Method : Solid-Phase Extraction
Expires: 11/17/2001

Blank Spike Recovery

1,3,5-Trinitrobenzene	67 - 112%	=<11% RPD
1,3-Dinitrobenzene	77 - 106%	=<7% RPD
2,4,6-Trinitrotoluene	69 - 110%	=<16% RPD
2,4-Dinitrotoluene	78 - 105%	=<13% RPD
2,6-Dinitrotoluene	68 - 119%	=<10% RPD
2-Nitrotoluene	74 - 106%	=<7% RPD
3-Nitrotoluene	76 - 101%	=<8% RPD
4-Nitrotoluene	73 - 108%	=<12% RPD
HMX	73 - 110%	=<9% RPD
Nitrobenzene	73 - 116%	=<8% RPD
RDX	68 - 111%	=<10% RPD
Tetryl	47 - 130%	=<14% RPD

Surrogate Recovery

3,4-Dinitrotoluene	48 - 143%

SOUTHWEST RESEARCH INSTITUTE

Thiodiglycol in Soil

Analysis Method : SWRI SOP for the Analysis of Thiodiglycol by HPLC
Matrix : **Soil**

Blank Spike Recovery

Thiodiglycol	60 - 120%	

Matrix Spike Recovery

Thiodiglycol	50 - 140%	=<50% RPD

Surrogate Recovery Not Applicable

SOUTHWEST RESEARCH INSTITUTE

Dithiane and Oxathiane in Soil

Analysis Method : SWRI SOP for the Analysis of Dithiane and Oxathiane by GC/FPD
Matrix : **Soil**

Blank Spike Recovery		
Dithiane/oxathiane	50 - 150%	
Matrix Spike Recovery		
Dithiane/oxathiane	50 - 150%	=<50% RPD
Surrogate Recovery	Not Applicable	

SOUTHWEST RESEARCH INSTITUTE

VX Thiols in Soil

Analysis Method : SWRI SOP for the Analysis of VX Thiols by GC/MS
Matrix : **Soil**

Blank Spike Recovery		
Dithiane/oxathiane	30 - 160%	
Matrix Spike Recovery		
Dithiane/oxathiane	30 - 160%	=<60% RPD
Surrogate Recovery	Not Applicable	

SOUTHWEST RESEARCH INSTITUTE

Methylphosphonic Acid in Soil

Analysis Method : SWRI SOP for the Analysis of Methylphosphonic Acid by IC
Matrix : **Soil**

Blank Spike Recovery

Methylphosphonic Acid	50 - 150%	

Matrix Spike Recovery

Methylphosphonic Acid	50 - 150%	=<35% RPD

Surrogate Recovery Not Applicable

on/off

Home

Volatile Organics Reporting Limits - Soils Preserved

EPA Method: SW 5035 / 8260B / 8260B BTEX
Matrix: soil
Container: 5035 Sampling Kit
Preservative: Methanol / Na2S2O3
Holding Time: 14 Days to Extract

Analyte	PQL	Units	CAS No.	Reporting Level	Instrument
1,1,1,2-Tetrachloroethane	0.4	ug/kg	630-20-6	Low Level	GCMS - Ion Trap
1,1,1-Trichloroethane	0.4	ug/kg	71-55-6	Low Level	GCMS - Ion Trap
1,1,2,2-Tetrachloroethane	0.4	ug/kg	79-34-5	Low Level	GCMS - Ion Trap
1,1,2-Trichloroethane	0.4	ug/kg	79-00-5	Low Level	GCMS - Ion Trap
1,1-Dichloroethane	0.4	ug/kg	75-34-3	Low Level	GCMS - Ion Trap
1,1-Dichloroethene	0.4	ug/kg	75-35-4	Low Level	GCMS - Ion Trap
1,1-Dichloropropene	0.4	ug/kg	563-58-6	Low Level	GCMS - Ion Trap
1,2,3-Trichlorobenzene	0.4	ug/kg	120-82-1	Low Level	GCMS - Ion Trap
1,2,3-Trichloropropane	0.4	ug/kg	96-18-4	Low Level	GCMS - Ion Trap
1,2,4-Trichlorobenzene	0.4	ug/kg	120-82-1	Low Level	GCMS - Ion Trap
1,2,4-Trimethylbenzene	0.4	ug/kg	95-63-6	Low Level	GCMS - Ion Trap
1,2-Dibromo-3-chloropropane	0.4	ug/kg	96-12-8	Low Level	GCMS - Ion Trap
1,2-Dibromoethane	0.4	ug/kg	106-93-4	Low Level	GCMS - Ion Trap
1,2-Dichlorobenzene	0.4	ug/kg	95-50-1	Low Level	GCMS - Ion Trap
1,2-Dichloroethane	0.4	ug/kg	107-06-2	Low Level	GCMS - Ion Trap
1,2-Dichloropropane	0.4	ug/kg	78-87-5	Low Level	GCMS - Ion Trap
1,3,5-Trimethylbenzene	0.4	ug/kg	108-67-8	Low Level	GCMS - Ion Trap
1,3-Dichlorobenzene	0.4	ug/kg	541-73-1	Low Level	GCMS - Ion Trap
1,3-Dichloropropane	0.4	ug/kg	142-28-9	Low Level	GCMS - Ion Trap
1,4-Dichlorobenzene	0.4	ug/kg	106-46-7	Low Level	GCMS - Ion Trap
2,2-Dichloropropane	0.4	ug/kg	594-20-7	Low Level	GCMS - Ion Trap

2-Chlorotoluene	0.4	ug/kg	95-49-8	Low Level	GCMS - Ion Trap
4-Chlorotoluene	0.4	ug/kg	106-43-4	Low Level	GCMS - Ion Trap
4-Isopropyltoluene	0.4	ug/kg	99-87-6	Low Level	GCMS - Ion Trap
Benzene	0.4	ug/kg	71-43-2	Low Level	GCMS - Ion Trap
Bromobenzene	0.4	ug/kg	108-86-1	Low Level	GCMS - Ion Trap
Bromochloromethane	0.4	ug/kg	74-97-5	Low Level	GCMS - Ion Trap
Bromodichloromethane	0.4	ug/kg	75-27-4	Low Level	GCMS - Ion Trap
Bromoform	0.4	ug/kg	75-25-2	Low Level	GCMS - Ion Trap
Bromomethane	0.4	ug/kg	74-83-9	Low Level	GCMS - Ion Trap
Carbon Tetrachloride	0.4	ug/kg	56-23-5	Low Level	GCMS - Ion Trap
Chlorobenzene	0.4	ug/kg	108-90-7	Low Level	GCMS - Ion Trap
Chloroethane	0.4	ug/kg	75-00-3	Low Level	GCMS - Ion Trap
Chloroform	0.4	ug/kg	67-66-3	Low Level	GCMS - Ion Trap
Chloromethane	0.4	ug/kg	74-87-3	Low Level	GCMS - Ion Trap
cis-1,2-Dichloroethene	0.4	ug/kg	156-60-5	Low Level	GCMS - Ion Trap
cis-1,3-Dichloropropene	0.4	ug/kg	10061-01-5	Low Level	GCMS - Ion Trap
Dibromochloromethane	0.4	ug/kg	124-48-1	Low Level	GCMS - Ion Trap
Dibromomethane	0.4	ug/kg	74-95-3	Low Level	GCMS - Ion Trap
Dichlorodifluoromethane	0.4	ug/kg	75-71-8	Low Level	GCMS - Ion Trap
Ethylbenzene	0.4	ug/kg	100-41-4	Low Level	GCMS - Ion Trap
Hexachlorobutadiene	0.4	ug/kg	87-68-3	Low Level	GCMS - Ion Trap
Isopropylbenzene	0.4	ug/kg	98-82-8	Low Level	GCMS - Ion Trap
m,p-Xylenes	0.8	ug/kg	08-38-3 & 106-42-3	Low Level	GCMS - Ion Trap
Methyl acetate	2	ug/kg	79-20-9	Low Level	GCMS - Ion Trap
Methylcyclohexane	0.4	ug/kg	108-87-2	Low Level	GCMS - Ion Trap
Methylene chloride	0.4	ug/kg	75-09-2	Low Level	GCMS - Ion Trap
Naphthalene	0.4	ug/kg	91-20-3	Low Level	GCMS - Ion Trap
n-Butylbenzene	0.4	ug/kg	104-51-8	Low Level	GCMS - Ion Trap
n-Propylbenzene	0.4	ug/kg	103-65-1	Low Level	GCMS - Ion Trap
o-Xylene	0.4	ug/kg	95-47-6	Low Level	GCMS - Ion Trap
sec-Butylbenzene	0.4	ug/kg	135-98-8	Low Level	GCMS - Ion Trap
Styrene	0.4	ug/kg	100-42-5	Low Level	GCMS - Ion Trap
t-Butylbenzene	0.4	ug/kg	98-06-6	Low Level	GCMS - Ion Trap
Tetrachloroethene	0.4	ug/kg	127-18-4	Low Level	GCMS - Ion Trap
Toluene	0.4	ug/kg	108-88-3	Low Level	GCMS - Ion Trap
trans-1,2-Dichloroethene	0.4	ug/kg	156-60-5	Low Level	GCMS - Ion Trap

trans-1,3-Dichloropropene	0.4	ug/kg	10061-02-6	Low Level	GCMS - Ion Trap
Trichloroethene	0.4	ug/kg	79-01-6	Low Level	GCMS - Ion Trap
Trichlorofluoromethane	0.4	ug/kg	75-69-4	Low Level	GCMS - Ion Trap
Vinyl chloride	0.4	ug/kg	75-01-4	Low Level	GCMS - Ion Trap

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Volatile Organics Reporting Limits - Waters

EPA Method: SW 8260B/5030B (prep)
Matrix: Water
Container: 3 - 40 ml VOA Vials
Preservative: HCl - pH<2
Holding Time: 14 Days

Analyte	PQL	Units	CAS No.	Reporting Level	Instrument
1,1,1,2-Tetrachloroethane	0.4	ug/L	630-20-6	Low Level	GCMS - Ion Trap
1,1,1-Trichloroethane	0.4	ug/L	71-55-6	Low Level	GCMS - Ion Trap
1,1,2,2-Tetrachloroethane	0.4	ug/L	79-34-5	Low Level	GCMS - Ion Trap
1,1,2-Trichloroethane	0.4	ug/L	79-00-5	Low Level	GCMS - Ion Trap
1,1-Dichloroethane	0.4	ug/L	75-34-3	Low Level	GCMS - Ion Trap
1,1-Dichloroethene	0.4	ug/L	75-35-4	Low Level	GCMS - Ion Trap
1,1-Dichloropropene	0.4	ug/L	563-58-6	Low Level	GCMS - Ion Trap
1,2,3-Trichlorobenzene	0.4	ug/L		Low Level	GCMS - Ion Trap
1,2,3-Trichloropropane	0.4	ug/L	96-18-4	Low Level	GCMS - Ion Trap
1,2,4-Trichlorobenzene	0.4	ug/L	120-82-1	Low Level	GCMS - Ion Trap
1,2,4-Trimethylbenzene	0.4	ug/L	95-63-6	Low Level	GCMS - Ion Trap
1,2-Dibromo-3-chloropropane	0.4	ug/L	96-12-8	Low Level	GCMS - Ion Trap
1,2-Dibromoethane	0.4	ug/L	106-93-4	Low Level	GCMS - Ion Trap
1,2-Dichlorobenzene	0.4	ug/L	95-50-1	Low Level	GCMS - Ion Trap
1,2-Dichloroethane	0.4	ug/L	107-06-2	Low Level	GCMS - Ion Trap
1,2-Dichloropropane	0.4	ug/L	78-87-5	Low Level	GCMS - Ion Trap
1,3,5-Trimethylbenzene	0.4	ug/L	108-67-8	Low Level	GCMS - Ion Trap
1,3-Dichlorobenzene	0.4	ug/L	541-73-1	Low Level	GCMS - Ion Trap
1,3-Dichloropropane	0.4	ug/L	142-28-9	Low Level	GCMS - Ion Trap
1,4-Dichlorobenzene	0.4	ug/L	106-46-7	Low Level	GCMS - Ion Trap
2,2-Dichloropropane	0.4	ug/L	594-20-7	Low Level	GCMS - Ion Trap

2-Butanone	2	ug/L	78-93-3	Low Level	GCMS - Ion Trap
2-Chlorotoluene	0.4	ug/L	95-49-8	Low Level	GCMS - Ion Trap
2-Hexanone	2	ug/L	591-78-6	Low Level	GCMS - Ion Trap
4-Chlorotoluene	0.4	ug/L	106-43-4	Low Level	GCMS - Ion Trap
4-Isopropyltoluene	0.4	ug/L	99-87-6	Low Level	GCMS - Ion Trap
4-Methyl-2-pentanone	2	ug/L	108-10-1	Low Level	GCMS - Ion Trap
Acetone	2	ug/L	67-64-1	Low Level	GCMS - Ion Trap
Benzene	0.4	ug/L	71-43-2	Low Level	GCMS - Ion Trap
Bromobenzene	0.4	ug/L	108-86-1	Low Level	GCMS - Ion Trap
Bromochloromethane	0.4	ug/L	74-97-5	Low Level	GCMS - Ion Trap
Bromodichloromethane	0.4	ug/L	75-27-4	Low Level	GCMS - Ion Trap
Bromoform	0.4	ug/L	75-25-2	Low Level	GCMS - Ion Trap
Bromomethane	0.4	ug/L	74-83-9	Low Level	GCMS - Ion Trap
Carbon disulfide	0.4	ug/L	75-15-0	Low Level	GCMS - Ion Trap
Carbon Tetrachloride	0.4	ug/L	56-23-5	Low Level	GCMS - Ion Trap
Chlorobenzene	0.4	ug/L	108-90-7	Low Level	GCMS - Ion Trap
Chloroethane	0.4	ug/L	75-00-3	Low Level	GCMS - Ion Trap
Chloroform	0.4	ug/L	67-66-3	Low Level	GCMS - Ion Trap
Chloromethane	0.4	ug/L	74-87-3	Low Level	GCMS - Ion Trap
cis-1,2-Dichloroethene	0.4	ug/L	156-60-5	Low Level	GCMS - Ion Trap
cis-1,3-Dichloropropene	0.4	ug/L	10061-01-5	Low Level	GCMS - Ion Trap
Dibromochloromethane	0.4	ug/L	124-48-1	Low Level	GCMS - Ion Trap
Dibromomethane	0.4	ug/L	74-95-3	Low Level	GCMS - Ion Trap
Dichlorodifluoromethane	0.4	ug/L	75-71-8	Low Level	GCMS - Ion Trap
Ethylbenzene	0.4	ug/L	100-41-4	Low Level	GCMS - Ion Trap
Hexachlorobutadiene	0.4	ug/L	87-68-3	Low Level	GCMS - Ion Trap
Isopropylbenzene	0.4	ug/L	98-82-8	Low Level	GCMS - Ion Trap
m,p-Xylenes	0.8	ug/L	136777-61-2	Low Level	GCMS - Ion Trap
Methylene chloride	0.4	ug/L	75-09-2	Low Level	GCMS - Ion Trap
Methyl Acetate	2	ug/L	79-20-9	Low Level	GCMS - Ion Trap
Methylcyclohexane	0.4	ug/L	108-87-2	Low Level	GCMS - Ion Trap
Naphthalene	0.4	ug/L	91-20-3	Low Level	GCMS - Ion Trap
n-Butylbenzene	0.4	ug/L	104-51-8	Low Level	GCMS - Ion Trap
n-Propylbenzene	0.4	ug/L	103-65-1	Low Level	GCMS - Ion Trap
o-Xylene	0.4	ug/L	95-47-6	Low Level	GCMS - Ion Trap
sec-Butylbenzene	0.4	ug/L	135-98-8	Low Level	GCMS - Ion Trap

Styrene	0.4	ug/L	100-42-5	Low Level	GCMS - Ion Trap
t-Butylbenzene	0.4	ug/L	98-06-6	Low Level	GCMS - Ion Trap
Tetrachloroethene	0.4	ug/L	127-18-4	Low Level	GCMS - Ion Trap
Toluene	0.4	ug/L	108-88-3	Low Level	GCMS - Ion Trap
trans-1,2-Dichloroethene	0.4	ug/L	156-60-5	Low Level	GCMS - Ion Trap
trans-1,3-Dichloropropene	0.4	ug/L	10061-02-6	Low Level	GCMS - Ion Trap
Trichloroethene	0.4	ug/L	79-01-6	Low Level	GCMS - Ion Trap
Trichlorofluoromethane	0.4	ug/L	75-69-4	Low Level	GCMS - Ion Trap
Vinyl chloride	0.4	ug/L	75-01-4	Low Level	GCMS - Ion Trap

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Semivolatile Organic Compounds Reporting Limits - Soils

EPA Method: SW 8270C/3050B (prep)
Matrix: soil
Container: 4 oz. Soil Jar
Preservative: Cool 4° C
Holding Time: 14 Days to Extract

Analyte	PQL	Units	CAS No.	Reporting Level	Instrument
1,2,4-Trichlorobenzene	50	ug/kg	120-82-1	Low Level	GCMS - Ion Trap
1,2-Dichlorobenzene	50	ug/kg	95-50-1	Low Level	GCMS - Ion Trap
1,2-Diphenylhydrazine	50	ug/kg	122-66-7	Low Level	GCMS - Ion Trap
1,3-Dichlorobenzene	50	ug/kg	541-73-1	Low Level	GCMS - Ion Trap
1,4-Dichlorobenzene	50	ug/kg	106-46-7	Low Level	GCMS - Ion Trap
2,4,5-Trichlorophenol	50	ug/kg	95-95-4	Low Level	GCMS - Ion Trap
2,4,6-Trichlorophenol	50	ug/kg	88-06-2	Low Level	GCMS - Ion Trap
2,4-Dichlorophenol	50	ug/kg	120-83-2	Low Level	GCMS - Ion Trap
2,4-Dimethylphenol	50	ug/kg	105-67-9	Low Level	GCMS - Ion Trap
2,4-Dinitrophenol	50	ug/kg	51-28-5	Low Level	GCMS - Ion Trap
2,4-Dinitrotoluene	50	ug/kg	121-14-2	Low Level	GCMS - Ion Trap
2,6-Dinitrotoluene	50	ug/kg	606-20-2	Low Level	GCMS - Ion Trap
2-Chloronaphthalene	10	ug/kg	91-58-7	Low Level	GCMS - Ion Trap
2-Chlorophenol	50	ug/kg	95-57-8	Low Level	GCMS - Ion Trap
2-Ethoxyethanol	50	ug/kg		Low Level	GCMS - Ion Trap
2-Methylnaphthalene	10	ug/kg	91-57-6	Low Level	GCMS - Ion Trap
2-Methylphenol	50	ug/kg	95-48-7	Low Level	GCMS - Ion Trap
2-Nitroaniline	50	ug/kg	88-74-4	Low Level	GCMS - Ion Trap
2-Nitrophenol	50	ug/kg	88-75-5	Low Level	GCMS - Ion Trap
2-Nitropropane	50	ug/kg		Low Level	GCMS - Ion Trap

3- & 4-Methylphenol	50	ug/kg		Low Level	GCMS - Ion Trap
3,3'-Dichlorobenzidine	50	ug/kg	91-94-1	Low Level	GCMS - Ion Trap
3-Nitroaniline	50	ug/kg	99-09-2	Low Level	GCMS - Ion Trap
4,6-Dinitro-2-methylphenol	50	ug/kg	534-52-1	Low Level	GCMS - Ion Trap
4-Bromophenylphenylether	50	ug/kg	101-55-3	Low Level	GCMS - Ion Trap
4-Chloro-3-methylphenol	50	ug/kg	59-50-7	Low Level	GCMS - Ion Trap
4-Chloroaniline	50	ug/kg	106-47-8	Low Level	GCMS - Ion Trap
4-Chlorophenylphenylether	50	ug/kg	7005-72-3	Low Level	GCMS - Ion Trap
4-Nitroaniline	50	ug/kg	100-01-6	Low Level	GCMS - Ion Trap
4-Nitrophenol	50	ug/kg	100-02-7	Low Level	GCMS - Ion Trap
Acenaphthene	10	ug/kg	83-32-9	Low Level	GCMS - Ion Trap
Acenaphthylene	10	ug/kg	208-96-8	Low Level	GCMS - Ion Trap
Acetophenone	100	ug/kg	98-86-2	Low Level	GCMS - Ion Trap
Aniline	500	ug/kg	62-53-3	Low Level	GCMS - Ion Trap
Anthracene	10	ug/kg	120-12-7	Low Level	GCMS - Ion Trap
Atrazine	50	ug/kg	1912-24-9	Low Level	GCMS - Ion Trap
Benzaldehyde	100	ug/kg	100-52-7	Low Level	GCMS - Ion Trap
Benzidine	100	ug/kg	92-87-5	Low Level	GCMS - Ion Trap
Benzo(a)anthracene	10	ug/kg	56-55-3	Low Level	GCMS - Ion Trap
Benzo(a)pyrene	10	ug/kg	50-32-8	Low Level	GCMS - Ion Trap
Benzo(b)fluoranthene	10	ug/kg	205-99-2	Low Level	GCMS - Ion Trap
Benzo(g,h,i)perylene	10	ug/kg	191-24-2	Low Level	GCMS - Ion Trap
Benzo(k)fluoranthene	10	ug/kg	207-08-9	Low Level	GCMS - Ion Trap
Benzoic Acid	50	ug/kg	65-85-0	Low Level	GCMS - Ion Trap
Benzyl Alcohol	50	ug/kg	100-51-6	Low Level	GCMS - Ion Trap
1,1'-Biphenyl	50	ug/kg	92-52-4	Low Level	GCMS - Ion Trap
bis(2-Chloroethoxy)methane	50	ug/kg	111-91-1	Low Level	GCMS - Ion Trap
bis(2-Chloroethyl)ether	50	ug/kg	111-44-4	Low Level	GCMS - Ion Trap
bis(2-Chloroisopropyl)ether	50	ug/kg	108-60-1	Low Level	GCMS - Ion Trap
bis(2-Ethylhexyl)phthalate	50	ug/kg	117-81-7	Low Level	GCMS - Ion Trap
Butylbenzylphthalate	50	ug/kg	85-68-7	Low Level	GCMS - Ion Trap
Caprolactam	100	ug/kg	105-60-2	Low Level	GCMS - Ion Trap
Carbazole	50	ug/kg	86-74-8	Low Level	GCMS - Ion Trap
Chrysene	10	ug/kg	218-01-9	Low Level	GCMS - Ion Trap
Cyclohexanone	100	ug/kg	108-94-1	Low Level	GCMS - Ion Trap
Dibenz(a,h)anthracene	10	ug/kg	53-70-3	Low Level	GCMS - Ion Trap

Dibenzofuran	50	ug/kg	132-64-9	Low Level	GCMS - Ion Trap
Diethylphthalate	50	ug/kg	84-66-2	Low Level	GCMS - Ion Trap
Dimethylphthalate	50	ug/kg	131-11-3	Low Level	GCMS - Ion Trap
Di-n-butylphthalate	50	ug/kg	87-74-2	Low Level	GCMS - Ion Trap
Di-n-octylphthalate	50	ug/kg	117-84-0	Low Level	GCMS - Ion Trap
Fluoranthene	10	ug/kg	206-44-0	Low Level	GCMS - Ion Trap
Fluorene	10	ug/kg	86-73-7	Low Level	GCMS - Ion Trap
Hexachlorobenzene	50	ug/kg	118-74-1	Low Level	GCMS - Ion Trap
Hexachlorobutadiene	50	ug/kg	87-68-3	Low Level	GCMS - Ion Trap
Hexachlorocyclopentadiene	50	ug/kg	77-47-4	Low Level	GCMS - Ion Trap
Hexachloroethane	50	ug/kg	67-72-1	Low Level	GCMS - Ion Trap
Indeno(1,2,3-cd)pyrene	10	ug/kg	193-39-5	Low Level	GCMS - Ion Trap
Isophorone	50	ug/kg	78-59-1	Low Level	GCMS - Ion Trap
Naphthalene	10	ug/kg	91-20-3	Low Level	GCMS - Ion Trap
Nitrobenzene	50	ug/kg	98-95-3	Low Level	GCMS - Ion Trap
N-nitrosodimethylamine	50	ug/kg	62-75-9	Low Level	GCMS - Ion Trap
N-nitroso-di-n-propylamine	50	ug/kg	621-64-7	Low Level	GCMS - Ion Trap
N-Nitrosodiphenylamine	50	ug/kg	86-30-6	Low Level	GCMS - Ion Trap
Pentachlorophenol	50	ug/kg	87-86-5	Low Level	GCMS - Ion Trap
Phenanthrene	10	ug/kg	85-01-8	Low Level	GCMS - Ion Trap
Phenol	50	ug/kg	108-95-2	Low Level	GCMS - Ion Trap
Pyrene	10	ug/kg	129-00-0	Low Level	GCMS - Ion Trap
Pyridine	50	ug/kg	110-86-1	Low Level	GCMS - Ion Trap
Tetrachlorophenols	50	ug/kg		Low Level	GCMS - Ion Trap

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Semivolatile Organic Compounds Reporting Limits - Waters

EPA Method: SW 8270C/3510C (prep)
Matrix: Water
Container: 125 ml Amber B.R. (low volume)
Container: 1 Liter Amber B.R.
Preservative: Cool 4° C
Holding Time: 7 Days to Extract

Analyte	PQL	Units	CAS No.	Reporting Level	Instrument
1,2,4-Trichlorobenzene	0.5	ug/L	120-82-1	Low Volume	GCMS - Ion Trap
1,2-Dichlorobenzene	0.5	ug/L	95-50-1	Low Volume	GCMS - Ion Trap
1,2-Diphenylhydrazine	0.5	ug/L	122-66-7	Low Volume	GCMS - Ion Trap
1,3-Dichlorobenzene	0.5	ug/L	541-73-1	Low Volume	GCMS - Ion Trap
1,4-Dichlorobenzene	0.5	ug/L	106-46-7	Low Volume	GCMS - Ion Trap
2,4,5-Trichlorophenol	0.5	ug/L	95-95-4	Low Volume	GCMS - Ion Trap
2,4,6-Trichlorophenol	0.5	ug/L	88-06-2	Low Volume	GCMS - Ion Trap
2,4-Dichlorophenol	0.5	ug/L	120-83-2	Low Volume	GCMS - Ion Trap
2,4-Dimethylphenol	0.5	ug/L	105-67-9	Low Volume	GCMS - Ion Trap
2,4-Dinitrophenol	0.5	ug/L	51-28-5	Low Volume	GCMS - Ion Trap
2,4-Dinitrotoluene	0.5	ug/L	121-14-2	Low Volume	GCMS - Ion Trap
2,6-Dinitrotoluene	0.5	ug/L	606-20-2	Low Volume	GCMS - Ion Trap
2-Chloronaphthalene	0.1	ug/L	91-58-7	Low Volume	GCMS - Ion Trap
2-Chlorophenol	0.5	ug/L	95-57-8	Low Volume	GCMS - Ion Trap
2-Ethoxyethanol	2	ug/L		Low Volume	GCMS - Ion Trap
2-Methylnaphthalene	0.1	ug/L	91-57-6	Low Volume	GCMS - Ion Trap
2-Methylphenol	0.5	ug/L	95-48-7	Low Volume	GCMS - Ion Trap
2-Nitroaniline	0.5	ug/L	88-74-4	Low Volume	GCMS - Ion Trap
2-Nitrophenol	0.5	ug/L	88-75-5	Low Volume	GCMS - Ion Trap
2-Nitropropane	2	ug/L		Low Volume	GCMS - Ion Trap

Dibenzofuran	0.5	ug/L	132-64-9	Low Volume	GCMS - Ion Trap
Diethylphthalate	0.5	ug/L	84-66-2	Low Volume	GCMS - Ion Trap
Dimethylphthalate	0.5	ug/L	131-11-3	Low Volume	GCMS - Ion Trap
Di-n-butylphthalate	0.5	ug/L	87-74-2	Low Volume	GCMS - Ion Trap
Di-n-octylphthalate	0.5	ug/L	117-84-0	Low Volume	GCMS - Ion Trap
Fluoranthene	0.1	ug/L	206-44-0	Low Volume	GCMS - Ion Trap
Fluorene	0.1	ug/L	86-73-7	Low Volume	GCMS - Ion Trap
Hexachlorobenzene	0.5	ug/L	118-74-1	Low Volume	GCMS - Ion Trap
Hexachlorobutadiene	0.5	ug/L	87-68-3	Low Volume	GCMS - Ion Trap
Hexachlorocyclopentadiene	0.5	ug/L	77-47-4	Low Volume	GCMS - Ion Trap
Hexachloroethane	0.5	ug/L	67-72-1	Low Volume	GCMS - Ion Trap
Indeno(1,2,3-cd)pyrene	0.1	ug/L	193-39-5	Low Volume	GCMS - Ion Trap
Isophorone	0.5	ug/L	78-59-1	Low Volume	GCMS - Ion Trap
Naphthalene	0.1	ug/L	91-20-3	Low Volume	GCMS - Ion Trap
Nitrobenzene	0.5	ug/L	98-95-3	Low Volume	GCMS - Ion Trap
N-nitrosodimethylamine	0.5	ug/L	62-75-9	Low Volume	GCMS - Ion Trap
N-nitroso-di-n-propylamine	0.5	ug/L	621-64-7	Low Volume	GCMS - Ion Trap
N-Nitrosodiphenylamine	0.1	ug/L	86-30-6	Low Volume	GCMS - Ion Trap
Pentachlorophenol	0.5	ug/L	87-86-5	Low Volume	GCMS - Ion Trap
Phenanthrene	0.1	ug/L	85-01-8	Low Volume	GCMS - Ion Trap
Phenol	0.5	ug/L	108-95-2	Low Volume	GCMS - Ion Trap
Pyrene	0.1	ug/L	129-00-0	Low Volume	GCMS - Ion Trap
Pyridine	0.5	ug/L	110-86-1	Low Volume	GCMS - Ion Trap
Tetrachlorophenols	0.5	ug/L		Low Volume	GCMS - Ion Trap
1,2,4-Trichlorobenzene	0.05	ug/L	120-82-1	Low Level	GCMS - Ion Trap
1,2-Dichlorobenzene	0.05	ug/L	95-50-1	Low Level	GCMS - Ion Trap
1,2-Diphenylhydrazine	0.05	ug/L	122-66-7	Low Level	GCMS - Ion Trap
1,3-Dichlorobenzene	0.05	ug/L	541-73-1	Low Level	GCMS - Ion Trap
1,4-Dichlorobenzene	0.05	ug/L	106-46-7	Low Level	GCMS - Ion Trap
2,4,5-Trichlorophenol	0.05	ug/L	95-95-4	Low Level	GCMS - Ion Trap
2,4,6-Trichlorophenol	0.05	ug/L	88-06-2	Low Level	GCMS - Ion Trap
2,4-Dichlorophenol	0.05	ug/L	120-83-2	Low Level	GCMS - Ion Trap
2,4-Dimethylphenol	0.05	ug/L	105-67-9	Low Level	GCMS - Ion Trap
2,4-Dinitrophenol	0.05	ug/L	51-28-5	Low Level	GCMS - Ion Trap
2,4-Dinitrotoluene	0.05	ug/L	121-14-2	Low Level	GCMS - Ion Trap
2,6-Dinitrotoluene	0.05	ug/L	606-20-2	Low Level	GCMS - Ion Trap

2-Chloronaphthalene	0.01	ug/L	91-58-7	Low Level	GCMS - Ion Trap
2-Chlorophenol	0.05	ug/L	95-57-8	Low Level	GCMS - Ion Trap
2-Ethoxyethanol	0.2	ug/L		Low Level	GCMS - Ion Trap
2-Methylnaphthalene	0.01	ug/L	91-57-6	Low Level	GCMS - Ion Trap
2-Methylphenol	0.05	ug/L	95-48-7	Low Level	GCMS - Ion Trap
2-Nitroaniline	0.05	ug/L	88-74-4	Low Level	GCMS - Ion Trap
2-Nitrophenol	0.05	ug/L	88-75-5	Low Level	GCMS - Ion Trap
2-Nitropropane	0.2	ug/L		Low Level	GCMS - Ion Trap
3- & 4-Methylphenol	0.05	ug/L		Low Level	GCMS - Ion Trap
3,3'-Dichlorobenzidine	0.5	ug/L	91-94-1	Low Level	GCMS - Ion Trap
3-Nitroaniline	0.05	ug/L	99-09-2	Low Level	GCMS - Ion Trap
4,6-Dinitro-2-methylphenol	0.05	ug/L	534-52-1	Low Level	GCMS - Ion Trap
4-Bromophenylphenylether	0.05	ug/L	101-55-3	Low Level	GCMS - Ion Trap
4-Chloro-3-methylphenol	0.05	ug/L	59-50-7	Low Level	GCMS - Ion Trap
4-Chloroaniline	0.05	ug/L	106-47-8	Low Level	GCMS - Ion Trap
4-Chlorophenylphenylether	0.05	ug/L	7005-72-3	Low Level	GCMS - Ion Trap
4-Nitroaniline	0.05	ug/L	100-01-6	Low Level	GCMS - Ion Trap
4-Nitrophenol	0.05	ug/L	100-02-7	Low Level	GCMS - Ion Trap
Acenaphthene	0.01	ug/L	83-32-9	Low Level	GCMS - Ion Trap
Acenaphthylene	0.01	ug/L	208-96-8	Low Level	GCMS - Ion Trap
Aniline	0.2	ug/L	62-53-3	Low Level	GCMS - Ion Trap
Anthracene	0.01	ug/L	120-12-7	Low Level	GCMS - Ion Trap
Benzidine	0.1	ug/L	92-87-5	Low Level	GCMS - Ion Trap
Benzo(a)anthracene	0.01	ug/L	56-55-3	Low Level	GCMS - Ion Trap
Benzo(a)pyrene	0.01	ug/L	50-32-8	Low Level	GCMS - Ion Trap
Benzo(b)fluoranthene	0.01	ug/L	205-99-2	Low Level	GCMS - Ion Trap
Benzo(g,h,i)perylene	0.01	ug/L	191-24-2	Low Level	GCMS - Ion Trap
Benzo(k)fluoranthene	0.01	ug/L	207-08-9	Low Level	GCMS - Ion Trap
Benzoic Acid	0.05	ug/L	65-85-0	Low Level	GCMS - Ion Trap
Benzyl Alcohol	0.05	ug/L	100-51-6	Low Level	GCMS - Ion Trap
bis(2-Chloroethoxy)methane	0.05	ug/L	111-91-1	Low Level	GCMS - Ion Trap
bis(2-Chloroethyl)ether	0.05	ug/L	111-44-4	Low Level	GCMS - Ion Trap
bis(2-Chloroisopropyl)ether	0.05	ug/L	108-60-1	Low Level	GCMS - Ion Trap
bis(2-Ethylhexyl)phthalate	1	ug/L	117-81-7	Low Level	GCMS - Ion Trap
Butylbenzylphthalate	1	ug/L	85-68-7	Low Level	GCMS - Ion Trap
Carbazole	0.05	ug/L	86-74-8	Low Level	GCMS - Ion Trap

Chrysene	0.01	ug/L	218-01-9	Low Level	GCMS - Ion Trap
Cyclohexanone	0.2	ug/L	108-94-1	Low Level	GCMS - Ion Trap
Dibenz(a,h)anthracene	0.01	ug/L	53-70-3	Low Level	GCMS - Ion Trap
Dibenzofuran	0.05	ug/L	132-64-9	Low Level	GCMS - Ion Trap
Diethylphthalate	0.05	ug/L	84-66-2	Low Level	GCMS - Ion Trap
Dimethylphthalate	0.05	ug/L	131-11-3	Low Level	GCMS - Ion Trap
Di-n-butylphthalate	0.05	ug/L	87-74-2	Low Level	GCMS - Ion Trap
Di-n-octylphthalate	0.05	ug/L	117-84-0	Low Level	GCMS - Ion Trap
Fluoranthene	0.01	ug/L	206-44-0	Low Level	GCMS - Ion Trap
Fluorene	0.01	ug/L	86-73-7	Low Level	GCMS - Ion Trap
Hexachlorobenzene	0.05	ug/L	118-74-1	Low Level	GCMS - Ion Trap
Hexachlorobutadiene	0.05	ug/L	87-68-3	Low Level	GCMS - Ion Trap
Hexachlorocyclopentadiene	0.05	ug/L	77-47-4	Low Level	GCMS - Ion Trap
Hexachloroethane	0.05	ug/L	67-72-1	Low Level	GCMS - Ion Trap
Indeno(1,2,3-cd)pyrene	0.01	ug/L	193-39-5	Low Level	GCMS - Ion Trap
Isophorone	0.05	ug/L	78-59-1	Low Level	GCMS - Ion Trap
Naphthalene	0.01	ug/L	91-20-3	Low Level	GCMS - Ion Trap
Nitrobenzene	0.05	ug/L	98-95-3	Low Level	GCMS - Ion Trap
N-nitrosodimethylamine	0.05	ug/L	62-75-9	Low Level	GCMS - Ion Trap
N-nitroso-di-n-propylamine	0.05	ug/L	621-64-7	Low Level	GCMS - Ion Trap
N-Nitrosodiphenylamine	0.01	ug/L	86-30-6	Low Level	GCMS - Ion Trap
Pentachlorophenol	0.05	ug/L	87-86-5	Low Level	GCMS - Ion Trap
Phenanthrene	0.01	ug/L	85-01-8	Low Level	GCMS - Ion Trap
Phenol	0.05	ug/L	108-95-2	Low Level	GCMS - Ion Trap
Pyrene	0.01	ug/L	129-00-0	Low Level	GCMS - Ion Trap
Pyridine	0.05	ug/L	110-86-1	Low Level	GCMS - Ion Trap
Tetrachlorophenols	0.05	ug/L		Low Level	GCMS - Ion Trap

on/off

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Pesticides / PCBs Reporting Limits - Soils

EPA Method:	SW 8081A, 8082
Matrix:	Soil
Prep Method:	3550B
Container:	4 oz. Soil Jar
Preservative:	Cool 4 degrees C
Holding Time:	14 Days to Extract

Analyte	EPA Method	PQL	Units	CAS No.	Reporting Level	Instrument
4,4'-DDD	SW8081A	2	ug/kg	72-54-8	Standard	GC/ECD
4,4'-DDE	SW8081A	2	ug/kg	72-55-9	Standard	GC/ECD
4,4'-DDT	SW8081A	2	ug/kg	50-29-3	Standard	GC/ECD
Aldrin	SW8081A	1	ug/kg	309-00-2	Standard	GC/ECD
alpha-BHC	SW8081A	1	ug/kg	319-84-6	Standard	GC/ECD
beta-BHC	SW8081A	1	ug/kg	319-84-6	Standard	GC/ECD
Chlordane (technical)	SW8081A	10	ug/kg	57-74-9	Standard	GC/ECD
delta-BHC	SW8081A	1	ug/kg	319-86-8	Standard	GC/ECD
Dieldrin	SW8081A	2	ug/kg	60-57-1	Standard	GC/ECD
Endosulfan I	SW8081A	1	ug/kg	959-98-8	Standard	GC/ECD
Endosulfan II	SW8081A	2	ug/kg	33213-65-9	Standard	GC/ECD
Endosulfan sulfate	SW8081A	2	ug/kg	1031-07-8	Standard	GC/ECD
Endrin	SW8081A	2	ug/kg	72-20-8	Standard	GC/ECD
Endrin aldehyde	SW8081A	2	ug/kg	7421-93-4	Standard	GC/ECD
Endrin ketone	SW8081A	2	ug/kg	53494-70-5	Standard	GC/ECD
gamma-BHC (Lindane)	SW8081A	1	ug/kg	58-89-9	Standard	GC/ECD
Heptachlor	SW8081A	1	ug/kg	76-74-8	Standard	GC/ECD
Heptachlor epoxide	SW8081A	1	ug/kg	76-44-8	Standard	GC/ECD
Methoxychlor	SW8081A	10	ug/kg	72-43-5	Standard	GC/ECD
Toxaphene	SW8081A	100	ug/kg	8001-35-2	Standard	GC/ECD

Aroclor 1016	SW8082	10	ug/kg	12674-11-2	Standard	GC/ECD
Aroclor 1221	SW8082	20	ug/kg	11104-28-2	Standard	GC/ECD
Aroclor 1232	SW8082	10	ug/kg	11141-16-5	Standard	GC/ECD
Aroclor 1242	SW8082	10	ug/kg	53469-21-9	Standard	GC/ECD
Aroclor 1248	SW8082	10	ug/kg	12672-29-6	Standard	GC/ECD
Aroclor 1254	SW8082	10	ug/kg	11097-69-1	Standard	GC/ECD
Aroclor 1260	SW8082	10	ug/kg	11096-82-5	Standard	GC/ECD

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Pesticides / PCBs Reporting Limits - Waters

EPA Method: SW 8081A , 8082
Matrix: Water
Container: 125 ml Amber B.R. (low volume)
Container: 1 Liter Amber B.R.
Preservative: Cool 4° C
Holding Time: 7 Days to Extract
Prep Method: 3510C

Analyte	EPA Method	PQL	Units	CAS No.	Reporting Level	Instrument
4,4'-DDD	SW8081A	0.02	ug/L	72-54-8	Standard	GC/ECD
4,4'-DDE	SW8081A	0.02	ug/L	72-55-9	Standard	GC/ECD
4,4'-DDT	SW8081A	0.02	ug/L	50-29-3	Standard	GC/ECD
Aldrin	SW8081A	0.01	ug/L	309-00-2	Standard	GC/ECD
alpha-BHC	SW8081A	0.01	ug/L	319-84-6	Standard	GC/ECD
beta-BHC	SW8081A	0.01	ug/L	319-84-6	Standard	GC/ECD
Chlordane (technical)	SW8081A	0.1	ug/L	57-74-9	Standard	GC/ECD
delta-BHC	SW8081A	0.01	ug/L	319-86-8	Standard	GC/ECD
Dieldrin	SW8081A	0.02	ug/L	60-57-1	Standard	GC/ECD
Endosulfan I	SW8081A	0.01	ug/L	959-98-8	Standard	GC/ECD
Endosulfan II	SW8081A	0.02	ug/L	33213-65-9	Standard	GC/ECD
Endosulfan sulfate	SW8081A	0.02	ug/L	1031-07-8	Standard	GC/ECD
Endrin	SW8081A	0.02	ug/L	72-20-8	Standard	GC/ECD
Endrin aldehyde	SW8081A	0.02	ug/L	7421-93-4	Standard	GC/ECD
Endrin ketone	SW8081A	0.02	ug/L	53494-70-5	Standard	GC/ECD
gamma-BHC (Lindane)	SW8081A	0.01	ug/L	58-89-9	Standard	GC/ECD
Heptachlor	SW8081A	0.01	ug/L	76-74-8	Standard	GC/ECD
Heptachlor epoxide	SW8081A	0.01	ug/L	76-44-8	Standard	GC/ECD
Methoxychlor	SW8081A	0.1	ug/L	72-43-5	Standard	GC/ECD
Toxaphene	SW8081A	1	ug/L	8001-35-2	Standard	GC/ECD

Aroclor 1016	SW8082	0.1	ug/L	12674-11-2	Standard	GC/ECD
Aroclor 1221	SW8082	0.2	ug/L	11104-28-2	Standard	GC/ECD
Aroclor 1232	SW8082	0.1	ug/L	11141-16-5	Standard	GC/ECD
Aroclor 1242	SW8082	0.1	ug/L	53469-21-9	Standard	GC/ECD
Aroclor 1248	SW8082	0.1	ug/L	12672-29-6	Standard	GC/ECD
Aroclor 1254	SW8082	0.1	ug/L	11097-69-1	Standard	GC/ECD
Aroclor 1260	SW8082	0.1	ug/L	11096-82-5	Standard	GC/ECD

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Metals Reporting Limits - Soil

EPA Method: Various, 3051 (preparation)
Matrix: Soil
Container: 4 oz. Soil Jar
Preservative: Cool 4o C
Holding Time: 6 Months
Holding Time: Mercury 28 Days

Analyte	EPA Method	PQL	Units	CAS No.	Reporting Level	Instrument
Aluminum	SW6010B	40	mg/kg	742-99-05	Standard	ICP - Leeman
Antimony	SW6010B	100	mg/kg	7440-36-0	Standard	ICP - Leeman
Arsenic	SW6010B	40	mg/kg	7440-38-2	Standard	ICP - Leeman
Barium	SW6010B	1	mg/kg	7440-39-3	Standard	ICP - Leeman
Beryllium	SW6010B	0.4	mg/kg	7440-41-7	Standard	ICP - Leeman
Boron	SW6010B	100	mg/kg	7440-42-8	Standard	ICP - Leeman
Cadmium	SW6010B	4	mg/kg	7440-43-9	Standard	ICP - Leeman
Calcium	SW6010B	100	mg/kg	7440-70-2	Standard	ICP - Leeman
Chromium	SW6010B	2	mg/kg	7440-47-3	Standard	ICP - Leeman
Cobalt	SW6010B	2	mg/kg	7440-48-4	Standard	ICP - Leeman
Copper	SW6010B	4	mg/kg	7440-50-8	Standard	ICP - Leeman
Iron	SW6010B	20	mg/kg	7439-89-6	Standard	ICP - Leeman
Lead	SW6010B	20	mg/kg	7439-92-1	Standard	ICP - Leeman
Magnesium	SW6010B	100	mg/kg	7439-95-4	Standard	ICP - Leeman
Manganese	SW6010B	3	mg/kg	7439-96-5	Standard	ICP - Leeman
Molybdenum	SW6010B	10	mg/kg	7439-98-7	Standard	ICP - Leeman
Nickel	SW6010B	8	mg/kg	7440-02-0	Standard	ICP - Leeman
Phosphorus	SW6010B	1000	mg/kg	7723-14-0	Standard	ICP - Leeman
Potassium	SW6010B	200	mg/kg	7440-09-7	Standard	ICP - Leeman
Selenium	SW6010B	80	mg/kg	7782-49-2	Standard	ICP - Leeman
Silicon	SW6010B	10	mg/kg	7440-21-3	Standard	ICP - Leeman

Silver	SW6010B	10	mg/kg	7440-22-4	Standard	ICP - Leeman
Sodium	SW6010B	200	mg/kg	7440-23-5	Standard	ICP - Leeman
Strontium	SW6010B	10	mg/kg	7440-24-6	Standard	ICP - Leeman
Thallium	SW6010B	100	mg/kg	7440-30-4	Standard	ICP - Leeman
Tin	SW6010B	100	mg/kg	7440-31-5	Standard	ICP - Leeman
Titanium	SW6010B	10	mg/kg	7440-32-6	Standard	ICP - Leeman
Vanadium	SW6010B	10	mg/kg	7440-62-2	Standard	ICP - Leeman
Zinc	SW6010B	4	mg/kg	7440-66-6	Standard	ICP - Leeman
Aluminum	SW6020	5	mg/kg	742-99-05	Low Level	ICPMS - PE ELAN 6100
Antimony	SW6020	3	mg/kg	7440-36-0	Low Level	ICPMS - PE ELAN 6100
Arsenic	SW6020	1	mg/kg	7440-38-2	Low Level	ICPMS - PE ELAN 6100
Barium	SW6020	1	mg/kg	7440-39-3	Low Level	ICPMS - PE ELAN 6100
Beryllium	SW6020	0.5	mg/kg	7440-41-7	Low Level	ICPMS - PE ELAN 6100
Boron	SW6020	5	mg/kg	7440-42-8	Low Level	ICPMS - PE ELAN 6100
Cadmium	SW6020	0.5	mg/kg	7440-43-9	Low Level	ICPMS - PE ELAN 6100
Chromium	SW6020	1	mg/kg	7440-47-3	Low Level	ICPMS - PE ELAN 6100
Cobalt	SW6020	0.5	mg/kg	7440-48-4	Low Level	ICPMS - PE ELAN 6100
Copper	SW6020	1	mg/kg	7440-50-8	Low Level	ICPMS - PE ELAN 6100
Lead	SW6020	0.5	mg/kg	7439-92-1	Low Level	ICPMS - PE ELAN 6100
Manganese	SW6020	0.5	mg/kg	7439-96-5	Low Level	ICPMS - PE ELAN 6100
Molybdenum	SW6020	1	mg/kg	7439-98-7	Low Level	ICPMS - PE ELAN 6100
Nickel	SW6020	1	mg/kg	7440-02-0	Low Level	ICPMS - PE ELAN 6100
Selenium	SW6020	3	mg/kg	7782-49-2	Low Level	ICPMS - PE ELAN 6100
Silver	SW6020	0.5	mg/kg	7440-22-4	Low Level	ICPMS - PE ELAN 6100
Strontium	SW6020	0.5	mg/kg	7440-24-6	Low Level	ICPMS - PE ELAN 6100
Thallium	SW6020	0.5	mg/kg	7440-30-4	Low Level	ICPMS - PE ELAN 6100
Tin	SW6020	2	mg/kg	7440-31-5	Low Level	ICPMS - PE ELAN 6100
Titanium	SW6020	1	mg/kg	7440-32-6	Low Level	ICPMS - PE ELAN 6100
Uranium	SW6020	0.1	mg/kg	7440-32-6	Low Level	ICPMS - PE ELAN 6100
Vanadium	SW6020	1	mg/kg	7440-62-2	Low Level	ICPMS - PE ELAN 6100
Zinc	SW6020	4	mg/kg	7440-66-6	Low Level	ICPMS - PE ELAN 6100
Mercury	SW7471	0.1	mg/kg	7439-97-6	Standard	CVAA - Leeman PS200

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Metals Reporting Limits - Waters

EPA Method: Various, 3010A (Prep)
Matrix: Water
Container: 250 ml HDPE
Preservative: HNO3 - pH<2
Holding Time: 6 Months
Holding Time: Mercury, 28 Days

Analyte	EPA Method	PQL	Units	CAS No.	Reporting Level	Instrument
Aluminum	SW6010B	0.20	mg/L	742-99-05	Standard	ICP - Leeman
Antimony	SW6010B	0.50	mg/L	7440-36-0	Standard	ICP - Leeman
Arsenic	SW6010B	0.20	mg/L	7440-38-2	Standard	ICP - Leeman
Barium	SW6010B	0.005	mg/L	7440-39-3	Standard	ICP - Leeman
Beryllium	SW6010B	0.002	mg/L	7440-41-7	Standard	ICP - Leeman
Boron	SW6010B	0.50	mg/L	7440-42-8	Standard	ICP - Leeman
Cadmium	SW6010B	0.02	mg/L	7440-43-9	Standard	ICP - Leeman
Calcium	SW6010B	0.50	mg/L	7440-70-2	Standard	ICP - Leeman
Chromium	SW6010B	0.01	mg/L	7440-47-3	Standard	ICP - Leeman
Cobalt	SW6010B	0.01	mg/L	7440-48-4	Standard	ICP - Leeman
Copper	SW6010B	0.02	mg/L	7440-50-8	Standard	ICP - Leeman
Iron	SW6010B	0.1	mg/L	7439-89-6	Standard	ICP - Leeman
Lead	SW6010B	0.10	mg/L	7439-92-1	Standard	ICP - Leeman
Magnesium	SW6010B	0.50	mg/L	7439-95-4	Standard	ICP - Leeman
Manganese	SW6010B	0.015	mg/L	7439-96-5	Standard	ICP - Leeman
Molybdenum	SW6010B	0.05	mg/L	7439-98-7	Standard	ICP - Leeman
Nickel	SW6010B	0.04	mg/L	7440-02-0	Standard	ICP - Leeman
Phosphorus	SW6010B	5.0	mg/L	7723-14-0	Standard	ICP - Leeman
Potassium	SW6010B	1.0	mg/L	7440-09-7	Standard	ICP - Leeman
Selenium	SW6010B	0.40	mg/L	7782-49-2	Standard	ICP - Leeman
Silicon	SW6010B	0.05	mg/L	7440-21-3	Standard	ICP - Leeman

Silver	SW6010B	0.05	mg/L	7440-22-4	Standard	ICP - Leeman
Sodium	SW6010B	1.0	mg/L	7440-23-5	Standard	ICP - Leeman
Strontium	SW6010B	0.05	mg/L	7440-24-6	Standard	ICP - Leeman
Thallium	SW6010B	0.50	mg/L	7440-30-4	Standard	ICP - Leeman
Tin	SW6010B	0.50	mg/L	7440-31-5	Standard	ICP - Leeman
Titanium	SW6010B	0.05	mg/L	7440-32-6	Standard	ICP - Leeman
Vanadium	SW6010B	0.05	mg/L	7440-62-2	Standard	ICP - Leeman
Zinc	SW6010B	0.02	mg/L	7440-66-6	Standard	ICP - Leeman
Aluminum	SW6020	0.005	mg/L	742-99-05	Low Level	ICPMS - PE ELAN 6100
Antimony	SW6020	0.003	mg/L	7440-36-0	Low Level	ICPMS - PE ELAN 6100
Arsenic	SW6020	0.001	mg/L	7440-38-2	Low Level	ICPMS - PE ELAN 6100
Barium	SW6020	0.001	mg/L	7440-39-3	Low Level	ICPMS - PE ELAN 6100
Beryllium	SW6020	0.0005	mg/L	7440-41-7	Low Level	ICPMS - PE ELAN 6100
Boron	SW6020	0.005	mg/L	7440-42-8	Low Level	ICPMS - PE ELAN 6100
Cadmium	SW6020	0.0005	mg/L	7440-43-9	Low Level	ICPMS - PE ELAN 6100
Chromium	SW6020	0.001	mg/L	7440-47-3	Low Level	ICPMS - PE ELAN 6100
Cobalt	SW6020	0.0005	mg/L	7440-48-4	Low Level	ICPMS - PE ELAN 6100
Copper	SW6020	0.001	mg/L	7440-50-8	Low Level	ICPMS - PE ELAN 6100
Lead	SW6020	0.0005	mg/L	7439-92-1	Low Level	ICPMS - PE ELAN 6100
Manganese	SW6020	0.0005	mg/L	7439-96-5	Low Level	ICPMS - PE ELAN 6100
Molybdenum	SW6020	0.001	mg/L	7439-98-7	Low Level	ICPMS - PE ELAN 6100
Nickel	SW6020	0.001	mg/L	7440-02-0	Low Level	ICPMS - PE ELAN 6100
Selenium	SW6020	0.003	mg/L	7782-49-2	Low Level	ICPMS - PE ELAN 6100
Silver	SW6020	0.0005	mg/L	7440-22-4	Low Level	ICPMS - PE ELAN 6100
Strontium	SW6020	0.0005	mg/L	7440-24-6	Low Level	ICPMS - PE ELAN 6100
Thallium	SW6020	0.0005	mg/L	7440-30-4	Low Level	ICPMS - PE ELAN 6100
Tin	SW6020	0.002	mg/L	7440-31-5	Low Level	ICPMS - PE ELAN 6100
Titanium	SW6020	0.001	mg/L	7440-32-6	Low Level	ICPMS - PE ELAN 6100
Uranium	SW6020	0.1	mg/L	7440-32-6	Low Level	ICPMS - PE ELAN 6100
Vanadium	SW6020	0.001	mg/L	7440-62-2	Low Level	ICPMS - PE ELAN 6100
Zinc	SW6020	0.004	mg/L	7440-66-6	Low Level	ICPMS - PE ELAN 6100
Mercury	SW7470	0.0002	mg/L	7439-97-6	Standard	CVAA - Leeman PS200

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Explosives Reporting Limits - Soils

EPA Method: SW 8330
Matrix: soil
MDL Update: 9/10/99
Container: 4 oz. Soil Jar
Preservative: Cool 4° C
Holding Time: 14 Days to Extract

Analyte	PQL	Units	CAS No.	Reporting Level	Instrument
1,3,5-Trinitrobenzene	0.05	mg/kg	99-35-4	Standard	HPLC
1,3-Dinitrobenzene	0.05	mg/kg	99-65-0	Standard	HPLC
2,4,6-Trinitrotoluene	0.05	mg/kg	118-96-7	Standard	HPLC
2,4-Dinitrotoluene	0.05	mg/kg	121-14-2	Standard	HPLC
2,6-Dinitrotoluene	0.05	mg/kg	606-20-2	Standard	HPLC
2-Aminodinitrotoluene	0.05	mg/kg	355-72-78-2	Standard	HPLC
2-Nitrotoluene	0.1	mg/kg	88-72-2	Standard	HPLC
3-Nitrotoluene	0.1	mg/kg	99-08-1	Standard	HPLC
4-Aminodinitrotoluene	0.05	mg/kg	1946-51-0	Standard	HPLC
4-Nitrotoluene	0.1	mg/kg	99-99-0	Standard	HPLC
HMX	0.05	mg/kg	2691-41-0	Standard	HPLC
Nitrobenzene	0.05	mg/kg	98-95-3	Standard	HPLC
RDX	0.05	mg/kg	122-82-2	Standard	HPLC
Tetryl	0.05	mg/kg	479-45-8	Standard	HPLC

Reporting Limits Table

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General Chemistry Parameters

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Analyte	Method #	Matrix	PQL	Units	Container	Preservative	Holding Time	CAS No.
Cyanide, total	SW9012A	water	0.01	mg/L	1 liter HDPE	Cool 4° C	14 Days	57-12-5
Cyanide, total	SW9012A/9013 (prep)	soil	1	mg/kg	4 oz. Soil Jar	Cool 4° C	14 Days	57-12-5

on/off

Home

Fuels Reporting Limits - Soils

EPA Method: Various
Matrix: Soil
Container: 4 oz. Soil Jar
Preservative: Cool 4° C (AK101 / 8260B BTEX - Methanol)
Holding Time: 14 Days

Analyte	EPA Method	PQL	Units	CAS No.	Reporting Level	Instrument
Diesel (>nC12-nC24)	NWTPH-Dx	25	mg/kg	68334-30-5	Standard	GC/FID
Motor Oil (C24-C36)	NWTPH-Dx	50	mg/kg		Standard	GC/FID

APPENDIX D

USACE Certification of Sound Analytical Services

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
HTRW CENTER OF EXPERTISE
12565 WEST CENTER ROAD
OMAHA, NEBRASKA 68144-3869

REPLY TO
ATTENTION OF

December 1, 1999

Hazardous, Toxic and Radioactive Waste
Center of Expertise

Sound Analytical Services, Inc.
4813 Pacific Highway East
Tacoma, WA 98424

Gentlemen:

This correspondence addresses the recent evaluation of Sound Analytical Services, Inc. of Tacoma, WA by the U.S. Army Corps of Engineers (USACE) for chemical analysis in support of the USACE Hazardous, Toxic and Radioactive Waste Program.

Your laboratory is now validated for the parameters listed below:

METHOD	PARAMETERS	MATRIX[1]
300 series	Anions[4]	Water[2]
8021B	Aromatic Volatile Organics	Water[2]
8021B	Aromatic Volatile Organics	Solids
9010B/9012A	Cyanide	Water[2]
9013	Cyanide	Solids
8330	Explosives	Water[2]
8330	Explosives	Solids[2]
8151A	Herbicides	Water[2]
8151A	Herbicides	Solids
8081A	Organochlorine Pesticides	Water[2]
8081A	Organochlorine Pesticides	Solids
8082	Polychlorinated Biphenyls	Water[2]
8082	Polychlorinated Biphenyls	Solids[2]
8310	Polynuclear Aromatic Hydrocarbons	Water[2]
8310	Polynuclear Aromatic Hydrocarbons	Solids
8270C	Semivolatile Organics	Water[2]
8270C	Semivolatile Organics	Solids[2]
6020	TAL Metals[6]	Water[2]
6020	TAL Metals[6]	Solids[2]
SW-846	TAL Metals[3]	Water[2]
SW-846	TAL Metals[3]	Solids[2]
9060	Total Organic Carbon	Water[2]
Mod 8015	TPH - GRO/DRO/RRO[5]	Water
Mod 8015	TPH - GRO/DRO/RRO[5]	Solids
8021B	Volatile Organics	Water[2]
8021B	Volatile Organics	Solids
8260B	Volatile Organics	Water[2]
8260B	Volatile Organics	Solids

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Remarks:

1) 'Solids' includes soils, sediments, and solid waste.

2) The laboratory has successfully analyzed a performance evaluation sample for this method/matrix.

3) TAL Metals: Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

4) Anions: Chloride, fluoride, sulfate, nitrate, nitrite, ortho-phosphate.

5) Approval for this parameter is based on review of SOPs only.

6) TAL metals less mercury.

Enclosed for your information is a copy of the Laboratory Inspection and Evaluation Report. Your laboratory has responded to the deficiencies as noted in the report. No further responses are necessary.

Based on the successful analysis of the performance evaluation samples and the results of the laboratory inspection, your laboratory will be validated for sample analysis by the methods listed above. The period of validation is 24 months and expires on September 10, 2001.

The USACE reserves the right to conduct additional laboratory inspections or to suspend validation status for any or all of the listed parameters if deemed necessary. It should be noted that your laboratory may not subcontract USACE analytical work to any other laboratory location without the approval of this office. This laboratory validation does not guarantee the delivery of any analytical samples from a USACE Contracting Officer Representative.

Any questions or comments can be directed to Richard Kissinger at (402) 697-2569. General questions regarding laboratory validation may be directed to the Laboratory Validation Coordinator at (402) 697-2574.

Sincerely,

for Marcia C. Davies, Ph.D.
Director, USACE Hazardous,
Toxic and Radioactive Waste
Center of Expertise

Enclosure

APPENDIX E

Electronic Data Deliverables

Electronic Data Deliverables

The left column contains the column headings. The spreadsheet column headings should look just like the left column. The right column contains a brief description of the type of information that should go into the columns. The laboratory electronic file should be a text file (comma or tab delimited).

Site	Site name or project name
Location	Site location
LabName	Lab name
SDG	SDG
SampleID	Client sample ID
QAQCType	QAQC type like MS, duplicate, or blank
Matrix	Sample matrix
LabSampleID	Laboratory sample ID
RunNumber	Run number
ExtractMethod	Extraction method
AnalysisMethod	Analysis method number (i.e., EPA number)
Filter	This field is yes or no and only for water samples
DateSampled	Date Sampled
DateReceived	Date laboratory received the samples
DateExtracted	Date extracted
DateAnalyzed	Date analyzed
PercentSolids	Percent solids
PercentMoisture	Percent moisture (can fill out either the solids or the moisture column)
CAS	CAS number
Analyte	Analyte name
Result	Result (no text)
LabQual	Laboratory qualifier
ReportLimit	Reporting Limit
Units	Units
Dilution	Dilution
Surrogate	yes or no
Basis	dry or wet
SpikeAmount	Spike concentration for MS, LCS or surrogates
Recovery	spike percent recovery for MS, LCS, or surrogates
RPD	Relative percent difference for dups or MS/MSDs
LowerLimit	Lower control limit for MS, LCS, or surrogates
UpperLimit	Upper control limit for MS, LCS, or surrogates
RPDlimit	RPD control limits for dups or MS/MSDs
MethodDesc	Name of the analytical method

CONTENTS

WORK PLAN

SAMPLING AND ANALYSIS PLAN

Part I - Field Sampling Plan
Part II - Quality Assurance Project Plan

INVESTIGATION - DERIVED WASTE PLAN

HEALTH AND SAFETY PLAN

F I N A L

WORK PLAN

SITE INVESTIGATION
Former North Pacific Division Laboratory
Troutdale, Oregon

Prepared for

U.S. Army Corps of Engineers
Seattle District
4735 East Marginal Way South
Seattle, Washington 98134-2835

August 2001

URS
1501 4th Avenue, Suite 1400
Seattle, Washington 98101-1616
(206) 438-2700
53F0074212

FINAL

INVESTIGATION-DERIVED WASTE PLAN

SITE INVESTIGATION
Former North Pacific Division Laboratory
Troutdale, Oregon

Prepared for

U.S. Army Corps of Engineers
Seattle District
4735 East Marginal Way South
Seattle, Washington 98134-2835

August 2001

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1501 4th Avenue, Suite 1400
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(206) 438-2700
53F0074212

FINAL

HEALTH AND SAFETY PLAN

SITE INVESTIGATION
Former North Pacific Division Laboratory
Troutdale, Oregon

Prepared for

U.S. Army Corps of Engineers
Seattle District
4735 East Marginal Way South
Seattle, Washington 98134-2835

August 2001

URS
1501 4th Avenue, Suite 1400
Seattle, Washington 98101-1616
(206) 438-2700
53F0074212

Project Number: 53-F0074212

Project Manager: Janette Rau

Site Manager: Janette Rau

Site Safety Officer: Janette Rau

Plan Preparer: Heather Boge

Preparation Date: 07/05/01

Start Date: August 2001

Project Duration: 2 to 3 weeks

APPROVALS

Plan Preparer:

Heather Boge 8/28/01

Heather Boge (DATE)

Health and Safety Representative:

Sharon Quiring 8/28/01

Sharon Quiring, CIH (DATE)

Project Manager:

8/27/01

Janette Rau (DATE)

This Health and Safety Plan is valid only for this specific project as described in Section 2. It is not to be used for other projects or subsequent phases of this project without the written approval of the Regional Health and Safety Manager. **A copy of this plan is to be maintained at the site at all times.**

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C Safety Plan Compliance Agreement and Medical Emergency Contact Sheet
D Material Safety Data Sheets
E Calibration/Site Safety Briefing

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ABBREVIATIONS AND ACRONYMS

ANSI	American National Standards Institute
bgs	below ground surface
CFR	Code of Federal Regulations
CGI/O_2	combustible gas indicator/oxygen
CRZ	contamination reduction zone
dBA	decibels A-weighted
DERA	Designated Emergency Response Authority
ESLI	end-of-service-life indicator
eV	electron volts
EZ	exclusion zone
°F	degrees Fahrenheit
HEPA	high-efficiency particulate air
HSP	health and safety plan
IDW	investigation-derived waste
LEL	lower explosive limit
mm Hg	millimeters mercury
MSDS	Material Safety Data Sheet
NIOSH	National Institute for Occupational Safety and Health
OBZ	operator's breathing zone
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEL	permissible exposure limit
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
RHSM	Regional Health and Safety Manager
SMS	Safety Management Standard
SSO	Site Safety Officer
SSR	Subcontractor's Safety Representative
SZ	support zone
TPH	total petroleum hydrocarbons
TSP	trisodium phosphate
URS	URS Corporation and subsidiaries
UST	underground storage tank

1.0 PLAN-AT-A-GLANCE SUMMARY

THIS SUMMARY IS PROVIDED AS A QUICK-REFERENCE/OVERVIEW ONLY. THE REMAINDER OF THIS SITE-SPECIFIC HEALTH AND SAFETY PLAN (HSP) IS INTEGRAL TO THE SAFE CONDUCT OF SITE OPERATIONS AND MUST BE APPLIED IN ITS ENTIRETY.

1.1 EMERGENCY INFORMATION

Ambulance/Fire/Police – 911
Hospital – (503) 257-5500
Project Manager/Site Safety Officer: Janette Rau – (206) 438-2283
Field Support: Andrew Zabel – (206) 438-2374
HSP Preparer: Heather Boge – (206) 438-2034
Regional Health and Safety Manager (RHSM): Tim Reinhardt – (206) 438-2286
Alternates: Sharon Quiring – (206) 438-2277 and Mark Litzinger – (206) 438-2199
National Response Center – (800) 424-8802

Hospital Directions:

To reach the hospital from the site, travel west on I-84 to Exit 13; left onto NE 181st Avenue; right onto NE Halsey Street; right onto NE Weidler Street; right onto NE 102nd Avenue (10 miles, 22 minutes).

Additional information concerning emergency procedures is located in Section 12 and the hospital route map is located in Appendix A. A copy of the hospital route map must be readily available in each site vehicle that may be used to transport accident victims to the hospital.

1.2 CONSTITUENTS OF CONCERN

- Metals
- Total petroleum hydrocarbons (TPH)
- Polychlorinated biphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs)

Additional information regarding site history, constituents of concern, and scope of work activities is located in Sections 2 and 5.

1.3 PROJECT HAZARD ANALYSIS

The results of the project hazard analysis are presented in Table 1-1.

Table 1-1
Project Hazard Analysis

Task	Chem. Hzds.	Heat Stress	Noise	Slip/Trip/ Fall	Lifting Hzds.	Mech'l. Hzds.	Electro-cution	Explo-sion	Excav-ation
1. Remove blackberry thickets if removed by gas-powered tool	N/A	High	High	High	Low	High	Low	High	N/A
2. Collect soil samples and install wells with Geoprobe®	High	High	High	High	Low	High	High	High	N/A
3. Collect groundwater and sediment samples	High	High	N/A	High	Med	Low	Low	N/A	N/A
4. Excavate trenches with backhoe and collect soil samples	High	High	High	High	Low	High	Low	Low	High
5. Drum (containing concrete) removal	Low	High	High	Low	N/A	High	Low	Low	N/A

Notes:
High – exposure likely more than 50% of the time
Med – exposure likely 10-50% of the time
Low – exposure likely less than 10% of the time
N/A – exposure not anticipated

Additional information concerning project hazards and their control can be found in Section 5.

1.4 PROTECTIVE CLOTHING

The minimum requirements for protective clothing for the tasks listed in Table 1-1 are summarized in Table 1-2.

Table 1-2
Minimum Protective Clothing/Equipment Requirements

Task	Requirements
1, 5	Steel-toed boots, hard hat, safety glasses, hearing protection, work gloves.
2, 4	Steel-toed boots, hard hat, traffic vest, safety glasses, hearing protection, work gloves, nitrile gloves when handling potentially contaminated materials, surgical nitriles for handling samples.
3	Steel-toed boots, safety glasses, nitrile gloves when handling potentially contaminated materials, surgical nitriles for handling samples.

1.4.1 First Action Level

Chemical-protective clothing will consist of the following:

- Outer coveralls: Kleenguard® or Tyvek®; substitute poly-coated Tyvek® if there is a potential for contact with liquids (groundwater, mud, etc.)
- Outer gloves: nitrile
- Inner Gloves: surgical nitriles
- Chemical-protective steel-toed boots or chemical-resistant boot covers over steel-toed boots

1.4.2 Second Action Level

Add half-face respirators with organic vapor cartridges. Notify Regional Health and Safety Manager (RHSM).

1.4.3 Third Action Level

Replace half-face respirators with full-face respirators with organic vapor cartridges.

The Health and Safety Plan preparer has conducted a hazard assessment for this project based upon information provided by the Project Manager, in accordance with 29 Code of Federal Regulations (CFR) 1910.132(d). For more information on personal protective equipment and respiratory protection requirements, see Tables 1-3 and 1-4 and Section 7.

Table 1-3
Action Levels for the Photoionization Detector

Analyzer Reading[a]	Location	Duration	Action	Personal Protective Equipment
<(5) ppm	Point of operations/release source point	—	Continued periodic monitoring.	Minimum site ensemble.
<(5) ppm	OBZ	—	No respirators required.	As for First Action Level.
>5 to 10 ppm First Action Level	Point of operations/release source point	> 1 minute	Monitor OBZ; don protective clothing.	Minimum site ensemble, plus chemical-resistant boot covers or steel-toed boots, Tyvek coveralls[b], nitrile outer gloves, and nitrile inner (surgical) gloves
>10 to 15 ppm Second Action Level	OBZ	> 1 minute	Provide respiratory protection; establish work zones as described in Section 9. Contact the RHSM to perform personal monitoring as described in Section 6.	Add half-face respirators with organic vapor cartridges.
>15 to 25 ppm Third Action Level	OBZ	>1 minute	Increase respiratory protection.	Replace half-face respirators with full-face respirators with organic vapor cartridges.
>(25) ppm OR >(50) ppm Fourth Action Level	OBZ OBZ	>1 minute instantaneous	Stop work; move upwind while vapors dissipate. If elevated levels remain, cover boring and cuttings, evacuate upwind and notify RHSM or Project Manager.	As specified by RHSM.

[a]Above background readings
[b]Substitute poly-coated Tyvek® if there is potential for contact with liquids (groundwater, mud, etc).

Notes:
OBZ - operator's breathing zone
RHSM - Regional Health and Safety Manager

Table 1-4
Action Levels for the Combustible Gas Indicator

LEL Reading	Location	Action
<10% LEL First Action Level	Point of operations/ general work area	Continue site operations and continue periodic monitoring
10-20% LEL Second Action Level	Point of operations/ general work area	Continue site operations and perform continuous monitoring
>20% LEL Third Action Level	Point of operations/ general work area	Shut down operations, evaluate source, ventilate work area

Note:
LEL - lower explosive limit

For additional information on Action Levels and their implementation, see Sections 6 and 7.

1.5 ENGINEERING CONTROLS

The following engineering controls will be used as applicable:

- Water spray for dust suppression
- Natural wind forces to reduce exposure to airborne contaminants
- Forced air ventilation (fans) to reduce potential airborne exposures
- Light-colored personal protective equipment (PPE) to reduce solar load for heat stress control
- Dining canopy to provide shaded work/rest area for heat stress control

For more information, see Section 5.

1.6 INSTRUMENTATION

The following instrumentation will be used:

_____ HNu PID w/ __ eV probe
_____ OVM PID w/ __ eV lamp
__X__ Photovac Microtip photoionization detector (PID) w/ 10.6eV lamp
_____ MiniRAE PID w/ ___ eV lamp
__X__ Combustible Gas/O_2 Indicator

_____ Foxboro OVA (FID)
_____ Miniram Real-time Dust Monitor

For more information, see Section 6.

1.7 PERSONAL EXPOSURE SAMPLING

The following personal exposure sampling will be conducted:

_____ Will be conducted

_____ Will be conducted if PID readings require the use of respiratory protection as described in Tables 1-3 and 1-4 and in Section 6.

__X__ Is not anticipated

For more information on monitoring, see Section 6.

1.8 HAZ-COM MATERIALS INVENTORY

The following materials will be used on site:

- Alconox (decontamination) or trisodium phosphate (TSP)
- Gasoline (equipment fuel)
- Hexane (decontamination)
- Hydrochloric acid (sample preservative)
- Isobutylene (calibration gas)
- Methane (calibration gas)
- Methanol (decontamination)
- Nitric acid (sample preservative)
- Sodium hydroxide (sample preservative)
- Water quality solutions

1.9 HEALTH AND SAFETY EQUIPMENT LIST

✓	URS Safety Management Standards (relevant to project – see Table 1-5)
	Occupational Safety and Health Administration (OSHA) "Safety on the Job" Posters
✓	Hardhats
✓	Safety glasses
✓	Ear plugs or muffs
	Cotton coveralls
✓	Traffic safety vest
✓	Tyvek® coveralls
	Polycoated Tyvek® Q-23 coveralls
✓	Steel-toed boots
	Chemical-resistant steel-toed boots or chemical-resistant boot covers
✓	Work gloves
✓	Nitrile outer gloves
✓	Surgical nitrile inner gloves
✓	Plastic sheeting (visqueen)
	55-gallon 17-H drums (for contaminated solids)
	55-gallon 17-E drums (for liquids)
	Drum liners
✓	Barricade tape and barricades
✓	Wash tubs and scrub brushes
✓	Decontamination solution (e.g., trisodium phosphate [TSP])
	Folding chairs
	5- or 10-gallon portable eyewash (American National Standards Institute [ANSI]-approved)
✓	Portable sterile eyewash bottles (American National Standards Institute [ANSI]-approved)
	Respirator sanitizing equipment
✓	First aid kit
✓	Infection control kit
✓	Drinking water
✓	Gatorade or similar drink
✓	Type ABC fire extinguishers
✓	Half-face respirators (National Institute for Occupational Safety and Health [NIOSA]-approved)
	Full-face respirators (NIOSH-approved)
✓	Respirator cartridges – organic vapor
✓	Photoionization detector (PID) w/10.6 eV lamp and calibration kit
	Combustible gas indicator and calibration kit
	Garden sprayer
✓	Compressed gas horn
✓	Duct tape
✓	Paper towels and hand soap
	Spill sorbent
✓	Plastic garbage bags
	Broom and/or shovel

1.10 SAFETY MANAGEMENT STANDARDS

Applicable Safety Management Standards (SMSs) are listed in Table 1-5.

Table 1-5
Safety Management Standards Referenced By This HSP

SMS	Topic	HSP Section
002	Worker Right to Know	5.1.2
15	Flammable, Combustible Liquids and Gases	5.1.2
17	Hazardous Waste Operations	5.2
018	Heat Stress	5.2.1
026	Noise and Hearing Conservation	5.2.2
045	Back Injury Prevention	5.2.4
019	Heavy Equipment Operations	5.2.5
46	Subcontractor Health and Safety	5.2.5
56	Drilling Safety Guide	5.2.5
034	Utility Clearances	5.2.6
032	Traffic Control	5.2.7
013	Excavation Safety	5.2.8
16	Hand Tools and Equipment	5.2.9
029	Personal Protective Equipment	7
042	Respiratory Protection	8
24	Medical Surveillance	8.2
030	Sanitation	10.2
048	DOT Shipping	11.3
014	Fire Prevention	12.2
049	Incident Reporting	12.6/14

Copies of SMSs are provided in Appendix B. They are also available on the URS Safety Intranet at health and safety/ or 10.1.5.21 (internal access only). Use the “Print This SMS” function on the “Safety Management Standards” page to print the complete SMS.

Copies of the SMSs referenced by this HSP are to be maintained on site. Project Managers are responsible to see that other SMSs relevant to field activities but not directly referenced by this HSP are also available on site.

2.0 FACILITY BACKGROUND/WORK PLAN

2.1 SITE HISTORY

The U.S. Army operated a materials testing laboratory at the site from 1948 to 1997, when the laboratory discontinued operations. The lab also conducted analytical testing from 1986 to 1997. The site is approximately 23 acres in size and includes a one-story main building and two smaller sheds. Previous investigations and remedial efforts have resulted in the removal of contaminated soil from a former dry well, drainage ditch, and former underground storage tank (UST) vault. A landfill on the site was used for disposal of concrete and aggregate used during testing.

2.2 SCOPE OF WORK

The following is a list of tasks to be performed during the site investigation:

- Remove blackberry thickets using a brush hog or by hand (machete).
- Collect soil samples using Geoprobe® to a maximum depth of 20 feet below ground surface (bgs), or by hand auger to a maximum depth of 2 feet bgs.
- Collect a sediment sample from the base of a concrete sump; water will be pumped from the sump first; sampling method not yet determined, but personnel will not enter sump.
- Install and sample groundwater from five temporary microwells using a bladder pump.
- Sample six existing groundwater monitoring wells using a bladder pump.
- Complete four exploratory trenches in the landfill (approximately 10 feet long, 3 feet wide, and 6 feet deep); personnel will not enter trenches; soil samples will be collected from the backhoe bucket.
- Remove drums containing hardened concrete from the landfill when encountered, and stage for removal by disposal contractor.
- Collect grab samples from 5-gallon buckets containing soil from the Umatilla Army Depot Borrow Site.

3.0 APPLICABILITY

This plan describes potential site hazards and the health and safety procedures to be followed by on-site workers implementing the field tasks specifically for operations at the North Pacific Division Laboratory site in Troutdale, Oregon. The purpose of this plan, which was developed specifically for operations at this site, is to assign responsibilities, establish personal protection standards and mandatory safety procedures, and provide for contingencies that may arise while operations are being conducted at the site. This plan complies with, but does not replace, federal health and safety regulations as set forth in 29 CFR 1910 and 1926, and applicable Oregon OSHA regulations. This plan is to be used by URS personnel as a supplement to such rules, regulations, and guidance. This health and safety plan is to be augmented by the URS Health and Safety Program and Management System, relevant standards from which are required to be available on site during all activities.

The provisions of the plan are mandatory for all on-site URS employees engaged in hazardous material management activities associated with this project that may involve health and safety hazards.

Changing and/or unanticipated site conditions may require modification of this site safety plan in order to maintain a safe and healthful work environment. Any proposed changes to this plan should be reviewed with a URS health and safety professional prior to their implementation. If this is not feasible, the site/project manager may modify the plan and record all changes in the field logbook; under no circumstances will modifications to this plan conflict with federal, state, or other governmental health and safety regulations.

URS is providing a copy of this HSP to each site subcontractor in order to fulfill its obligation under 29 CFR 1910.120(b) to inform subcontractors of site hazards. Each subcontractor is to provide a health and safety plan that complies with 29 CFR 1910.120 and addresses the activities of its employees relative to this project.

4.0 RESPONSIBILITIES

URS will have site safety and health oversight and coordination responsibilities for URS personnel; each subcontractor will be held accountable for the safe and healthful performance of work by each of its employees, subcontractors, or support personnel who may enter the site.

URS will strictly adhere to the provisions of this health and safety plan, along with the applicable regulations issued by governmental entities.

4.1 PROJECT MANAGER (URS)

The Project Manager (PM) shall direct URS on-site operations. The PM may delegate all or part of these duties to a properly qualified URS employee who is designated as the Site Manager. At the site, the PM, assisted by the Site Safety Officer (SSO), has primary responsibility for:

- Seeing that appropriate personal protective equipment and monitoring equipment are available and properly utilized by all on-site URS employees
- Establishing that URS personnel are aware of the provisions of this plan, are instructed in the work practices necessary to ensure safety, and are familiar with planned procedures for dealing with emergencies
- Establishing that all URS on-site personnel have completed a minimum of 40 hours of health and safety training and have appropriate medical clearance as required by 29 CFR 1910.120, and have been fit-tested for the appropriate respirators
- Seeing that URS personnel are aware of the potential hazards associated with site operations
- Monitoring the safety performance of all URS personnel to see that the required work practices are employed
- Correcting any URS work practices or conditions that may result in injury or exposure to hazardous substances
- Preparing any accident/incident reports for URS activities and notifying the RHSM within 24 hours of the incident (see Section 12.6)
- Seeing to the completion of Safety Plan Compliance Agreements by URS personnel (see Appendix C)

- Halting URS site operations, if necessary, in the event of an emergency or to correct unsafe work practice
- Seeing that utility clearances are obtained prior to the commencement of work (see Section 5.2.7)
- Seeing that the appropriate SMSs are appended to this HSP and are available on site (see Section 1)
- Reviewing and approving this project HSP

4.2 SITE SAFETY OFFICER (URS)

The Site Safety Officer's (SSO) duties may be carried out by the PM or other qualified URS site manager. The SSO is responsible for:

- Implementing project HSPs, and reporting any deviations from the anticipated conditions described in the plan to the PM, and, if necessary, the RHSM
- Determining that monitoring equipment is used properly by URS personnel and is calibrated in accordance with manufacturer's instructions or other standards, and that results are properly recorded and filed
- Checking with the PM or RHSM to see that assigned URS personnel have current Fit-for-Duty medical and training authorizations
- Assuming any other duties as directed by the PM or RHSM
- Coordinating with a URS health and safety professional to identify URS personnel on site for whom special PPE, exposure monitoring, or work restrictions may be required
- Conducting safety meetings for all site personnel in accordance with Section 13
- Conducting daily site inspections prior to the start of each shift (All inspections must be documented, preferably in a bound field logbook.)
- Providing ongoing review of the protection level needs as project work is performed, and informing the PM of the need to upgrade/downgrade protection levels as appropriate
- Contacting the RHSM to perform personal industrial hygiene monitoring for aromatic hydrocarbons if the Second Action Level is reached (above 10 parts per million [ppm] in the operator's breathing zone) as described in Table 1-3 and Section 6.

- Seeing that decontamination procedures described in Section 10 are followed by URS personnel
- Establishing monitoring of URS personnel and recording results of exposure evaluations
- Halting URS site operations, if necessary, in the event of an emergency or to correct unsafe work practices
- Maintaining the visitor log
- Posting OSHA "Safety on the Job" and other required posters at the site

4.3 REGIONAL HEALTH AND SAFETY MANAGER (URS)

The Regional Health and Safety Manager (RHSM) is responsible for:

- Determining the need for periodic audits of the operation to evaluate compliance with this plan
- Providing health and safety support as requested by the SSO and PM

4.4 PROJECT PERSONNEL (URS)

Project personnel involved in on-site investigations and operations are responsible for:

- Taking all reasonable precautions to prevent injury to themselves and to their fellow employees
- Performing only those tasks that they believe they can do safely, and immediately reporting any accidents and/or unsafe conditions to the SSO or PM
- Implementing the procedures set forth in the HSP, and reporting any deviations from the procedures described in the Plan to the SSO or PM for action
- Notifying the PM and SSO of any special medical problems (e.g., allergies) and seeing that all on-site URS personnel are aware of such problems
- Reviewing project Health and Safety Plan and signing the Safety Plan Compliance Agreement (see Appendix C)

4.5 SUBCONTRACTOR'S SAFETY REPRESENTATIVE

Each subcontractor is requested to designate a subcontractor's safety representative (SSR) who is the subcontractor supervisor. The SSRs are responsible for the safe and healthful performance of work by their work force and subcontractors. During subcontractor activities on site, the SSR will perform continuing work area inspections, and conduct safety meetings and safety orientations for all new employees. The SSR will attend periodic safety meetings with the SSO and will also investigate accidents and overexposures involving subcontractor personnel.

5.0 JOB HAZARD ANALYSIS

A complete Project Hazard Analysis form (PHA-1) is included in Appendix B. The form is used to identify site-specific health and safety hazards. SMSs identified for this project (Table 1-5) are also attached as part of this HSP, and shall be maintained on site. This section describes the chemical and physical hazards that may be encountered during site operations.

5.1 CHEMICAL HAZARDS

There are two categories of chemical hazards associated with site activities:

- Site constituents
- Chemicals used to conduct the site work

Site constituents are those chemicals that exist at the site and are the cause for conducting site activities. The chemicals that are brought on site in order to conduct the work may be hazardous and subject to regulation under OSHA's Hazard Communication Standard (29 CFR 1910.1200).

5.1.1 Site Constituents

From an occupational health standpoint, given that any potential exposure of site personnel will be for only a short period of time, the levels of contaminants that have been, or could be, encountered during site activities should not represent a significant concern if the provisions of this HSP are appropriately implemented. However, the site is still under investigation, so the potential for exposure to elevated levels of these contaminants may exist. Overviews of the hazards associated with exposure to the chemicals that may pose a hazard during site activities are presented below.

Metals

Metals have been previously detected in soil and groundwater on site. However, the concentrations have historically not been high enough to be a concern. Metals bound to soil may be inhaled and, if present at elevated concentrations, can cause irritation of the upper respiratory tract, and on contact with moist skin or eyes can cause itching or burning. Inhalation, ingestion, or skin contact with airborne dust can cause a variety of symptoms depending on the concentrations of the individual metal constituents. The central nervous system and the dermal

system are most likely to be affected. Some symptoms of dust exposure for specific metals include:

- Arsenic — Nasal ulceration, dermatitis, respiratory irritation, gastrointestinal problems
- Barium — Hypertension and kidney problems
- Cadmium — Throat dryness, cough, headache, vomiting, irritability, bronchopneumonia
- Chromium — Eye irritation, sensitization dermatitis
- Lead — Intoxication of central nervous system, anxiety, inhibited muscle coordination
- Mercury — Skin and eye irritation, cough, tremors, and insomnia

Polychlorinated Biphenyls (PCBs; Chlorodiphenyl)

PCBs were detected in a tar layer found in soil at the on-site drainage ditch. However, the area has been remediated.

PCBs are in a mixture of compounds, and the commercial product is often described in terms of the relative proportion of chlorine. The greater the chlorine content, in general, the higher the toxicity.

Exposure to the vapors and fumes of PCBs may result in acne (chloracne), irritation of respiratory passages, and injury to the liver. Chronic exposures to levels below the permissible exposure limit (PEL) have induced chloracne in personnel at some industrial operations. PCB vapor pressure is less than 0.001 millimeters mercury (mm Hg). Ionization potentials and odor thresholds have not been reported. Some PCBs are considered to be animal carcinogens. PCBs are known to the State of California to cause cancer under the criteria of Proposition 65.

Polycyclic Aromatic Hydrocarbons (PAH)

Diesel was not detected above Oregon clean-up levels in previous sampling. Polycyclic aromatic hydrocarbons (PAHs) are a class of compounds formed during the incomplete combustion of organic materials containing carbon and hydrogen. Several hundred different PAHs have been identified. These include naphthalene, benz(a)anthracene, benz(a)pyrene and chrysene among many others. PAHs are highly lipid-soluble and, in general, are probably readily absorbed by all routes of exposure. A most significant aspect of the PAHs is that several compounds in this

category have been shown to cause cancer in humans or in experimental animals. Many PAHs are known to the State of California to cause cancer under the criteria of Proposition 65.

Oil-Range TPH

Inhalation does not present a problem, except if misting occurs, although frequent and prolonged direct skin contact may produce skin irritation and dermatitis in certain hypersensitive individuals, mainly owing to the presence of certain additives. Aspiration is also less likely to occur, except for the lower-boiling light oils. Because lubricating oil is a complex mixture of varying proportions of hydrocarbons, a mean odor threshold and ionization potential has not been determined.

Skin contact with potentially contaminated materials will be minimized by the use of personal protective clothing (as described in Sections 1 and 7). Inhalation of vapors or particulates during the site activities will be minimized by air monitoring and the use of engineering controls, and respiratory protection will be used if Action Levels described in Section 1 are exceeded. Ingestion of contaminated materials will be minimized by the use of appropriate personal hygiene procedures during decontamination (i.e., thoroughly washing face and hands with soap and water after leaving the work area and prior to eating or drinking).

5.1.2 Hazard Communication Materials

Materials that are considered hazardous materials under the OSHA Hazard Communication Standard (29 CFR 1910.1200) may be used during this project. Nitrile gloves shall be worn when working with these chemicals. In accordance with the URS Hazard Communication Program, the Material Safety Data Sheets (MSDSs) for the hazardous materials listed in Section 1 are included in Appendix D. The SSO will make copies of these MSDSs available to any subcontractors (e.g., drillers, excavators) on this project. The MSDSs describe the hazards associated with each chemical that will be used on site.

URS' written Hazard Communication Program can be found in SMS 002, a copy of which shall be maintained on site. In addition, refer to SMS 015 for proper storage of combustible gases.

5.2 PHYSICAL HAZARDS

Physical hazards at this work site include:

- Heat stress
- Noise from the operation of brush hog, Geoprobe®, and excavator
- Slip/trip/fall type of accidents

- Back injuries due to improper lifting
- Being caught in or struck by moving equipment
- Electrocution or explosion hazards associated with drilling or excavation activities, such as, contact with overhead or underground power lines or pipelines
- Excavation hazards
- Muscle strains from hand auger work and groundwater sampling
- Biological hazards (e.g., bees and wasps)

General guidelines and requirements for hazardous waste operations are contained in SMS 017.

5.2.1 Heat Stress Recognition and Control

Heat stress monitoring shall commence when personnel are wearing PPE, including Tyvek-type coveralls, and the ambient temperature exceeds 70°F. If standard work garments (e.g., cotton coveralls) are worn, monitoring shall commence at 85°F. Heat stress monitoring and control guidance can be found in SMS 018. Additional information regarding heat stress can be found in SMS 018, a copy of which shall be maintained on site.

5.2.2 Noise Hazards

Previous surveys indicate that heavy equipment such as drilling or excavation equipment may produce continuous and impact noise at or above the Action Level of 85 dBA. All URS personnel within 25 feet of operating equipment, or near an operation that creates noise levels high enough to impair conversation, shall wear hearing protective devices (either muffs or plugs). URS personnel who are in the Medical Surveillance Program are automatically enrolled in the URS Hearing Conservation Program and have had baseline and, where appropriate, annual audiograms. Personnel shall wash their hands with soap and water prior to inserting earplugs to avoid initiating ear infections. Additional information regarding the URS Hearing Conservation Program can be found in SMS 026, a copy of which shall be maintained on site.

5.2.3 Slip/Trip/Fall Hazards

Workers should exercise caution when walking around the site to avoid slip/trip/fall hazards. If there are holes or uneven terrain in the work area that could cause site personnel to fall or trip, they must be covered, flagged, or marked to warn workers. Workers should exercise caution around open excavations, such as test pits, and avoid getting closer than 2 feet to the edge of an unsloped excavation unless guardrails or fall protection is provided. Also, when sampling the sediment from the sump, workers will avoid the edge and not enter the concrete vault.

If conditions become slippery, workers should take small steps with their feet pointed slightly outward to decrease the probability of slipping. Gravel or sand should be spread in muddy areas to reduce slipperiness. Workers should watch where they are walking and walk only in areas of good stability. In addition, the work site should be kept clean and organized to reduce slip/trip/fall hazards.

5.2.4 Lifting Hazards

The following guidelines will be followed whenever lifting equipment such as portable generators, coolers filled with samples, or any other objects that are of odd size or shape, or that weigh over 40 pounds. Safe lifting procedures are described in SMS 045, a copy of which is to be available on site.

5.2.5 Heavy Equipment

Operation of heavy equipment during site activities presents potential physical hazards to personnel. Issues associated with heavy equipment operations are addressed in SMSs 019, 046, and 056. In addition, the following will be observed whenever heavy equipment is in use:

- Personal protective equipment (PPE) including steel-toed shoes, safety glasses or goggles, hard hats, and safety vests shall be worn whenever such equipment is present.
- When an equipment operator must operate in tight quarters, the equipment subcontractor should provide a person to assist in guiding the operator's movements.
- All non-essential personnel shall be kept out of the work area.
- Any heavy equipment that is used in the exclusion zone should remain in that zone until its task is completed. The equipment subcontractor should completely decontaminate such equipment in the designated equipment decontamination area as required prior to moving the equipment outside of the Exclusion Zone and Contamination Reduction Zone.

5.2.6 Underground and Aboveground Utilities

The Site Manager or SSO is responsible for ensuring underground utilities are located prior to the commencement of any subsurface (deeper than 0.3 meter or 1 foot) activities. Resources include site plans, utility companies, and regional utility locating services. The proper utility company personnel shall certify in writing to the Site Manager or SSO the deactivation of

underground utilities, and the certification shall be retained in the project files. The procedures for activities proximal to utility locations can be found in SMS 034.

5.2.7 Work Area Protection

Project operations may be undertaken in a roadway or parking lot and motor vehicles may be a hazard. Consideration should be given to parking a work vehicle within the coned area between the work area and oncoming traffic. Procedures for work zone traffic control can be found in SMS 032.

5.2.8 Trenching and Excavation

All URS personnel are prohibited from entering a trench or excavation until it has been inspected by a competent person in accordance with 29 CFR 1926.650-651. If personnel are required to enter a trench or excavation that is deeper than 4 feet, the provisions in SMS 013 shall be followed. A copy of the federal OSHA Excavation Standard can be obtained from the RHSM. All provisions of this regulation must be complied with when working in a trench or excavation.

Caution will be exercised when excavating in the landfill. Because the landfill was used for disposal of building materials, such as concrete and fiberglass insulation, puncture hazards may occur from protruding metal. If a suspected hazardous material container is uncovered, work will stop immediately and the PM and RHSM will be notified.

5.2.9 Hand Augering/Hand Tool Use

Muscle strains can occur with hand augering. To minimize the occurrence of injury, the following should be observed:

- Augers shall be kept sharp; a dull auger requires more work to advance through the soil.
- Before beginning work, personnel should stretch or warm up the body as they would prior to exercising.
- Personnel shall avoid excessive twisting or wrenching motions when using the auger.

Hand tools will be used while clearing brush and sampling. The guidelines in SMS 016 shall be followed.

5.2.10 Biological Hazards (Bees and Wasps)

Bees and wasps may inhabit the work area. Site workers will walk the site so that wasp and bees nests can be identified. It is best to eradicate any nests, as necessary, during the cool morning hours when the wasps are lethargic. All persons with known allergies should be identified prior to beginning work. At the recommendation of their personal physician, persons with severe allergies may wish to carry a self-administered treatment for allergic reaction.

6.0 EXPOSURE MONITORING PLAN

Heat stress, noise, and chemical exposures may be encountered at this site. Heat stress monitoring and prevention are addressed in Section 5.2.1. Noise levels will not be monitored; URS personnel will wear hearing protection as described in Section 5.2.2.

6.1 CHEMICAL EXPOSURE MONITORING

The field instrumentation described in this HSP has been specifically selected for the contaminants that may be encountered during this course of this project. Selection factors include anticipated airborne concentrations, potential interference, ionization potentials, instrument sensitivity, and occupational exposure limits. The Action Levels specified in Section 1 were established with the expectation that specific instruments will be used. **Substitute instruments shall not be used without the consent of the HSP preparer or the RHSM.**

The monitoring equipment specified in Section 1 will be used on a regular basis to evaluate the potential for exposure to airborne contaminants, typically every 5 to 10 minutes. Monitoring will be conducted in the immediate vicinity of the contaminant source point or work area (e.g., at the borehole and cuttings adjacent to the borehole). If readings reach the First Action Level (above 5 parts per million [ppm] for longer than 1 minute), monitoring in the OBZ of the person working nearest the point of operations/contaminant source will start immediately, and site personnel will don protective clothing (see Table 1-3).

A reading in the OBZ that reaches the Second Action Level (above 10 ppm for longer than 1 minute) will require the use of half-face respirators with appropriate cartridges. An OBZ reading that reaches the Third Action Level (above 15 ppm for longer than 1 minute) will require the use of full-face respirators with appropriate cartridges. If the monitoring instrument reaches the Fourth Action Level (25 ppm for longer than 1 minute, or 50 ppm instantaneously), work will stop, and workers will move upwind while the airborne contaminants dissipate. If elevated levels remain for more than 5 minutes, the source of the airborne contamination will be covered with clean soil, plastic sheeting, or foam (or controlled in an appropriate manner), and the RHSM or PM will be contacted for further guidance.

Personal monitoring will not be performed during this project.

6.2 BACKGROUND READINGS

All direct-reading instrument readings will be evaluated relative to background reading, not "meter zero." Prior to the start of work at each shift, and whenever there is a significant shift in wind direction, instrument readings will be obtained upwind of the site work zone in order to determine the level of "background" readings from local vehicle traffic, emissions from nearby operations unrelated to the site, etc. Site readings will be evaluated against these background readings (e.g., if an Action Level is listed as 20 ppm, it is evaluated as 20 ppm above background). The SSO should consult with the industrial hygienist regarding the potential health hazards associated with background readings above 5 ppm.

6.3 DATA LOGGING

All monitoring data, including background readings, will be logged in the field logbook. The results of daily instrument calibrations can either be logged on the form provided in Appendix E or in the field logbook. All monitoring instruments will be calibrated in accordance with the manufacturer's instructions prior to the start of each shift. Calibration should also be performed when inconsistent or erratic readings are obtained. **If an instrument cannot be calibrated to specification, or becomes otherwise inoperable, all invasive site work (i.e., drilling, excavating) will cease until the instrument is appropriately repaired or replaced**; the PM or RHSM should be contacted for further guidance.

6.4 DUST CONTROL

High winds and site operations can cause airborne dust hazards. If site operations generate sustained visible dust, a water mist will be applied to reduce dust generation. If the mist is not effective in reducing dust generation, personnel will don respirators (half-face or full-face as appropriate for analyzer readings) with combination organic vapor/high-efficiency particulate air (HEPA) cartridges (such as MSA's GMC-H cartridges).

Sand and Portland cement that may be used in groundwater monitoring well construction may contain free silica (quartz). Airborne exposure to silica dust may occur during handling of these materials. Half-face respirators with HEPA cartridges should be worn for those sand and cement handling operations that present reasonable possibility for exposure to sustained airborne dust from the pouring and mixing of dry sand or cement.

6.5 EXPLOSIVE ATMOSPHERES

Due to the type of work performed during this project (intrusive drilling and trenching), the potential exists for explosive atmospheres at the site. Therefore, a combustible gas indicator/oxygen (CGI/O_2) meter will be used to monitor ambient conditions. Decisions will be based on the levels measured using a CGI/O_2 meter (measurements are in percent of the lower explosive limit) as determined by the Action Level in Table 1-4.

For excavation operations, a CGI with a remote sensing head should be used. The sensing head should be attached to the excavator arm near the bucket, and the cable run back along the arm to the CGI located in the excavator cab. This will permit the operator to be alerted to hazardous situations without requiring monitoring personnel to stand at the working face.

Fire suppression equipment (minimum of one 20B fire extinguisher or fire hose) is to be present at all times during site operations in areas where a fire potential exists.

6.6 OXYGEN-DEFICIENT ATMOSPHERES

Oxygen-deficient atmospheres may be encountered in excavations. However, during this project no workers will enter the excavation trenches; soil samples will be collected from the backhoe bucket.

7.0 PERSONAL PROTECTIVE EQUIPMENT

While performing drilling/excavation oversight and environmental sampling, the minimum level (Level D) of personal protective equipment (PPE) for site personnel consists of:

- Hardhat
- Safety glasses with side shields (or impact-resistant goggles)
- Steel-toed boots or chemical-resistant steel-toed boots
- Ear protection in vicinity of noisy equipment
- Work gloves or chemical-resistant gloves when handling potentially contaminated media
- Traffic safety vest in the vicinity of heavy equipment

As the various monitoring Action Levels are reached, additional PPE is required. Section 1 provides the description of the incremental PPE requirements relative to specific Action Levels, as well as the specific kinds of PPE to be used. Procedures for use and selection of personal protective equipment can be found in SMS 029.

7.1 LIMITATIONS OF PROTECTIVE CLOTHING

The protective equipment ensembles selected for this project are anticipated to provide protection against the types and concentrations of hazardous materials that may potentially be encountered during field operations. However, no protective garment, glove, or boot is resistant to all chemicals at any concentration; in fact, chemicals may continue to permeate or degrade a garment even after the source of the contamination is removed.

In order to obtain optimum usage from PPE, the following procedures are to be followed by all URS personnel:

- When using disposable coveralls, don a clean, new garment after each rest break or at the beginning of each shift.
- Both prior to and during use, inspect all clothing, gloves, and boots for:
  - Imperfect seams
  - Non-uniform coatings
  - Tears

- Poorly functioning closures
- Visible signs of chemical permeation such as swelling, discoloration, stiffness or brittleness
- Cracks or any signs of puncture or abrasion

- Any reusable garments exhibiting any such characteristics will be discarded.

7.2 DURATION OF WORK TASKS

The duration of work tasks in which personnel use PPE ensembles that include chemical protective clothing (including uncoated Tyvek) will be established by the SSO. Variables to be considered include ambient temperature and other weather conditions, the capacity of individual personnel to work in the required level of PPE in heat and cold, and the limitations of specific PPE ensembles. The recommended rest breaks are as follows:

- Midway between shift startup and lunch (15 minutes)
- Lunch break (30 to 60 minutes)
- Midway between lunch and shift end (15 minutes)

Rest breaks are to be taken in the support zone or other clean area after personnel have completed the decontamination process, including washing hands and face with soap and water. Additional rest breaks will be scheduled according to heat stress monitoring protocols as described in SMS 018.

8.0 RESPIRATORY PROTECTION

Engineering controls and safe work practices (e.g., elimination of the source of contamination, use of ventilation equipment, working upwind, limiting exposure time, etc.) must always be the primary control for air contaminants. Respirators will be used if engineering or work practice controls are not feasible for controlling airborne exposures below acceptable concentrations and as an interim control measure while engineering or work practice controls are implemented. SMS 042, Respiratory Protection, outlines respiratory requirements for URS employees.

8.1 RESPIRATOR SELECTION

Attachment 42-1 to SMS 42 provides guidance for identifying when a respiratory is needed. Once the need for respirators has been established, the respirators will be selected on the basis of the hazards to which the worker is exposed. Only National Institute for Occupational Safety and Health (NIOSH)-approved respirators will be issued. Selection criteria established in 29 CFR 1910.134 have been used by the HSP preparer in determining respirator requirements for this project.

The forms (i.e., aerosol, dust, fume, gas, particulate, or vapor) of airborne contaminants have been evaluated based upon the suspected contaminants of concern. Direct-reading instruments will be used to evaluate the airborne chemical concentration and provide data for respirator selection. Airborne readings will be compared to the Action Levels in Section 1. In addition, see Action Level/respirator requirements in Section 6.

8.2 MEDICAL SCREENING

Project employees are enrolled in the URS Medical Surveillance Program (see SMS 024) and are medically evaluated in compliance with the requirements of 29 CFR 1910.134(a)(10). Employees not medically cleared to wear respirators will not be assigned to this project. The examining physician reviews the medical status of each employee annually or as deemed necessary if the physical status of the employee changes.

8.3 FIT TESTING

No individual will enter an area where the use of respiratory protective equipment is required unless the person has been fit tested. Fit testing is required annually or when the employee is assigned a respirator of a different make, type, or size from that previously tested. Fit testing will be performed in accordance with accepted fit test procedures defined in SMS 042 (see

Attachment 42-5 to SMS 042). Records of fit testing will be maintained on site or by the employee's office.

8.4 RESPIRATOR TRAINING AND USE

All employees whose job assignment requires the use of respirators are given training in accordance with 29 CFR 1910.134 during the initial 40-hour and annual refresher training for hazardous waste operations. Only those employees who have been properly trained and qualified for the specific type of respirator may use respirators while performing site work. In addition, site-specific respirator training is provided during site safety briefings conducted by the SSO. Training records are kept in the employee's training file.

Respirator wearers will perform a user seal check (i.e., negative and positive check) each time the respirator is put on. See Attachment 42-3 to SMS 042 for respirator standard operating procedures.

Employees wearing respirators while performing site work will abide by the following:

- The area of the face piece seal must be clean shaven.
- Long hair, sideburns, and skullcaps that extend under the seal are not allowed.
- Glasses with temple pieces extending under the seal are not allowed for full-face respirators.
- Persons with facial conditions that prevent a proper seal are not allowed to wear a respirator until the condition is corrected. Facial conditions that may cause a seal problem include missing dentures, scars, severe acne, etc.
- Contact lenses may be worn with respiratory protection.

Particulate respirator cartridges should be changed out when the wearer has difficulty breathing through the cartridges. The fit of a chemical gas or vapor respirator should be rechecked and the cartridges changed if the wearer detects chemical odor or feels chemical irritation on the skin, both indicators of leakage or cartridge breakthrough.

When available, respirator cartridges with an end-of-service-life indicator (ESLI) will be used. Cartridges will be changed as soon as the ESLI indicates that the cartridge is saturated and no longer effective in absorbing airborne chemicals. When ESLI chemical gas or vapor respirator cartridges are not available, cartridges will be changed out at least daily.

8.5 RESPIRATOR INSPECTION

The user will inspect respirators before and after each day's use.

The inspection procedure for air purifying respirators (full-face piece and half-face piece cartridge respirators) will be as follows.

The face piece shall be examined for:

- Excessive dirt
- Cracks, tears, holes, or distortion from improper storage
- Inflexibility
- Cracked or badly scratched lenses (full-face only)
- Incorrectly mounted eyeglass lenses or broken or missing mounting clips (full-face only)
- Cracked or broken air purifying element holder, badly worn threads, or missing gaskets

The head straps or head harness shall be examined for:

- Breaks or cracks
- Broken or malfunctioning buckles
- Excessively worn serration on the headstraps, which may permit slippage

Both inhalation valves (2) and the exhalation valve shall be examined for:

- Foreign material (e.g., hairs, particles, etc.)
- Improper insertion of the valve body in the face piece
- Cracks, tears, or chips in the valve body, particularly in the sealing surface
- Missing or defective exhalation valve covers

The air-purifying cartridge shall be examined for:

- Missing or worn cartridge holder gasket

- Incorrect cartridge/canister for the hazard
- Incorrect cartridge installation, loose connections, or cross threading in the holder
- Cracks or dents in the outside case or threads of filter or cartridge/canister

8.6 CLEANING OF RESPIRATORS

Respirators assigned and worn by one individual must be dismantled and thoroughly cleaned and disinfected after each day's use. Visitor or multi-assigned respirators must be cleaned and disinfected after each use. A disinfectant spray or wipe is approved as a disinfectant between uses during the day but not for cleaning and sanitizing after each day's use. Care must be taken to prevent damage from rough handling during the cleaning procedure. After cleaning, respirators must be reassembled.

The respirator cleaning procedure is as follows:

1. Washing: Disassemble and wash with a mild liquid detergent in warm water (not to exceed 110 degrees F). A stiff bristle (not wire) brush may be used.

2. Rinsing: Rinse in clean water (110 degrees F maximum) to remove all traces of detergent. This is very important to prevent dermatitis.

3. Disinfecting: Thoroughly rinse or immerse in a sanitizer provided by the manufacturer. Alternatively, a weak chlorine bleach solution (1 milliliter liquid bleach/liter of water) may be used.

4. Final Rinsing: Rinse thoroughly in clean water (110 degrees F maximum) to remove all traces of disinfectant. This is very important to prevent dermatitis.

5. Drying: Drain and dry hanging by the straps from racks (take care to prevent damage); or towel dry with clean soft cloths or paper towels.

8.7 MAINTENANCE OF RESPIRATORS

Routine respirator maintenance, such as replacing missing valves, gaskets, or nosecups, shall be performed only by trained respirator users or a respirator manufacturer's representative. Only approved replacement parts shall be used. Substitution of parts from a different brand or type of respirator is generally not possible, invalidates the technical approval of the respirator, and is not

permitted. Any respirator suspected of being defective must be removed from service and replaced.

8.8 STORAGE OF RESPIRATORS

When not in use, respirators shall be stored to protect them from dust, sunlight, heat, extreme cold, excessive moisture, damaging chemicals, and physical damage. Respirators must be stored in sealable (e.g., zipper locking or twist-tie) reusable plastic bags between shifts.

The respirator storage environment must be clean, dry, and away from direct sunlight. On-site cabinets or cases are suggested. Storing bagged respirators in vehicles is discouraged due to the potential for damage from other material or equipment.

9.0 SITE CONTROL

9.1 GENERAL

The SSO will provide a copy of this HSP to all site visitors before entering the site to explain site hazards and emergency action information. The site visitor will sign into the visitor's log and sign the Compliance Agreement form (Appendix C) after reviewing the HSP. In addition, all URS personnel and visitors entering the site must present evidence of their participation in a medical surveillance program and completion of health and safety training programs that fulfill the requirements of this HSP.

At the end of the shift, all boring/sampling holes and excavations must be covered or otherwise secured. Heavy equipment will be secured. All cuttings and decontamination fluids are to be handled in accordance with relevant regulations and instructions from the PM.

9.2 WORK ZONES

Work zones are established for safety purposes, to keep out unauthorized people, and to contain contamination. For sites where monitoring instrument readings are below the Second Action Level (Table 1-3), the Activity Zone (AZ) shall be delineated by, at a minimum, traffic cones, barricade tape, or barricades. A small opening in the barrier shall be used for entry and exit of personnel and equipment. A decontamination station will be set up at this opening.

However, if monitoring instrument readings reach the Second Action Level (above 10 ppm for longer than 1 minute), the use of chemical-protective equipment is required, and work zones must be established as described below.

- Exclusion Zone (EZ) – A 25-foot-diameter (as practical) circle around the work area will be defined before work starts. The encircled area will constitute the exclusion zone. This zone is where potentially hazardous contaminants and physical hazards to the workers will be contained. Appropriate personal protection as described in Section 1 will be required in this area. Plastic sheeting (Visqueen) and/or tarps may be used as necessary to control contaminated materials spilled to the ground during site operations. The size of the EZ may be altered to accommodate site conditions and to ensure contaminant containment.
- Contamination Reduction Zone – A defined corridor between the EZ and clean areas shall constitute the Contamination Reduction Zone (CRZ). The CRZ provides a transition between the contaminated EZ and other parts of the site. All decontamination activities shall occur in the CRZ. A waste container

(e.g., 55-gallon drum with lid) shall be placed at the end of the corridor and used for contaminated disposable PPE and tools. Plastic sheeting shall be used in this area to control ground contamination.

- Support Zone (SZ) – The outermost part of the site shall be defined as the SZ for each field activity. Support equipment is located in this uncontaminated or clean area. Normal work clothes are appropriate within this zone. The location of this zone depends on factors such as accessibility, wind direction (upwind of work area), and resources (e.g., roads, shelter, utilities).

10.0 DECONTAMINATION PROCEDURES

10.1 DECONTAMINATION PROCEDURES FOR ACTIVITY ZONES

For sites where monitoring instrument readings do not reach the Second Action Level, the following minimal decontamination procedures will be used whenever personnel leave the AZ.

1. Scrub boots with a stiff-bristled brush, wash with a decontamination solution, and rinse with water. (The decontamination station at the AZ will be provided with washtubs and chairs.)

2. Remove outer gloves and boot covers, if used.

3. Remove hardhats, wash outer layer, rinse.

4. Remove eye protection, hearing protection, and inner gloves (if used).

5. Thoroughly wash hands, neck, and face.

10.2 DECONTAMINATION PROCEDURES FOR EXCLUSION ZONES

If the monitoring instrument readings reach the Second Action Level (above 10 ppm for more than 1 minute) in the OBZ or visible airborne dust indicate respirator use, the following steps will be followed whenever personnel leave the EZ:

1. Remove all equipment, sample containers, and notes from EZ and place in the CRZ.

2. Scrub boots with a stiff-bristled brush, wash with a decontamination solution, and then rinse with water. Washtubs and chairs will be provided.

3. Remove outer gloves (and boot covers, if used).

4. Remove Tyvek coverall; discard in provided container.

5. Remove hardhat; wash outer layer, rinse.

6. Remove eye protection.

7. Remove respirator.

8. Remove hearing protection.

9. Remove inner gloves.

10. Thoroughly wash hands, neck, and face.

11. Proceed to SZ.

12. Redress in street clothes and exit.

The decontamination area will be covered with plastic sheeting, which will be replaced when torn or heavily soiled, and at the end of each shift.

Each worker will be responsible for cleaning, sanitizing, and storing their own respirator in accordance with manufacturer's guidance (i.e., washing in warm water and detergent or sanitizing solution, air drying, and storing in a plastic storage bag; see Sections 8.6 through 8.8). Cartridges will be changed in accordance with the procedures described in Section 8.4.

All investigation-derived wastes (IDW) will be segregated into one of three categories:

- Wastewater (includes well purge water and decontamination water)
- Soil (includes drill cuttings and sediment from decontamination containers)
- Solids (includes disposable PPE and sampling equipment)

Each waste type will be placed in an appropriate container such as an open-topped, 55-gallon drum. Labels identifying the contents will be placed on each container. Waste containers will be stored on site pending laboratory analysis. Ultimate disposal will be coordinated with the PM and in accordance with relevant regulations.

10.3 SANITATION

Potable water will be made available at the site, either from a pressurized source or commercially available bottled water. Drinking cups will be supplied so personnel will neither drink directly from the source of water nor have to share drinking cups. Sources of non-potable water shall be clearly labeled as such.

Unless toilet facilities are available on site or transportation is readily available to transport personnel to nearby (within 5 minutes) toilet facilities, portable toilet facilities, such as chemical toilets, will be provided on site.

Washing facilities will be provided on site, and will be located in the decontamination area or the support area. Soap, clean water, wash basins, and single-use towels will be available for personnel use.

URS procedures for site sanitation can be found in SMS 030.

10.4 DECONTAMINATION – MEDICAL EMERGENCIES

In the event of physical injury or other serious medical concerns, immediate first aid is to be administered in lieu of further decontamination efforts.

10.5 DECONTAMINATION OF TOOLS

When all work activities have been completed, contaminated tools used by URS personnel will be either appropriately decontaminated or properly disposed of as hazardous waste. Tools that can be decontaminated are constructed of non-porous, non-absorbent materials. Decontaminate tools (shovels, auger flights, etc.) by brushing them with a decontamination solution (e.g., Alconox and water) and rinsing with water. A high-pressure steam cleaner may also be used for decontamination. All visible particles are to be removed before the tool is considered clean. All waste and spent decontamination solutions will be properly contained. Any tool, or part of a tool, that is made of a porous/absorbent material will be discarded and disposed of as a hazardous waste if it cannot be properly decontaminated.

11.0 SAFE WORK PRACTICES

11.1 GENERAL

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in the contaminated or potentially contaminated area or where the possibility for the transfer of contamination exists.
- All personnel will enter designated EZ only through the CRZ. All personnel leaving an EZ (or AZ) must exit through the CRZ (or decontamination station) as described in Section 10.
- Personnel will wash their hands and face thoroughly with soap and water prior to eating, drinking, or smoking.
- Personnel will avoid contact with potentially contaminated substances and avoid walking through puddles, pools, mud, etc. Personnel will avoid, whenever possible, kneeling, leaning, or sitting on contaminated surfaces. Monitoring equipment will not be placed on potentially contaminated surfaces (e.g., ground, etc.).
- All field crew members should make use of their senses to alert them to potentially dangerous situations that they should avoid (e.g., avoid areas with strong, irritating, or nauseating odors).
- Only those vehicles and equipment required to complete work tasks should be permitted within the EZ/AZ (drill rigs, excavators, and similar items). All non-essential vehicles should remain within the SZ.
- Containers such as drums will be moved only with the proper equipment and will be secured to prevent dropping or loss of control during transport.
- Field survey instruments such as PIDs should be covered with plastic or similar covering to minimize the potential for contamination.
- No matches or lighters will be permitted in the AZ, EZ, or CRZ.
- Contaminated protective equipment, such as respirators, hoses, boots, and disposable protective clothing, will not be removed from the AZ, EZ, CRZ or decontamination station until it has been cleaned, or properly packaged and labeled.
- To the extent possible, spills shall be prevented; in the event that a spill occurs, the liquid should be contained if possible.
- Personnel shall prevent splashing of the contaminated materials.

- Field crewmembers shall be familiar with the physical characteristics of the site operations including:
  - Wind direction in relation to the contaminated area
  - Accessibility to equipment and vehicles
  - Areas of known or suspected contamination
  - Site access
  - Nearest water sources
- The number of personnel and equipment in the EZ should be minimized but only to the extent consistent with workforce requirements of safe site operations.
- All wastes generated by URS activities at the site will be disposed of as directed by the PM.
- All personal protective equipment will be used as specified and required.
- The buddy system will be used at all times when performing sampling for hazardous material when the First Action Level criteria have been exceeded or when working in remote areas.
- Personnel are to immediately notify the SSO or Site Manager if any indications of potential explosions or unusual conditions are observed.

11.2 SAMPLING PRACTICES

For all sampling activities, the following standard safety procedures shall be employed:

- All sampling equipment shall be cleaned before proceeding to the site.
- At the sampling site, sampling equipment shall be cleaned after each use.
- Work in “cleaner” areas shall be conducted first where practical.
- All unauthorized personnel shall remain outside the EZ at all times.

11.3 SAMPLE SHIPMENT/HAZARDOUS MATERIALS SHIPMENT

If samples collected during the course of this project are defined as hazardous materials under DOT regulations 49 CFR Parts 171-177 (see URS SMS 048 guidelines for determination), then they **must** be shipped in accordance with those regulations by a certified Hazardous Material Shipping Specialist.

12.0 EMERGENCY RESPONSE PLAN

It is URS policy to evacuate personnel from areas involved in hazardous material emergencies and to summon outside assistance from agencies with personnel trained to respond to the specific emergency. This section outlines the procedures to be followed by URS personnel in the event of a site emergency. These procedures are to be reviewed during the on-site safety briefings conducted by the SSO. If an emergency incident occurs, those involved will perform a follow-up evaluation of the emergency response procedures and provide any helpful suggestions to the RHSM.

In the event of a fire or medical emergency, the emergency numbers identified in Section 1 will be called for assistance.

12.1 PLACES OF REFUGE

In the event of a site emergency requiring evacuation, all personnel will evacuate to a pre-designated area located a safe distance from any health or safety hazard (typically the URS field office, unless conditions dictate otherwise). The SSO will designate a primary assembly area prior to the start of work each day. The daily pre-designated assembly area may have to be re-designated by the SSO in the event of an emergency where the area of influence affects the primary assembly area. Once personnel are assembled, the SSO shall take a head count. The SSO will evaluate the assembly area to determine if the area is outside the influence of the situation; if not, the SSO will redirect the group to a new assembly area where a new head count will be taken.

The PM or SSO will determine an upwind evacuation area prior to each shift, and all personnel will be notified of its location. A horn or other signaling device will be used to signal an evacuation in the event of an emergency. Three blasts of the horn will be the signal to immediately stop work and proceed to the evacuation area.

During any site evacuation, all employees shall be instructed to observe wind direction indicators. During evacuation, employees will be instructed to travel upwind or crosswind of the area of influence. The SSO will provide specific evacuation instructions, via the site emergency radio if necessary, to site personnel regarding the actual site conditions.

12.2 FIRE

Fire prevention procedures are described in SMS 014. To protect against fires, the following special precautions must be taken:

- Before any flame-producing devices (e.g., cutting torches or welding irons) are used in the exclusion zone, the SSO must be contacted. In some cases, the client may require that they be contacted as well to determine if a "hot work" permit is required. A detailed inspection of the work area will be conducted to determine if potential fire sources (combustible or flammable solids, liquids, or gases) exist. The combustibles must be removed to at least 35 feet away before work can commence.
- At least one 10BC fire extinguishers must be located at the work area when cutting/welding is being conducted, and a fire watch will be posted.
- Upon completion of the cutting/welding activities, the area will be inspected for hot metal, slag, etc. The fire watch will remain on station for at least 15 minutes after the hot work is completed.

12.3 COMMUNICATION

A communication network must be set up to alert site personnel of emergencies and to summon outside emergency assistance. Where voice communication is not feasible, an alarm system (e.g., sirens, horns, etc.) will be set up to alert employees of emergencies. Radio communication may be useful to communicate with personnel in the exclusion zone. Where phone service is not readily available, radios or portable phones should be used to communicate with outside agencies. Site personnel should be trained in the use of the site emergency communication network. Emergency phone numbers shall be posted at the phone or radio used for outside communication. The SSO is responsible for establishing the communication network prior to the start of work, and for explaining it to all site personnel during the site safety briefing.

In the event of an emergency, personnel will use the following hand signals where voice communications are not feasible:

Signal	Definition
Hands clutching throat	Out of air/can't breathe
Hands on top of head	Need assistance
Thumbs up	OK/I'm all right/I understand
Thumbs down	No/negative

Signal	Definition
Arms waving upright	Send back support
Grip partner's wrist	Exit area immediately

12.4 EMERGENCY RESPONSE PROCEDURES

The emergency response team will consist of employees who assume the following roles:

- Emergency Care Provider(s)—Provide first aid/cardiopulmonary resuscitation as needed.
- Communicator—The role of the communicator is to maintain contact with appropriate emergency services, providing as much information as possible, such as the number injured, the type and extent of injuries, and the exact location of the accident scene. The communicator should be located as close to the scene as possible in order to transmit to the emergency care providers any additional instructions that may be given by emergency services personnel in route.
- Site Supervisor—The site supervisor (usually the SSO) should survey and assess existing and potential hazards, evacuate personnel as needed, and contain the hazard. Followup responsibilities include replacing or repairing damaged equipment, documenting the incident, and notifying appropriate personnel/agencies described under incident reporting. They also include reviewing and revising site safety and contingency plans as necessary.

In the event of an emergency, notify site personnel of the situation. Survey the scene to determine if the situation is safe, to determine what happened, and to search for victims. The Emergency Response Checklist (Figure 12-1, provided at the end of Section 12) can be used to help remember the things to do in an emergency.

12.5 MEDICAL EMERGENCY RESPONSE PLAN

At least one URS employee on site will hold a current certificate in American Red Cross Standard First Aid. This training provides 6½ hours of adult cardiopulmonary resuscitation and basic first aid. If a medical emergency exists, the emergency phone number list shall be consulted and an ambulance immediately requested. The medical response team shall be informed about site chemicals present as relevant to the injured person. First aid/CPR shall be performed as necessary, the injured stabilized and decontaminated if necessary, and extricated **only** if the environment they are in is dangerous or unsafe and **only** if the rescuers are appropriately protected for potential hazards they may encounter during the rescue. When

emergency service personnel arrive, all first aid activities that have occurred shall be communicated. Responsibility for care of the injured/ill shall then be transferred to the emergency service personnel.

The following items and emergency response equipment will be located within easy access at all times:

- First aid kit and infection control kit
- Eyewash – A 15-minute eyewash (required if corrosives are present) or an appropriate amount of portable sterile eyewash bottles will be available on site for flushing foreign particles or contaminants out of eyes. The SSO will demonstrate the proper operation of the unit(s) prior to the start of work.
- Emergency phone numbers list
- Portable radios for emergency communications in remote areas

Drugs, inhalants, or medications shall not be included in the first aid kit.

Supplies should be re-ordered as they are used. The first aid kit and infection control kit contents shall be inventoried each month and supplies that have been used and not reported shall be re-ordered.

12.6 INCIDENT REPORT

All site injuries and illnesses must be reported to the SSO and PM immediately following first-aid treatment. The SSO will notify the RHSM (Tim Reinhardt 206-438-2286) within 24 hours of incident. Work is to be stopped until the PM or SSO has determined the cause of the incident and have taken the appropriate action to prevent a reoccurrence. Any injury or illness, regardless of severity, is to be reported (see SMS 049).

12.7 OPERATION SHUTDOWN

Under certain extremely hazardous situations the SSO or SSR may request that site operations be temporarily suspended while the underlying hazard is corrected or controlled. During operation shutdown, all personnel shall stand upwind to prevent exposure to fugitive emissions. The SSO, with concurrence from the RHSM, will have ultimate authority for operations shutdown and restart.

12.8 SPILL OR HAZARDOUS MATERIALS RELEASE

Small spills will be immediately reported to the SSO and dealt with according to the chemical manufacturer's recommended procedures found on the MSDS. Steps will be taken to contain and/or collect small spills for approved storage and disposal.

In the unlikely event of a larger release of hazardous materials as a result of site activities, site personnel will evacuate to the predesignated assembly area. The local Designated Emergency Response Authority (DERA) will be notified by the SSO immediately and appropriate actions will be taken to protect the public health and mitigate the contaminant release. The DERA can be reached through the local police or fire department. The Site Manager will make the following emergency contacts:

- Regional Health and Safety Manager – Tim Reinhardt (206) 438-2286
- URS Project Manager – Janette Rau (206) 438-2283
- USACE Project Manager – Mike Gross (503) 808-4913
- EPA Response Center (if reportable quantity is exceeded) – (800) 424-8802

Figure 12-1
Emergency Response Checklist

In an Emergency	Yes	No
Confirm the reported incident	_____	_____
Evacuate and secure the area	_____	_____
Render first aid/emergency medical care	_____	_____
Notify promptly:		
Project Manager	_____	_____
Fire department	_____	_____
Police department	_____	_____
Nearest hospital or medical care facility	_____	_____
Start documentation	_____	_____
If spill or leak occurs:		
Don the proper PPE	_____	_____
Stop the source	_____	_____
Contain the spill	_____	_____
Clean up the spill	_____	_____
Upon evacuating, take attendance at the assembly area	_____	_____
Authority given to:		
Leave the site	_____	_____
Restart the operations	_____	_____
Debrief and document the incident	_____	_____
A copy of the document submitted to the RHSM within 24 hrs	_____	_____

13.0 TRAINING, MEDICAL SURVEILLANCE, AND SITE INSPECTIONS

13.1 TRAINING AND MEDICAL SURVEILLANCE

All URS site personnel will have met the requirements of 29 CFR 1910.120(e), including:

- Forty hours of initial off-site training or its recognized equivalent
- Eight hours of annual refresher training for all personnel (as required)
- Eight hours of supervisor training for personnel serving as SSOs
- Three days of work activity under the supervision of a trained and experienced supervisor

All URS site personnel are participating in medical surveillance programs that meet the requirements of 29 CFR 1910.120(f). Current copies of training certificates and statements of medical program participation for all URS personnel are maintained by the local office.

In addition, all URS site personnel will review this HSP and sign a copy of the Safety Plan Compliance Agreement, which is found in Appendix C. The PM will maintain these agreements at the site, and place them in the project file at the conclusion of the operation.

Prior to the start of operations at the site, the SSO will conduct an initial site safety briefing that will include all personnel involved in site operations. At this meeting, the SSO will discuss:

- Contents of this HSP
- Types of hazards at the site and means for minimizing exposure to them
- The type of monitoring that will be performed
- Action levels for upgrade and downgrade of PPE
- PPE that will be used
- Site-specific respiratory protection requirements
- Decontamination protocol
- Site control measures, including safe operating practices and communication
- Location and use of emergency equipment
- Evacuation signals and procedures

Subsequent site safety briefings will be conducted at least weekly, or whenever there is a change in task or significant change in task location. Briefings will also be conducted whenever new personnel report to the site. All site personnel, including subcontractor personnel, will attend the briefings and sign the Site Safety Briefing form (see Appendix E).

13.2 SITE INSPECTIONS

The URS Site Manager or SSO will conduct a daily site inspection prior to the start of each shift. It is the responsibility of the PM or Site Manager to resolve discrepancies immediately, and contact the RHSM if necessary for assistance. Inspections will be documented and the documentation maintained on site until the completion of the project, at which time the records will be placed in the project files.

14.0 RECORDKEEPING

The PM and SSO are responsible for site recordkeeping. Prior to the start of work, they will review this plan; if there are no changes to be made, they will sign the approval form (PM) or acceptance form (SSO) and forward a copy to the RHSM.

All URS personnel will review the HSP and sign the Safety Plan Compliance Agreement in Appendix C; copies of these forms will be maintained in the project file as noted in Section 12.

The SSO will conduct a site safety briefing in accordance with Section 13 and have all attendees sign the form in Appendix C; copies will be maintained in the project file.

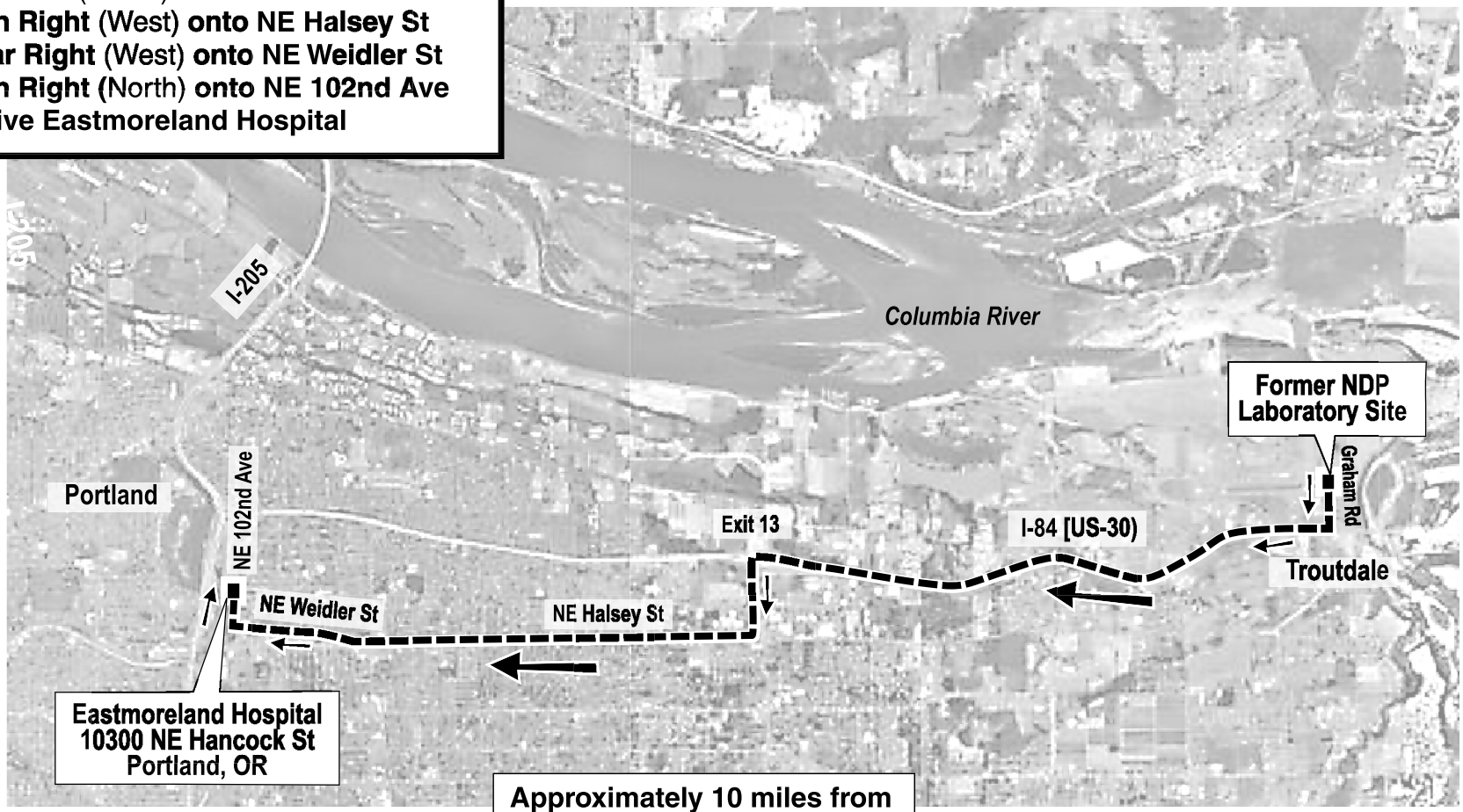
Any incident or exposure incident will be investigated and the incident report form (Attachment 49-1 to SMS 049) will be completed and forwarded to the office Human Resources Administrator and the RHSM.

All instrument readings and calibrations, PPE use and changes, health and safety-related issues, and deviations from or problems with this HSP will be recorded in the field logbook.

APPENDIX A

Hospital Route Map

1. **Merge onto I-84 [US-30]** (West)
2. **At I-84 Exit 13, turn off onto Ramp**
3. **Turn Left** (South) **onto NE 181st Ave**
4. **Turn Right** (West) **onto NE Halsey St**
5. **Bear Right** (West) **onto NE Weidler St**
6. **Turn Right (**North) **onto NE 102nd Ave**
7. **Arrive Eastmoreland Hospital**



Approximately 10 miles from site to Eastmoreland Hospital

NORTH

0 1
Scale In Miles

URS
53-F0074212

MANAGEMENT PLAN FOR
SITE INVESTIGATION
Former NPD Laboratory
Troutdale, Oregon

Figure A-1
Hospital Route

APPENDIX B

URS Project Hazard Analysis Form (PHA-1)
URS Safety Management Standards

URS	Health and Safety Program **PROJECT HAZARD ANALYSIS FORM**	Attachment PHA-1 Revision: 02/12/01

Completed by: Janette Rau Date: 5/30/01

Project Name: Former NPDL Site Investigation Project #: 53F00742 12.01

Determine the applicability of these SMSs to your project	See SMS #
Emergency Action Plan	003
Sanitation	030
Regulatory Inspections	001
Incident reporting	049

Will project activities involve any of the following?	Yes	See SMS #
Abrasive blasting or exposure to abrasive blasting media or waste?		006
Accident investigation?		049
Aerial lifts?		007
Air contaminants in hazardous concentrations?		043, 042
Asbestos surveys or abatement oversight?		008
Bloodborne Pathogens		051
Boating		027, 053
California job activities?		005
Computer use / ergonomic concerns?		054
Corrosive materials used or handled?		009
Confined space entries?		010
Cranes or hoists?		038, 041
Demolition activities of any type of structures?		011
Drilling	X	056, 034
Electrical equipment? • Generators? • Live electrical circuits?		012
Excavations or exposure to excavation hazards?	X	013
Fall Hazards (into sump?) HAB 9	X	040
Flammable or combustible materials used or stored which could constitute a fire hazard? methane, hexane	X	014, 015
Hand tool use: • Portable • Gas powered • Electric • Powder actuated	X	016
Hazardous materials shipping		048
Hazardous substances – physical, chemical or health hazards?	X	002

URS	Health and Safety Program PROJECT HAZARD ANALYSIS FORM	Attachment PHA-1 Revision: 02/12/01

Will project activities involve any of the following?	Yes	See SMS #
Hazardous waste activities (investigative or remedial)?	X	017
Heat Stress potential to employees working in: • Hot environments; or • Impermeable Chemical Protective Clothing?	X	018
Heavy equipment in use at this project site?	X	019
Hot Work (welding, cutting, grinding)		020
Industrial site access of any kind?		004
Lead exposures (lead paint removal, lead in dust, etc)?		022
Lockout/tagout to control exposure to hazardous energy?		023
Manbasket (Crane Suspended Personnel Platforms) for working at heights?		037, 038, 041
Marine Safety and Boat Operations		053
Medical Surveillance requirements? Examples would include exposures to: • Noise • Asbestos • Lead • Hazardous Wastes • High Altitude • Carcinogens • Respirator Use	X	024
Noise exposures?	X	026
Nuclear Density Gauge Use		044
Portable ladder use?		028
Personal protective equipment?	X	029
Radiation		052
Respiratory protection use – required and/or voluntary?		042
Scaffolding?		031
Sewer Entry		010
Subcontractors?	X	046
Traffic control due to work in streets and/or roadways?		032
Travel to remote locations and/or developing countries?		036
Utility Clearances – overhead or underground? both	X	034
Unexploded Ordnance/Chemical Warfare agents present or potential?		039
Underground Storage Tank investigation, removal, etc.		033
Water, work over or around?		027
Work at altitudes greater than 7,000 feet (~ 2,100 meters)		035
Working at heights of greater than 6 feet without protective measures such as guard rails?		040

URS SAFETY MANAGEMENT STANDARD

Worker Right-to-Know (Hazard Communication)

1. Applicability

This procedure applies to URS office and field operations.

2. Purpose and Scope

The worker right-to-know program provides URS personnel with information and training about safety and health hazards associated with the chemicals they might encounter in the workplace. This procedure describes how chemical safety hazards are communicated to URS personnel working in offices and at field site locations, and how information is to be provided to employees of other employers working at the location. The requirements include steps to acquire this information, maintain it, and train everyone to use it.

3. Implementation

Office Locations: Implementation of this program is the responsibility of the Office Manager.

Field Activities: Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Hazardous Material Inventory

1. Maintain a hazardous material inventory that lists all of the hazardous materials used at this workplace. Use chemical names consistent with the applicable MSDS's.

2. File a copy of the chemical inventory in the Safety Filing System.

B. Material Safety Data Sheets (MSDS's)

1. Obtain a MSDS for each chemical before it is used.

2. Review each MSDS when it is received to evaluate whether the information is complete and to determine if existing protective measures are adequate.

3. Maintain a collection of all MSDS's where they are accessible at all times.

4. Replace MSDS sheets when updated sheets are received. Communicate any significant changes to those who work with the chemical.

5. MSDS's are required for all hazardous materials used on site by project personnel.

C. Labels

Label all chemical containers with:

1. Identity of the hazardous chemical(s),

2. Appropriate hazard warnings, and

3. Name and address of the chemical manufacturer, importer, or other responsible party.

D. Hazardous Nonroutine Tasks

Periodically, employees are required to perform hazardous non-routine tasks. Prior to starting work on such projects, provide each employee with information about hazards to which they may be exposed during such an activity.

This information will include:

1. Specific chemical hazards.

2. Protective/safety measures which must be utilized.

3. Measures that have been taken to lessen the hazards including ventilation, respirators, presence of another employee and emergency procedures.

E. Informing Contractors/Subcontractors

Provide contractors/subcontractors the following information on chemicals used by or provided to URS personnel:

1. Names of hazardous chemicals to which they may be exposed while on the jobsite.

2. Precautions the employees may take to lessen the possibility of exposure by usage of appropriate protective measures.

3. Location of URS MSDS's and written chemical inventory.

F. Training

1. Conduct training of all employees potentially exposed to hazardous materials on the following schedule:

   a. Before new employees begin their jobs.

   b. Whenever new chemicals are introduced into the workplace, or

   c. Annually thereafter.

2. This training will include:

   a. Applicable regulatory requirements.

   b. Names of those responsible for implementing this program.

   c. Location of the program, inventory and MSDS 's.

   d. Chemicals used, and their hazards (chemical, physical and health).

   e. How to detect the presence or release of chemicals.

   f. Safe work practices.

   g. How to read an MSDS.

3. Document the training.

5. Documentation Summary

A. File these records in the Office Safety Filing System

1. Chemical Inventory.

2. Location of the MSDS inventory.

3. Training records.

4. Contractor/Subcontractor notifications.

B. File these records in the Project Safety File.

1. Chemical Inventory.
2. Location of the MSDS inventory.
3. Training records.
4. Contractor/Subcontractor notifications.

6. Resources

A. U.S. OSHA Technical Links - Hazard Communication (http://www.osha-slc.gov/SLTC/hazardcommunications/index.html)

B. U.K. - Control of Substance Hazardous to Health - Regulations

URS **SAFETY MANAGEMENT STANDARD**

Excavation Safety

1. Applicability

This procedure applies to projects where URS controls trenching and excavation activities, and/or where URS employees are exposed to hazards associated with trenching and excavation activities.

2. Purpose and Scope

This procedure is intended to protect personnel from the hazards associated with excavation entry activities.

3. Implementation

Field Operations - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Competent Person

Appoint an Excavation Competent Person when URS controls excavation activities. The Excavation Competent Person:

1. Is responsible for conducting daily inspections of excavation, adjacent areas, and protective systems prior to each shift.
2. Is responsible for inspection after every rainstorm or other hazard.
3. Must have knowledge of soils and soil classification.
4. Understands design and use of protective systems.
5. Has authority to stop work and take corrective actions when conditions change.
6. Has the ability to recognize and test hazardous atmospheres.
7. Has formal documentation of training as an Excavation Competent Person.
8. Is physically located at the excavation while work is in progress.

B. Access/Egress

1. Trench excavations will have ramps or ladders within 25 feet (8 meters) of the entrants.

C. Soil Classification

Soil classifications must be conducted in accordance with Attachment 13-1. For the purposes of this standard all soils will be classified by a person meeting the qualifications of a competent person as described in 29 CFR 1929 subpart P. The competent person shall consult with a Registered Professional Engineer in the event the soil classification requires additional technical expertise.

D. Protective Systems

Protect employees in excavations deeper than 4 feet (1.2 meters) by means of properly designed protective systems. All protective systems must comply with 29 CFR 1926 Subpart P Appendices B, D, and E.

1. Sloping and Benching

   See Attachment 13-2

2. Timber Shoring for Trenches

   Timber shoring for trenches must be designed and stamped by a Registered Professional Engineer in accordance with 29CFR Subpart P, Appendix C.

3. Aluminum Hydraulic Shoring for Trenches

   Aluminum hydraulic shoring for trenches must be approved by a Registered Professional Engineer in accordance with 29CFR 1926 Subpart P, Appendix D.

4. Alternatives to Timber Shoring

   Trench shields and boxes must be either premanufactured with listed load ratings or designed, stamped and constructed under the direction of a Registered Professional Engineer.

5. Protective systems designed to protect employees in excavations deeper than 20 feet (6.1 meters) must be designed and stamped by a Registered Professional Engineer.

6. Excavations will be clearly identified and barricaded to keep unauthorized individuals out.

E. Permit Authorization and Inspections

1. Use the Excavation Authorization Form (Attachment 13-3) of this procedure that requires the following issues to be addressed:

   a. Employee training/briefings.

   b. Electrical safety.

   c. Surface encumbrances.

   d. Underground installations and utilities.

   e. Protective systems.

   f. Access and egress.

   g. Exposure to vehicular traffic.

   h. Exposure to falling loads.

   i. Warning systems for mobile equipment.

   j. Testing for hazardous atmospheres.

   k. Emergency rescue equipment.

   l. Protection from hazards associated with water accumulation.

   m. Stability of adjacent structures.

   n. Protection of employees from loose rock.

   o. Inspections.

   p. Fall protection.

2. Require daily inspections of excavations to be conducted by Competent Person using Attachment 13-4.

F. Training/Briefings

Conduct daily safety briefings for all employees associated with excavation activities and document on Attachment 13-3. Discuss excavation hazards, protective measures, and work practices that will be applicable to the day's activities.

5. Documentation Summary

Records required for the Project Safety File:

A. Competent person qualifications.

B. Excavation Authorization Form.

C. Daily Competent Person inspections.

D. Daily worker briefing documentation.

E. Daily inspection records.

6. Resources

A. U.S. OSHA Standard - Excavations - 29 CFR 1926, Subpart P

1. Appendix B, Sloping and Benching
2. Appendix C, Timber Shoring
3. Appendix D, Aluminum Hydraulic Shoring

B. U.S. OSHA Technical Links - Trenching and Excavation

The following documents are PDF files requiring the use of Adobe Acrobat reader.

C. US Army Corp of Engineers projects, the requirements of EM 385-1-1, Section 25 (PDF file)

D. Attachment 13-1 - Soils Classification

E. Attachment 13-2 - Simple Slopes

F. Attachment 13-3 - Excavation Authorization Form

G. Attachment 13-4 - Daily Excavation/Trench Inspection Form

SOILS CLASSIFICATION

"Type A" soils

Are cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144kPa) or greater.

Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A.

However, no soil is Type A if:

i. The soil is fissured; or
ii. The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
iii. The soil has been previously disturbed; or
iv. The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V)or greater; or
v. The material is subject to other factors that would require it to be classified as a less stable material.

"Type B" soils are:

i. Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or
ii. Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.
iii. Previously disturbed soils except those which would otherwise be classed as Type C soil.
iv. Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or
v. Dry rock that is not stable; or
vi. Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

"Type C" soils are:

i. Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or
ii. Granular soils including gravel, sand, and loamy sand; or
iii. Submerged soil or soil from which water is freely seeping; or
iv. Submerged rock that is not stable, or
v. Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

SIMPLE SLOPES

MAXIMUM ALLOWABLE SLOPES
SOIL OR ROCK TYPE
MAXIMUM ALLOWABLE SLOPES (H:V)[1]
FOR
EXCAVATIONS LESS THAN 20 FEET DEEP[3]

STABLE ROCK	VERTICAL (90 Deg.)
TYPE A[2]	¾:1 (53 Deg.)
TYPE B	1:1 (45 Deg.)
TYPE C	1 ½:1 (34 Deg.)

[1] *Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.*

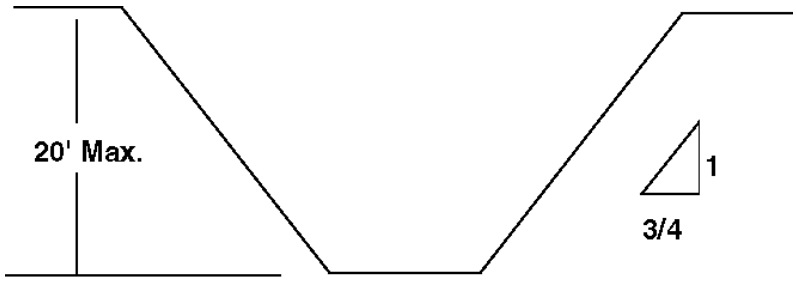
[2] *A short-term maximum allowable slope of 1/2H:1V (63 degrees) is allowed in excavation in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth shall be 3/4H:1V (53 degrees).*

[3] *Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.*

Slope Configurations (All slopes stated below are in the horizontal to vertical ratio)

Excavations Made in Type A Soil

All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of ¾:1.



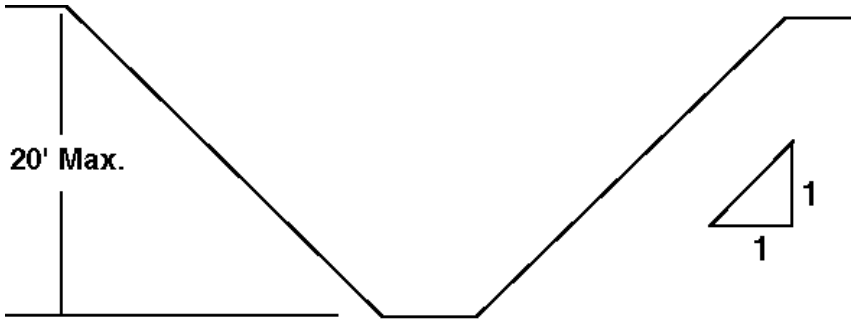
SIMPLE SLOPE - GENERAL

<u>Exception:</u> Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of ½:1.

SIMPLE SLOPES

Excavations Made in Type B Soil

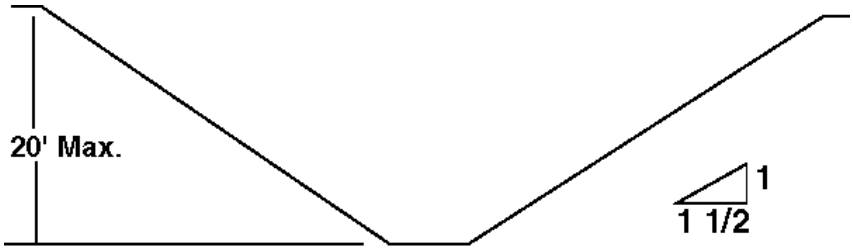
All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1.



SIMPLE SLOPE

Excavations Made in Type C Soil

All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1½:1.



SIMPLE SLOPE

URS	Health and Safety Program **EXCAVATION / TRENCHING AUTHORIZATION**	Attachment 13-3

POST AT LOCATION
(GOOD FOR ONE WEEK ONLY)

Authorization No. _____ Authorization From _____ To _____

Competent Person: _____

Project Name: _____ Project Location: _____

Description of Job or Special procedures:

Check Yes, No, or N/A for Not Applicable

EMPLOYEE TRAINING AND PRE-EXCAVATION BRIEFING

1. Safe Excavation and Rescue Training Conducted on: Date:			
2. Mandatory pre-excavation briefing conducted on: Date:			
	Yes	**No**	**N/A**
3. Does this job require special training?	○	○	○

ELECTRICAL SAFETY

	Yes	**No**	**N/A**
1. Are all electrical devices grounded, double insulated, or GFCI protected?	○	○	○
2. Have all power cords and tools been visually inspected?	○	○	○

SURFACE ENCUMBRANCES

1. Have all surface encumbrances that are located so as to create a hazard to employees been removed or supported, as necessary, to safeguard employees?	○	○	○

UNDERGROUND INSTALLATIONS

1. Have the estimated locations of all underground installation been determined prior to excavation?	○	○	○
2. Have utility companies been contacted and advised of proposed work?	○	○	○
3. Are underground installations protected, supported or removed while excavations are open?	○	○	○

PROTECTIVE SYSTEMS

1. Excavation slopes comply with Type C Soil Classification?	○	○	○
2. If no to question 1, has soil been examined and been determined to be other than Type C soil by a Competent Person?	○	○	○
3. If protective measures beyond sloping are required, do they meet OSHA Appendix standards?	○	○	○

EXCAVATION / TRENCHING AUTHORIZATION

	Yes	No	N/A
4. If no to question 3, has the protective system been designed and stamped by a Registered Professional Engineer?	○	○	○

MEANS OF EGRESS FOR TRENCHES DEEPER THAN 4 FEET

1. Are stairways, ladders, or ramps provided every 25 feet?	○	○	○

ACCESS AND EGRESS

1. Are structural ramps that are used solely by personnel as a means of access or egress from excavations designed by a competent person?	○	○	○
2. Are ramps and runways constructed so structural members are connected to prevent displacement?	○	○	○
3. Are structural ramps that are used for access and egress of equipment designed by a competent person qualified in structural design and constructed in accordance with the design?	○	○	○
4. Are structural members used for ramps and runways of uniform thickness?	○	○	○
5. Are cleats used in connecting runway structural members attached in a manner to prevent tripping?	○	○	○
6. Are structural ramps used in lieu of steps provided with cleats or other surface treatment to prevent slipping?	○	○	○

EXPOSURE TO VEHICULAR TRAFFIC

1. Are personnel exposed to public vehicular traffic wearing reflectorized or high visibility vests?	○	○	○

EXPOSURE TO FALLING LOADS

1. Are employees prohibited from standing underneath loads handled by lifting or digging equipment?	○	○	○
2. Are employees prohibited from standing next to vehicles being loaded or unloaded?	○	○	○

WARNING SYSTEMS FOR MOBILE EQUIPMENT

1. Are warning systems such as barricades, hand or mechanical signals, or stop logs utilized when mobile equipment is operated adjacent to or at the edge of an excavation?	○	○	○

TESTING FOR HAZARDOUS ATMOSPHERES

1. Are the atmospheric hazards that can be reasonably expected to exist in excavations greater then 4 feet deep tested and controlled?	○	○	○

	READING:	TIME:	INITIAL:
2. Test of Oxygen Content:	_____ % 02 (19.5% Minimum)	_____	_____
3. Test for Flammable Concentrations:	_____ % LEL (10% Maximum)	_____	_____
4. Test for Toxic Concentration:	_____ %PPM of _____	_____	_____

EXCAVATION / TRENCHING AUTHORIZATION

	Yes	No	N/A
5. Is testing conducted as often as necessary to ensure safety personnel?	○	○	○

EMERGENCY RESCUE EQUIPMENT

1. Is emergency rescue equipment such as SCBA, safety harness and line, or basket stretcher readily available and attended when hazardous atmospheric conditions exist?	○	○	○
2. Are employees who enter bell-bottom pier holes or other similar deep and confining excavations wearing a body harness with a life-line?	○	○	○

PROTECTION FROM HAZARDS ASSOCIATED WITH WATER ACCUMULATION

1. Are employees prohibited from entering excavations that have accumulated water?	○	○	○
2. Is water being controlled or prevented from accumulating in excavation by the use of water removal equipment?	○	○	○
3. Is water control equipment operation being monitored by a competent person?	○	○	○
4. Are diversion ditches, dikes, or other suitable means used to prevent surface water from entering excavation?	○	○	○
5. Are excavations subjected to run-off from heavy rain immediately re-inspected by a competent person?	○	○	○

PROTECTION OF EMPLOYEES FROM LOOSE ROCK OR SOIL

1. Is adequate protection provided to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face?	○	○	○
2. Are employees protected from excavated or other material and equipment by placing this material a minimum of two (2) feet from the edge of excavations or by the use of retraining devices?	○	○	○

STABILITY OF ADJACENT STRUCTURES

1. Are support systems such as shoring, bracing, or underpinning provided to ensure stability of adjoining structures (i.e., buildings, walls) endangered by excavation activities?	○	○	○
2. Has any excavation below the level of the base or footing of foundations or retaining walls been:			
• Provided with a support system such as under pinning to ensure the safety of employees and stability of the structure?	○	○	○
• Performed in stable rock?	○	○	○
• Determined by a registered professional engineer that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity?	○	○	○
• Determined by a registered professional that the excavation work will not pose a hazard to employees?	○	○	○
3. Is the undermining of sidewalks and pavement structures prohibited?	○	○	○

INSPECTIONS

1. Are daily inspections of excavations where employee exposure can be reasonably anticipated being done by the competent person?	○	○	○
2. Are inspections being performed by a competent person after every rainstorm or other hazard increasing occurrence?	○	○	○
3. Are employees removed from the excavation if the competent person finds evidence at any time of a situation that could result in a possible cave-in, protective system failure, hazardous atmosphere or other hazardous condition?	○	○	○

URS	Health and Safety Program **EXCAVATION / TRENCHING AUTHORIZATION**	Attachment 13-3

	Yes	No	N/A

FALL PROTECTION

1. Are standard guardrails provided on walkways and bridges that cross over excavations?	○	○	○
2. Are all remotely located excavations adequately barricaded or covered?	○	○	○
3. Are temporary wells, pits, shafts and similar exploratory operations backfilled upon completion?	○	○	○

I have inspected the excavation described in this authorization:

Signature of Competent Person _____ Date _____

URS	Health and Safety Program **DAILY EXCAVATION / TRENCH INSPECTION REPORT**	Attachment 13-4

Competent Person: _____ Date: _____

Project Name: _____ Weather Conditions: _____

Project Location: _____ Rainfall Amounts 24 hours Previous: _____

"I hereby attest that the following conditions existed and that the following items were checked or reviewed during this inspection".

Check Yes, No or N/A for Not Applicable. If comment is required, circle the number and see Page 2.

		Yes	No	N/A
1.	Are barricades or covers in place and in good condition?			
2.	Have any tension cracks observed along top on any slopes?			
3.	Is excavated material at least 2' from the edge of the excavation.			
4.	Are slopes cut at design angle of repose?			
5.	Is any water seepage noted in trench walls or bottom?			
6.	Are pumps in place or available if needed?			
7.	Is bracing system installed in accordance with design?			
8.	Is there evidence of significant fracture planes in soil or rock?			
9.	Is there any evidence of caving or sloughing of soil since the last inspection?			
10.	Are there any zones of unusually weak soils or materials not anticipated?			
11.	Are there any noted dramatic dips or bedrock?			
12.	Are all short-term trench(s) covered within 24 hours?			
13.	Have non-compliance items been photographed?			
14.	Are hydraulic shores pumped to design pressure?			
15.	Is shoring being used secure?			
16.	Does plan include adequate safety factor for equipment being used?			
17.	Is traffic adequately away from trenching operation?			
18.	Are barricade up and secure?			
19.	Are there trees, boulders or other hazards in area?			
20.	Is vibration from equipment or traffic to close to trenching operation?			
21.	Are trench box(s) certified?			
22.	Are GFCI's used on ALL temporary electrical cords?			
23.	Is access and egress located every 25 feet?			
24.	Is hazardous testing done on a regular basis?			
25.	Has rescue procedure been established and is equipment immediately available?			

Comments: Place question number in front of applicable comment.

URS SAFETY MANAGEMENT STANDARD

Fire Prevention

1. Applicability

This procedure applies URS office and project locations.

2. Purpose and Scope

The purpose of this procedure is to reduce/eliminate potential fire hazards in the workplace and to provide for a rapid, effective response should a fire occur.

3. Implementation

Office Locations – Implementation of this procedure is the responsibility of the Office Manager.

Field Activities – Implementation of this procedure is the responsibility of the Project Manager.

4. Requirements

General

A. Develop an Emergency Action Plan as outlined in SMS 3, "Emergency Action Plans."

B. Maintain good housekeeping to reduce fire hazards and to provide safe routes of egress should a fire occur.

C. Provide the appropriate number and types of fire extinguishers for the operations being performed. Refer to Attachment 14-1 for guidance.

D. Inspect fire extinguishers monthly and maintain an inspection log.

E. Conduct frequent periodic inspections to identify fire hazards such as:

1. Unnecessary accumulation of combustibles.

2. Unnecessary storage of flammables.

3. Sources of ignition (e.g., faulty wiring, sparks, open flame, etc.).

F. Remove all fire hazards promptly.

G. Prohibit smoking and other ignition sources in flammable storage and other fire hazard areas.

H. Post emergency numbers near telephones and evacuation maps in appropriate locations.

I. Conduct evacuation drills.

J. Train employees in:

1. Fire hazard recognition.
2. Fire hazard prevention.
3. Fire extinguisher use.
4. Emergency and evacuation procedures.

6. Documentation Summary

File the following in the Office/Project Health and Safety File:

A. Emergency Action Plans.

B. Fire extinguisher inspection logs.

C. Employee training documentation.

D. Site audits.

E. Evacuation drills.

7. Resources

A. U.S. OSHA Standard - Means of Egress - 29 CFR 1910, Subpart E

B. U.S. OSHA Standard - Employee Emergency Plans and Fire Prevention Plans - 29 CFR 1910.38

C. U.S. OSHA Standard - Fire Protection - 29 CFR 1910, Subpart L

D. U.S. OSHA Technical Links - Fire Safety

E. U.S. OSHA Construction Standard - Fire Protection and Prevention 29 CFR 1926, Subpart F

F. U.K. - "Fire Precaution" Regulations

G. Australian Standards AS 1851.1-1995 - Maintenance of Fire Protection Equipment - Portable Fire Extinguishers and Blankets

H. Australian Standards Collection 15 - Fire Extinguishing Equipment

I. USACE EM 385-1-1 Section 9 - Fire Prevention and Protection

J. Attachment 14-1 - Fire Extinguisher Placement Guidelines

FIRE EXTINGUISHER PLACEMENT GUIDELINES

1. Fire Extinguishers – General

The following are **minimum** requirements for fire extinguisher placement in office buildings, construction facilities, support buildings, and/or buildings under construction. In some cases, client requirements may be more stringent, in which case the client's requirements supercede the guidelines below.

A. A fire extinguisher, rated at a minimum of 2A, must be provided for each 3,000 square feet of the protected building area, or major fraction thereof. Travel distance from any point of the protected area to the nearest fire extinguisher shall not exceed 100 feet.

B. At least one fire extinguisher, rated at a minimum of 2A, must be provided on each floor. In multi-story buildings, at least one fire extinguisher must be located adjacent to the stairway.

C. Where more than 5 gallons of flammable or combustible liquids or 5 pounds of flammable gas are being used, a fire extinguisher, rated at least 10B, must be provided within 50 feet.

D. Portable fire extinguishing equipment, suitable for the fire hazard involved, must be provided at convenient, conspicuously accessible locations in Yard Storage areas. Portable fire extinguishers, rated at least 2A, shall be placed so that maximum travel distance to the nearest unit does not exceed 100 feet.

2. Flammable/Combustible Liquid Storage

The following are **minimum** requirements for fire extinguisher placement in flammable/combustible liquid and gas storage areas. In some cases, client requirements may be more stringent, in which case the client requirements supercede the guidelines below. Refer to SMS 15, "Flammable and Combustible Liquids and Gases, Attachment 15-2".

A. At least one portable fire extinguisher, rated at least 20B, must be located outside of, but not more than 10 feet from, the door opening into any room used for storage of more than 60 gallons of flammable or combustible liquids.

B. At least one portable fire extinguisher, rated at least 20B, must be located not less than 25 feet, nor more than 75 feet, from any flammable liquid storage area located outside.

C. At least one portable fire extinguisher, rated at least 20BC, must be provided on all tank trucks or other vehicles used for transporting and/or dispensing flammable/combustible liquids.

D. At least one fire extinguisher, rated at least 20BC, must be provided within 75 feet of each pump, dispenser, underground fill pipe opening, and lubrication/service areas.

E. At least one fire extinguisher, rated at least 20BC, must be provided at each LPG container storage area.

3. Hot Work

A minimum of one fire extinguisher, rated at least 20BC, must be provided for each hot work location. The extinguisher should be conspicuously positioned no more than 10 feet from the hot work. Refer to SMS 20, “Hot Work”.

URS SAFETY MANAGEMENT STANDARD

Flammable and Combustible Liquids and Gases

1. Applicability

This procedure applies to URS office and field operations where flammable and combustible liquids and gases are stored or used.

2. Purpose and Scope

The purpose of this procedure is to provide information regarding the proper storage, handling and work practices associated with flammable and combustible liquids and gases.

3. Implementation

Office Locations- Implementation of this program is the responsibility of the Office Manager.

Field Activities- Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Appoint a Responsible Person who will:

1. Inspect storage areas periodically.
2. Monitor the quantity of flammable and combustible liquids and gases on the site.
3. Review work practices.

B. Control flammables, combustibles, and flammable gases entering the site.

1. Order only those materials and quantities that are needed to complete a job.
2. Check compliance with SMS 2, "Worker Right to Know".

C. Storage

1. Store flammable and combustible materials in appropriate tanks and containers. See Attachment 15-1.
2. Limit building storage outside of a flammable storage cabinet or storage room per Attachment 15-1.

3. Store oxidizers separately from flammables.

4. Segregate gas cylinders for storage based on their hazard (keep oxygen and acetylene cylinders stored separately).

D. Labeling and Signage

1. Post a "NO SMOKING OR OPEN FLAME" sign in all areas where flammable and combustible materials are stored, handled, and processed.

2. Require all containers and cylinders to be labeled with the contents and hazard-warning label.

E. Use of Materials on Site

1. Use flammable, combustible, and compressed gases in a manner that is consistent with the label and material safety data sheet for the product.

2. Use only those amounts of materials needed for the job. Transfer of flammables, combustibles, oxidizers to ready use containers is encouraged.

3. Use personal protective equipment stated on the product label and material safety data sheet.

F. Spill Control

1. Have a written spill response plan in place before materials are stored on site.

2. Clean up or respond to spills promptly.

G. Disposal

1. Keep solvent waste and flammable liquids in fire resistant, covered containers until they are removed from the worksite.

2. Do not place flammable or combustible waste in municipal garbage.

3. Dispose of flammable hazardous materials with a licensed hazardous material disposal company.

H. Inspection

1. Periodically inspect flammable and combustible storage and use areas; gas storage areas and oxidizer storage areas:

    a. Office settings inspect quarterly.

    b. Field related projects, inspect once a month.

2. Use the inspection sheet provided as Attachment 15-2 to inspect the storage areas.

I. Training

Require that Hazard Communication training includes specific hazard information for the flammables, combustibles and oxidizers used.

5. Documentation Summary

A. File these records in the Office Safety Filing System:

1. Location of the MSDS inventory.

2. Completed Flammable and Combustibles Inspection Checklist.

B. File these records in the Project Safety Filing System:

1. Attach program to Project Safety Action Plan.

2. File these records in the Project Safety File.

    a. Location of the MSDS inventory

    b. Completed Flammable and Combustible Inspection Checklist.

6. Resources

A. National Fire Protection Association - Standard 58

B. Regulations of the U.S. Coast Guard

C. U.S. OSHA Standard - Flammable and Combustible Liquids - 29 CFR 1910.106

D. U.K. - "Highly Flammable Liquids" and "Liquid Petroleum Gases" Regulations

E. Australian Standards AS 1940-1993. The Storage and Handling of Flammable and Combustible Liquids

F. Attachment 15-1 - Flammable and Combustible Liquid Classifications

G. Attachment 15-2 - Flammable, Combustible, Oxidizer & Compressed Gas Inspection Sheet

FLAMMABLE AND COMBUSTIBLE LIQUID CLASSIFICATIONS

Flammable Liquid	Flash Point	Boiling Point
Class 1A	< 73^0 F	< 100^0 F
Class 1B	< 73^0 F	> 100^0 F
Class 1C	> 73^0 F < 100^0 F	
Combustible Liquid		
Class 2	> 100^0 F < 140^0 F	
Class 3	≥ 140^0 F	

Maximum Allowable Size of Containers and Portable Tanks

	Flammable Liquids			Combustible Liquids	
Container Type	Class 1A	Class 1B	Class 1C	Class II	Class III
Glass or approved plastic	1 pt	1 qt	1 gal	1 gal	1 gal
Metal (other than DOT drums)	1 gal	5 gal	5 gal	5 gal	5 gal
Safety cans	2 gal	5 gal	5 gal	5 gal	5 gal
Metal drums (DOT specifications)	60	60	60	60	60
Approved portable tanks	660 gal	660 gal	660 gal	660 gal	660 gal

Maximum Storage in Buildings Outside of Storage Cabinet or Storage Room

Type	Amount
Class 1A	25 gallons
Class 1B (containerized)	120 gallons
Class 1B (single portable tank)	660 gallons
Class 1C (Containerized)	120 gallons
Class 1C (single portable tank)	660 gallons
Class 2 (containerized)	120 gallons

URS	Health and Safety Program FLAMMABLE, COMBUSTIBLE, OXIDIZER & COMPRESSED GAS INSPECTION CHECKLIST	Attachment 15-2

Location Inspected: _____ **Job No.:** _____

Date Inspected: _____ **Name of Inspector:** _____

		Yes	No	N/A
	Storage Cabinets			
1.	Flammable cabinets do not obstruct room exits.			
2.	No more than 60 gallons of flammable or 120 gallons of combustible liquid is stored in a cabinet.			
3.	No more than three cabinets are located in a storage area.			
4.	Metal storage cabinets have self-closing doors.			
5.	Cabinets are labeled “FLAMMABLE-KEEP FIRE AWAY”			
	Safety Cans			
6.	Safety cans are constructed of stainless steel, Monel or tin.			
7.	Safety cans have a flame arrestor and spring-loaded cap on both the filling and pouring spouts.			
	Drum & Drum Storage Areas			
8.	Drums are stored in a vertical position.			
9.	Bungs are closed when liquid is not being transferred.			
10.	Drums are shielded from the sun.			
11.	Funnels with installed flash arrestor are used when transferring flammable liquids into drums.			
12.	A minimum distance of 25 feet between a drum storage area and buildings is present.			
13.	A “NO SMOKING” sign is posted in the area.			
14.	An emergency spill kit is near the drum storage area.			
15.	A 20 lb. Dry-chemical fire extinguisher is no less than 10 feet or more than 50 feet from the storage area.			
	Waste Cans			
16.	Combustible scrap, debris and waste materials (oily rags, etc.) are stored in covered metal cans.			
17.	Waste cans are removed from the work area daily.			
18.	Waste cans have spring-loaded self-closing lids.			
	Storage Rooms Designed Specifically For Flammable			
19.	Room construction meets NFPA fire-resistance requirements.			
20.	Rooms with automatic extinguishing systems have the following:			

FLAMMABLE, COMBUSTIBLE, OXIDIZER & COMPRESSED GAS INSPECTION CHECKLIST

		Yes	No	N/A
	• Noncombustible liquid-tight raised sills or ramps at least 4 inches in height.			
	• Flooring at least four inches below the surrounding floor, or an open grated trench that drains to a safe location.			
	• Openings with approved self-closing fire doors.			
	• Liquid-tight construction where the walls join the floors.			
	• Shelving, racks, dunnage floor overlay and other interiors with one inch wood.			
21.	Rooms are ventilated by a gravity or mechanical exhaust system that:			
	Commences not more than 12 inches above the floor.			
	• Is designed to provide for a complete change of air within the room at least six times per hour.			
	• Is controlled by a switch located outside the door, with ventilating equipment and any light fixtures operated form the same switch.			
	Flammable & Combustible Storage Areas Within Buildings			
22.	At least one portable fire extinguisher rated not less than 20-B is located outside of but not more than ten feet from the door opening into any room used for the storage of more than sixty gallons of flammable or combustible liquids.			
23.	Buildings or rooms are locked when not occupied.			
24.	Exits, stairways or passageways are not used for storing flammables and combustibles.			
25.	No more than 25 gallons of Class IA or 60 gallons of Class IB; II or III liquids is located in a room outside of a flammable storage locker or flammable storeroom.			
26.	An isle at least three feet wide is maintained in storage areas.			
27.	No more than those amounts needed for one day's use are stored in buildings under construction.			
	Outside Storage of Flammable and Combustible Liquids			
28.	At least one portable fire extinguisher having a rating of not less than 20-B is located not less than twenty-five feet or more than 75 feet from any outside flammable liquid storage area.			
29.	For containers not more than 60 gallons each, no more than 1,100 gallons in any one group are stored.			
30.	Groups of containers are separated by five-foot clearances.			
31.	Groups of containers are more than fifty feet from buildings.			
32.	Portable tanks (not exceeding 660 gallons in capacity) are provided with emergency venting devices as specified by NFPA 30.			
33.	Storage areas are free of accumulation of weeds, debris, and other combustible materials not necessary to the storage.			

		Yes	No	N/A
Storage Tanks				
34.	Tanks have relief vents.			
35.	Tank vents are not close to open flames, stacks, heating apparatus, or any other source of ignition.			
36.	A dike or curb or other suitable means to prevent the spread of leakage from tanks.			
37.	Diked areas have a capacity equal in volume to at least that of the largest tank plus 10% of all other tanks in the enclosure.			
38.	Provisions to drain off accumulations of ground or rainwater or spills in diked areas.			
Dispensing of Flammable and Combustible Liquids				
39.	Dispensing outlets for above ground tanks with nationally listed automatic-closing valve, without a latch-open device.			
40.	Dispensing Systems are electrically bonded and grounded.			
41.	Tanks, hoses and containers of five gallons or less in metallic contact while transferring flammable liquids.			
42.	Electrically bonded systems are used for transferring flammable liquids in containers in excess of five gallons.			
43.	Closed piping systems are used for drawing flammable liquids during transfer.			
44.	Flammables and combustibles are drawn from a container or portable tank by use of gravity or through a pump suing an approved self-closing valve.			
Liquefied Petroleum Gas – Refueling				
45.	Equipment is shut down during refueling operations.			
46.	Leather gloves and safety glasses are worn during refueling operations.			
47.	Smoking and hot work is prohibited during refueling.			
48.	Refueling occurs at least 25 feet from buildings.			
Compressed Gases - Storage				
49.	Cylinders must be capped when regulators are removed.			
50.	Oxygen and fuel cylinders are stowed in designated well-ventilated areas.			
51.	Storage areas have temperatures less than 130 degrees.			
52.	Cylinders are stored upright and secured from falling over.			
53.	Cylinders are in segregated groups by gas type and not intermingled with other cylinders.			
54.	Oxygen cylinders are stored at least 20 feet away from flammables. (A fire resistive partition of at least 1-hour fire resistance rating of at least 5-foot height may also be used.)			
55.	Flammable or combustible materials are kept at least 20 feet away from stored cylinders.			

		Yes	No	N/A
56.	Gas cylinder valves are protected from snow and ice during winter months.			
57.	Oxygen cylinders are kept free from oil and grease.			
58.	Welding cylinders are securely fastened to ready-use racks.			
59.	Smoking or open flames are not permitted in areas where cylinders are stored.			
60.	Cylinder storage areas are posted with the following sing: "DANGER – NO SMOKING OR OPEN FLAME"			
61.	Cylinders are labeled with gas contents and warning statement.			
62.	Empty cylinders are segregated from full cylinders.			
Oxidizers				
63.	Oxidizers are stored separately from flammables.			
64.	When oxidizers are shifted to a second container, the container is labeled with the appropriate warning labels.			
65.	Secondary containers are compatible with oxidizers.			
66.	Oxidizers are stored away from heat sources where the maximum temperature exceeds 100 degrees F.			
67.	Chromic acid, nitric acid, perchloric acid, potassium permanganate (all oxidizers) are stored separately from other corrosives and flammables.			

URS SAFETY MANAGEMENT STANDARD

Hand Tools and Portable Equipment

1. Applicability

This procedure applies to URS operations involving the use of hand tools and/or power equipment, including chain saws, brush cutters, powder-actuated tools, and similar high-hazard implements.

2. Purpose and Scope

The purpose of this standard is to provide guidelines for the safe use and handling of hand tools and power equipment.

3. Implementation

Office/Facility Locations - Implementation of this program is the responsibility of the Office Manager.

Field Locations - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. General

1. Keep hand and power tools in good repair and used only for the task for which they were designed.
2. Remove damaged or defective tools from service.
3. Keep surfaces and handles clean and free of excess oil to prevent slipping.
4. Do not carry sharp tools in pockets.
5. Clean tools and return to the toolbox or storage area upon completion of a job.
6. Wrenches must have a good bite before pressure is applied.
    a. Brace yourself by placing your body in the proper position so that in case the tool slips you will not fall.
    b. Make sure hands and fingers have sufficient clearance in the event the tool slips.

c. Always pull on a wrench, never push.

7. When working with tools overhead, place tools in a holding receptacle or secure when not in use.

8. Do not throw tools from place to place, from person to person, or drop from heights.

9. Use non-sparking tools in atmospheres with fire or explosive characteristics.

10. Inspect all tools prior to start-up or use to identify any defects.

11. Powered hand tools should not be capable of being locked in the on position.

12. Require that all power fastening devices be equipped with a safety interlock capable of activation only when in contact with the work surface.

13. Do not allow loose clothing, long hair, loose jewelry, rings and chains to be worn while working with power tools.

14. Do not use cheater pipes.

15. Make provisions to prevent machines from automatically restarting upon restoration of power.

B. Grinding Tools

1. Inspect work rests and tongue guards for grinders.

   a. Work rest gaps should not exceed 1/8 inch (3 mm).

   b. Tongue guards gap should not exceed ¼ inch (6 mm).

2. Do not adjust work or tool rests while the grinding wheel is moving.

3. Inspect the grinding wheel for cracks, chips or defects. Remove from service if any defects are found.

4. Wear goggles when grinding. A clear full face shield may be worn with the goggles.

5. Do not use the side of a grinding wheel unless the wheel is designed for side grinding.

6. Always stand to the side of the blade, never directly behind it.

7. Use grinding wheels only at their rated speed.

8. Grinding aluminum is prohibited.

9. For U.K. operations:

    a. No grinding wheels exceeding 55mm are to be used.

    b. All wheels are to be marked with their safe maximum speed.

    c. Abrasive wheels will only be operated by personnel who have been specifically trained and specified competent by URS.

    d. Abrasive wheels will only be operated by persons specified as competent, under the 'Abrasive Wheels" Regulations.

    e. Abrasive wheels must only be operated if the manufacturer's guard is fitted and they are in good working order.

C. Power Saws

1. Require that circular saws are fitted with blade guards.

2. Remove damaged, bent or cracked saw blades from service immediately.

3. Require that table saws are fitted with blade guards and a splitter to prevent the work from squeezing the blade and kicking back on the operator.

4. Require guards that cover the blade to the depth of the teeth on hand held circular saws. The guard should freely return to the fully closed position when withdrawn from the work surface.

D. Wood Working Machinery

1. Do not use compressed air to remove dust, chips and from wood working machinery.

2. Locate the on-off switch to prevent accidental start up. The operator must be able to shut off the machine without leaving the work station.

3. Guard planers and joiners to prevent contact with the blades.

4. Use a push stick when:

   a. The cutting operation requires the hands of the operator to come close to the blade.

   b. Small pieces are being machined.

5. Adjust saw blades so they only clear the top of the cut.

6. Automatic feed devices should be used whenever feasible.

E. Pneumatic Tools and Equipment

1. Require that pneumatic tools have:

   a. Tool retainers to prevent the tool from being ejected from the barrel during use.

   b. Safety clip or tie wire to secure connections between tool/hose/compressor if they are of the quick connection (Chicago fittings) type.

2. Do not lay hose in walkways, on ladder or in any manner that presents a tripping hazard.

3. Never use compressed air to blow dirt from hands, face or clothing.

4. Compressed air exhausted through a chip guarded nozzle shall be reduced to less than 30 psi. Proper respiratory, hand, eye and ear protection must be worn.

5. Never raise or lower a tool by the air hose.

F. Powder Actuated Fastener Tools

1. Use powder actuated tools that comply with the requirements of the American National Standards Institute (ANSI) standard A 10.3 - 1970.

2. Use only individuals that have been trained by a manufacturer's representative and possess the proper license to operate, repair, service and handle powder actuated tools.

3. Never use a powder actuated tool in a flammable or explosive atmosphere.

4. Require the use of goggles or a full face shield as well as safety glasses during operation of powder actuated tools.

5. Powder actuated tool must not be able to be fired unless the tool is pressed against the work surface.

6. The tool must not be able to fire if the tool is dropped when loaded.

7. Firing the tool should require two separate operations, with the firing movement being separate from the motion of bringing the tool to the firing position.

8. Never fire into soft substrate where there is potential for the fastener to penetrate and pass through, creating a flying projectile hazard.

9. Do not use powder actuated tools in reinforced concrete if there is the possibility of striking the re-bar.

10. Do not use on cast iron, glazed tile, surface hardened steel, glass block, live rock or face brick.

11. Never load and leave a powder actuated tool unattended. It should only be loaded prior to intended firing.

12. Test tools each day prior to loading by testing safety devices according to manufacturer's recommended procedure.

G. Chain Saws

1. Inspect the saw prior to each use and periodically during daily use.

2. Operate the chain saw with both hands at all times.

3. Never cut above chest height.

4. Require that the idle is correctly adjusted on the chain saw. The chain should not move when the saw is in the idle mode.

5. Start cutting only after a clear escape path has been made.

6. Shut the saw off when carrying through brush or on slippery surfaces. The saw may be carried no more than 50 feet (15 meters) while idling.

7. Require applicable protective gear. This may include, but is not limited to:

    a. Loggers safety hat.

    b. Safety glasses.

    c. Steel-toed boots.

    d. Protective leggings.

    e. Hearing protection.

8. Inspect saws to require that they are fitted with an inertia break and hand guard.

9. *Never* operate a chain saw when fatigued.

10. Do not allow others in the area when chain saws are operated.

11. Make sure there are no nails, wire or other imbedded material that can cause flying particles.

12. Do not operate a chain saw that is damaged, improperly adjusted, or is not completely and securely assembled. Always keep the teeth sharp and the chain tight. Worn chains should immediately be replaced.

13. Keep all parts of your body away from the saw chain when engine is running.

14. For U.K. operations, only personnel specifically trained and certified as competent by URS can operate chain saws.

H. Hand Operated Pressure Equipment

1. Pressure equipment such as grease guns, paint and garden sprayers shall be directed away from the body and other personnel in the area. The person operating any equipment such as this, which has a potential for eye injury, must wear protective goggles.

2. The noise produced when using certain types of pressure equipment may require the use of hearing protection.

3. Never allow the nozzle of a pressurized tool to come in contact with any body parts while operating. There is potential for injection of a chemical directly into the user's body, resulting in severe injury or death.

I. Gasoline Powered Tools

1. Never pour gasoline on hot surfaces.

2. Never fuel around open flame or while smoking.

3. Shut down the engine before fueling.

4. Provide adequate ventilation when using in enclosed spaces.

5. Use only OSHA approved safety cans to transport flammable liquids.

J. Inspection

Inspect all hand tools on a regular basis. Defective tools shall be immediately removed from service, tagged or destroyed to prevent further use.

5. Documentation Summary

Place in the Project Safety File:

A. Site briefings regarding tool use.

B. Records of tools removed from service.

C. Copies of powder actuated tool licenses (as applicable).

D. Tool inspection documentation.

6. Resources

A. U.S. OSHA Standard - Hand and Portable Power Tools - 29 CFR 1910, Subpart P

B. U.S. OSHA Standard - Construction Tools - Hand and Power - 29 CFR 1926, Subpart I

C. ANSI A10.3 – 1970

D. National Association of Demolition Contractors (http://www.demolitionassociation.com/)

E. U.K. - 'Abrasive Wheel' Regulations

F. U.K. - 'Wood-Working Machine' Regulations

G. U.K. - 'Provision and Use of Work Equipment' Regulations

H. Australian Standards Collection 26 - Occupational Health & Safety - Powered Machining and Tools

URS **SAFETY MANAGEMENT STANDARD**

Hazardous Waste Operations

1. Applicability

This standard applies to URS field operations involving the investigation or remediation of sites impacted with hazardous wastes or hazardous materials including those associated with underground storage tanks.

Investigation projects for real estate transactions conducted to confirm that a site is "clean" are not covered under this standard. Reference related Safety Management Standards for such operations.

2. Purpose and Scope

The purpose of this standard is to provide guidance designed to minimize hazardous chemical exposures to URS personnel while URS is conducting hazardous waste field operations.

Investigation techniques included under this standard include, but are not limited to, hand auger, soil gas evaluation, test pits, and all types of power drilling, including direct push. Remediation techniques included under this standard include, but are not limited to, excavation, groundwater treatment, soil gas treatment, containment, and landfarming and similar insitu methods.

3. Implementation

Field Activities - Implementation of this procedure is the responsibility of the Project Manager or Superintendent.

4. Requirements

A. Project Evaluation

Assess the technical and field aspects of every hazardous waste site project to evaluate:

1. Risk of exposure to hazardous chemicals, with particular attention to suspected or known human carcinogens.
2. Personal protective equipment requirements.
3. Air monitoring requirements.
4. Emergency services requirements.
5. Hazards addressed by other URS Safety Management Standards.

6. Logistical considerations, such as access, distance from population centers.

7. Other safety and health hazards associated with site operations.

B. Client/Contract Evaluation

1. Review contract documents to determine whether the client has any special internal or regulatory requirements for hazardous waste site operations.

2. Implement client requirements in addition to those of this standard. Those requirements that are the most protective (e.g., most stringent) will be used.

C. Site-specific Health and Safety Plan

1. Prepare a site-specific Health and Safety Plan (HSP) for every project under this standard.

2. HSPs must be written or reviewed by a URS Health and Safety Regional Health and Safety Manager (RHSM) or a safety professional specifically approved by the RHSM.

3. Evaluate client and agency requirements prior to preparing the HSP, particularly if the client or an agency will approve the HSP prior to implementation.

D. Training

Verify that each assigned URS employee has completed required training. In general, the following are required for operations within North America:

1. 40-hours of initial training from an approved training provider.

2. 3-days of on-the-job training.

3. 8-hours of refresher training completed within 12 months of the initial or subsequent refresher training.

4. 8-hours of Site Safety Officer (Supervisor) training for directing the activities of any other URS employee.

5. Additional training for the Site Safety Officer as described below.

E. Site Safety Officer

1. Appoint a Site Safety Officer (SSO) with appropriate qualifications for the specific hazardous waste project.

2. Assure that the SSO for complex projects, such as those with complicated remediation activities, has no duties other than site safety and health.

3. Verify that the SSO has completed basic supervisor training, and has additional required training and experience as applicable:

   a. Advanced respiratory protection training is required for projects where supplied air respirators may be used.

   b. Heavy equipment/construction safety.

   c. Personal air monitoring.

F. Exposure Monitoring

Require that exposure monitoring is conducted in accordance with the HSP on all hazardous waste projects.

G. Project Equipment

1. Provide all health and safety equipment as described by the project Health and Safety Plan.

2. Provide all personal protective equipment as described by the project Health and Safety Plan.

H. Medical Surveillance

Verify that each URS employee assigned to the project meets the minimum requirements of the URS Medical Surveillance Program. This typically includes:

1. Baseline examination.

2. Annual examination.

3. Appropriate clearance for respirator use.

5. Documentation Summary

In the Project Safety File:

A. Completed Health and Safety Plan.

B. Completed and signed HSP approval form.

C. Signed HSP acceptance form.

D. Completed H&S field forms that are included in each HSP.

E. Training and Medical Surveillance Clearance documentation for project personnel.

6. Resources

A. U.S. OSHA Technical Links - Hazardous Waste Operations

The following documents are PDF files which must be read with Adobe Reader:

B. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities - NIOSH 85-115

C. USACE EM 385-1-1 - Hazardous, Toxic and Radioactive Waste

URS SAFETY MANAGEMENT STANDARD

Heat Stress

1. Applicability

This procedure applies to URS field projects where ambient (not adjusted) temperatures exceed 70°F (21°C) for personnel wearing chemical protective clothing, including Tyvek coveralls, and 90°F (32°C) for personnel wearing normal work clothes.

2. Purpose and Scope

The purpose of this procedure is to protect project personnel from the effects of heat related illnesses.

3. Implementation

Field Activities - Implementation of this procedure is the responsibility of the Project Manager.

4. Requirements

A. Monitor ambient temperatures and conduct Heat Stress Monitoring when threshold temperatures (see Section 1) are reached.

B. Conduct initial monitoring to determine first rest break.

1. Measure the air temperature with a standard thermometer with the bulb shielded from radiant heat; this yields T (actual).

2. Estimate the fraction of sunshine by judging what percent time the sun is not shielded by clouds that are thick enough to produce a shadow. 100 percent sunshine - no cloud cover = 1.0; 50 percent sunshine - 50 percent cloud cover = 0.5; 0 percent sunshine - full cloud cover = 0.0.

3. Plug these variables into the following equation to determine the adjusted temperature:

   T (adjusted) = T (actual) + (13 x fraction sunshine)

C. Body Temperature Monitoring

1. Monitor oral body temperature to determine if employees are adequately dissipating heat buildup. Ear probe thermometers which are adjusted to oral temperature are convenient and the

preferred method of measurement. Determine work/rest regimen as follows:

a. Measure (oral adjusted) temperature at the end of the work period.

b. If temperature exceeds 99.6 ^{o}F (37.5^{o}C)., shorten the following work period by 1/3 without changing the rest period.

c. If temperature still exceeds 99.6 ^{o}F (37.5^{o}C), shorten the following work period by 1/3.

d. Do not allow a worker to wear impermeable PPE when his/her oral temperature exceeds 100.6 ^{o}F (38.1^{o}C).

2. Oral temperatures are to be obtained prior to the employee drinking water or other fluids.

D. Record monitoring results on Heat Stress Monitoring Form (Attachment 18-2).

E. Investigate the use of auxiliary cooling devices in extreme heat conditions.

F. Conduct briefings for employees regarding health hazards and control measures associated with heat stress whenever conditions require the implementation of heat stress monitoring. Review the information provided in Attachment 18-3.

G. Provide water and electrolyte replacement drinks fluids as described in Attachment 18-3.

H. Allow employees who are not accustomed to working in hot environments appropriate time for acclimatization (see Attachment 18-3).

I. Provide break areas as described in Attachment 18-3.

5. Documentation Summary

File these records in the Project Safety File.

A. Heat Stress Monitoring Forms.

B. Employee Safety Briefing Verification Forms.

6. Resources

A. NIOSH - "Working in Hot Environments"

B. AFL-CIO Building Trades Division - "Heat Stress in Construction"

The following documents are PDF Files that must be read with Adobe Reader.

C. Attachment 18-1 - Initial Work Monitoring Cycles

D. Attachment 18-2 - Heat Stress Monitoring Record

E. Attachment 18-3 -Informational Supplement

INITIAL WORK / MONITORING CYCLES

Adjusted Temperature	Normal Work Clothes	Protective Clothing
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°F - 90°F (30.8° - 32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°F – 87.5°F (28.1°C – 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°F – 82.5°F (25.3°C – 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°F – 77.5°F (22.5°C – 25.3°C)	After each 150 minutes of work	After each 120 minutes of work

URS Corporation

URS Corporation Health & Safety Program
EMPLOYEE HEAT STRESS EXPOSURE MONITORING RECORD

DATE: _____ **SAFETY REPRESENTATIVE:** _____

WORKER'S NAME: _____ **SUBCONTRACTOR:** _____

WORK ACTIVITY: _____

Time (24 hour)	*Oral Temp (^oF)*	*Pulse (BPM)*	*Comments*

DATE: _____ **SAFETY REPRESENTATIVE:** _____

WORKER'S NAME: _____ **SUBCONTRACTOR:** _____

WORK ACTIVITY: _____

Time (24 hour)	*Oral Temp (^oF)*	*Pulse (BPM)*	*Comments*

DATE: _____ **SAFETY REPRESENTATIVE:** _____

WORKER'S NAME: _____ **SUBCONTRACTOR:** _____

WORK ACTIVITY: _____

Time (24 hour)	*Oral Temp (^oF)*	*Pulse (BPM)*	*Comments*

HEAT STRESS INFORMATIONAL SUPPLEMENT

HEAT RASH

Heat rash (prickly heat) may result from continuous exposure to heat or humid air. It appears as red papules (elevated skin lesion), usually in areas where the clothing is restrictive, and gives rise to a prickly sensation, particularly as sweating increases. It occurs in skin that is persistently wetted by unevaporated sweat. The papules may become infected unless treated.

> **First Aid for Heat Rash -** to prevent heat rash: shower after work, dry off thoroughly, and put on clean, dry underwear and clothes. Try to stay in a cool place after work. If, in spite of this, you develop heat rash, see your physician.

HEAT CRAMPS

Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:

- Muscle spasms.
- Pain in the hands, feet and abdomen.

> **First Aid for Heat Cramps -** leave the work area, and rest in a cool, shaded place. Drink one or two glasses of electrolyte replacement drink, and try to gently massage the cramped muscle. Once the spasms disappear, you may return to work; taking adequate breaks and drinking electrolyte replacement drink should prevent the cramps from returning.

HEAT EXHAUSTION

Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- Pale, cool, moist skin.
- Heavy sweating.
- Dizziness.
- Nausea.
- Fainting.

The key here is that the victim is still sweating, so the cooling system is still working; it's just under severe stress. The body core temperature may be elevated. It is important to

recognize and treat these symptoms as soon as possible, as the transition from heat exhaustion to the very hazardous heat stroke can be quite rapid.

First Aid for Heat Exhaustion - leave the work area immediately, go through decon and remove all chemical protective clothing. Rest in a cool, shaded place and open your clothing to allow air circulation; lay flat except when taking fluids. Drink plenty of cooled electrolyte replacement drinks. Your work is over for the day; do not attempt to return. Medical assistance in severe cases may be warranted.

HEAT STROKE

Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occurs. Competent medical help must be obtained. Signs and symptoms are:

- Red, hot, usually dry skin.
- Lack of or reduced perspiration (lack of perspiration may be masked for those wearing chemical protective clothing since perspiration from earlier in the day will be present).
- Nausea.
- Dizziness and confusion.
- Strong, rapid pulse.
- Coma.

First Aid for Heat Stroke - THIS IS A MEDICAL EMERGENCY! SUMMON MEDICAL ASSISTANCE IMMEDIATELY! Remove the victim from the work area, perform a gross decon, and remove all PPE. Have the victim lie down in a cool, shady area. Attempt to bring the victim's temperature down by increasing air movement (electric fan) or placing wetted sheets or towels on them. Place an ice bag on the victim's head. The victim must not be sent home or left unattended without a physician's specific order.

HEAT STRESS PREVENTION

The best approach to avoiding heat-related illnesses is through preventative heat stress management. The site manager and site safety officer are responsible for implementing this program.

Rest areas - a relatively cool, shaded area must be provided for breaks when ambient temperatures exceed 70° F and workers are wearing chemical protective clothing (including uncoated Tyvek), or if temperatures exceed 90° F and workers are wearing "Level D"

coveralls or work clothes. A car or van is an oven, not a rest area. For Hazardous Waste Sites, the rest area should be located in the support zone adjacent to the contamination reduction zone, situated so that part of it is in the decon area so workers can take breaks without going through full decon. If shade is not available, build some: use a plastic "dining canopy", which can be obtained at sporting goods stores. This same type of canopy can be set up to shade personnel performing various types of work in hot weather.

Liquids - encourage employees to drink plenty of cool plain water and electrolyte replacement drinks. Supplementing water with cool electrolyte replacement drinks, such as Gatorade, Squench or Quik-kick (drink) is helpful to employees who tend to sweat a lot. Do not use "community cups"; use paper cups. Have workers drink 16 ounces of drink before beginning work, such as in the morning and after lunch. At each break, workers should take 8-16 ounces of drink. Don't wait until you are thirsty to drink.

Discourage the use of alcohol during non-working hours, and discourage the intake of coffee during work hours, as these make heat stress control more difficult.

Acclimatization - this is the process by which your body "gets used to" hot work environments. This is achieved by slowly increasing workloads. Start at 50 percent capacity on day one, and increase by 10 percent per day; on day six, you'll be at 100 percent. You don't lose acclimatization over a weekend, but it'll start to decrease after three to four days. If you don't do hot work for a week, it is gone. You don't have to do full shift hot work to achieve or retain acclimatization; a minimum of 100 minutes of continuous hot work exposure per day is adequate.

Auxiliary Cooling - auxiliary cooling is usually obtained by providing workers with a specially-designed vest, which is worn under the protective clothing, but over any underclothing. These vests typically provide cooling via one of two methods: the use of ice or other frozen media, or the use of a vortex cooler. Each method has its advantages and disadvantages.

The frozen media vest requires a means for freezing the media, and the media (usually water or "blue ice") will melt, requiring replacement.

The vortex cooler tends to cool more uniformly. Instead of frozen media, this vest uses the expansion of compressed air to cool the wearer. The drawback is the compressed air requirement, but this is negated when the wearer is already using an airline respirator supplied by a compressor. A vortex cooler should not be supplied from air cylinders, as this will draw down the cylinders rapidly.

Auxiliary cooling should be considered when the following conditions exist:

- Ambient temperature over 80° F
- Workers wearing impermeable garments (PE Tyvek, Saranex, Chemrel, etc.)
- It is desirable to have long work shifts with minimum interruption

URS SAFETY MANAGEMENT STANDARD

Heavy Equipment Operations

1. Applicability

This procedure applies to URS field projects where heavy equipment is in operation.

2. Purpose and Scope

The purpose of this procedure is to require that heavy equipment is operated in a safe manner, that the equipment is properly maintained and that ground personnel are protected.

3. Implementation

Field Activities - Implementation of this procedure is the responsibility of the Project Manager.

4. Requirements

A. Authorized Operators

1. Evaluate operators through documentable experience (resume) and a practical evaluation of skills.

2. Allow only qualified operators to operate equipment.

3. Prohibit equipment from being operated by any personnel who have not been specifically authorized to operate it.

4. Maintain a list of operators for the project and the specific equipment that they are authorized to operate.

5. Require operators to use seat belts at all times in all equipment and trucks.

6. Brief operators on the following rules of operation:

   a. Operators are in control of their work area.

   b. Equipment will be operated in a safe manner and within the constraints of the manufacturer's Operation Manual.

   c. Operators will stop work whenever unauthorized ground personnel or equipment enter their work area and only resume work when the area has been cleared.

B. Ground Personnel

1. Require that ground personnel on the site have received training and comply with the following rules of engagement:

    a. All ground personnel must wear orange protective vests when in work areas with any operating equipment.

    b. Ground personnel will stay outside of the swing zone or work area of any operating equipment.

    c. Ground personnel may only enter the swing or work area of any operating equipment when:

        1. They have attracted the operator's attention and made eye contact.

        2. The operator has idled the equipment down and grounded all extensions.

        3. The operator gives the ground personnel permission to approach.

    d. Ground personnel shall never walk or position themselves between any fixed object and running equipment or between two running pieces of equipment.

C. Equipment

1. Maintain operations manuals at the site for each piece of equipment that is present on the site and in use.

2. Require that operators are familiar with the manual for the equipment and operate the equipment within the parameters of the manual.

3. Require that all equipment is provided with roll-over protection systems (ROPS). Tracked excavators are exempt from ROPS requirements but must have a cab which provides protection from overhead hazards

4. Verify that seatbelts are present and functional in all equipment.

5. Prohibit the use of equipment which has cab glass which is cracked, broken or missing.

6. Require that backup alarms are functional on all trucks and equipment. Tracked excavators must have bidirectional alarms or the operator must be provided with a spotter whenever tracking in either direction.

7. Require all extensions such as buckets, blades, forks, etc. to be grounded when not in use.

8. Require brakes to be set and wheels chocked (when applicable) when not in use.

D. Inspection and Maintenance

1. Require daily inspections of equipment by operators using Attachment 19-1.

2. Prohibit use of equipment deemed to be unsafe as a result of daily inspection until required repairs or maintenance occur.

3. Conduct maintenance as prescribed by the manufacturer in the Operations Manuals for each piece of equipment.

4. During maintenance/repair, require that:

   a. Motors are turned off.

   b. All extensions are grounded or securely blocked.

   c. Controls are in a neutral position.

   d. Brakes are set.

5. Documentation Summary

File the following documents in the Project Health and Safety File.

A. List of authorized operators.

B. Operator qualifications.

C. Daily Equipment Inspection Logs.

D. Site Briefing documentation for operator rules and ground personnel "rules of engagement".

6. Resources

A. U.S. OSHA Standard - Motorized Vehicles and Mechanized Equipment - 29 CFR 1926, Subpart O

B. National Association of Demolition Contractors – Safety Manual (http://www.demolitionassociation.com/)

C. Queensland Workplace Health and Safety - Competency Standard for Users & Operators of Industrial Equipment

D. Attachment 19-1 - Equipment Inspection Form

URS	Health and Safety Program **DAILY HEAVY EQUIPMENT SAFETY INSPECTION CHECKLIST**	Attachment 19-1

Equipment Id No. _____ Inspector's Name _____

Equipment Name _____ Employee No. _____

Beg. Hours _____ End Hours _____ Date _____

INSTRUCTIONS: Each shift shall inspect all applicable items indicated. If an unsatisfactory condition is observed, suspend operation of the equipment and report the unsatisfactory condition to the site supervisor immediately.

ITEM INSPECTED	CHECK IF SATISFACTORY	COMMENTS
Falling Object Protective Structure (FOP)		
Roll-Over Protection Structure (ROP)		
Seat Belts		
Operator Seat Bar(s)		
Side Shields, Screens or Cab		
Lift Arm Device		
Grab Handles		
Back-up Alarm – Working		
Lights		
Guards		
Horn		
Anti-Skid Tread Clear of Mud		
Safety Signs (i.e., counterbalance swing area)		
Fire Extinguisher		
General Condition		
Fuel Connection		
Oil (fuel and no leaks)		
Clear of Extra Materials		
Controls Function Properly		
Damaged Parts		
Hydraulic System (full and no leaks)		
Parking Brake		
Lift Arm and Bucket		
Tires/Tracks		
Steering		
Breathing Air System		
Blast Shields		
Gallons of Fuel Added		
Quarts of Oil Added		

Operator Signature _____

URS SAFETY MANAGEMENT STANDARD

Medical Screening & Surveillance

1. Applicability

This program applies to employees assigned to work environments where there is a potential for exposure to chemical, biological, and/or physical hazards. Individuals will be selected for medical screening based on regulatory standards, project health and safety plan assessments, the expected use of personal protective equipment, and client contract requirements.

2. Purpose and Scope

The overall goal of this program is to prevent occupational illness and injury by early identification of exposure-related health effects before they result in disease. Medical examinations will be performed in order to determine if employees are capable of safely performing assigned tasks, to verify protective equipment and controls are effectively providing protection, and to comply with governmental regulations. Included are provisions for emergency medical consultation and treatment.

3. Implementation

Office/laboratory locations – Implementation is the responsibility of the Office Manager.

Field activities – Implementation is the responsibility of the Project Manager.

Program Administration – The Occupational Health Specialist (OHS) is responsible for development and administration of this program in coordination with the URS Medical Service Provider (MSP). The OHS will maintain current injury and illness data and participate with Corporate Health & Safety Managers in evaluation of this program. The MSP will provide board certified occupational medicine oversight for the program and will approve medical surveillance protocols.

The United States and Canada locations will follow all requirements of this program.

International locations will follow sections B.1,2,3,5,6,7,8; G.3; and H.1 of this program.

4. Requirements

A. Selection of program participants.

1. The Medical Surveillance Evaluation (MSE) form provides the primary guidance for determining whether medical screening is required for an employee and the frequency of periodic exams. The MSE is to be completed by the employee and their supervisor at time of hire for any employee who may work outside an office environment and is to be reviewed for accuracy at each annual performance review. Other reviews are required whenever there is a change in job tasks.

2. Additional site/project specific biological monitoring or toxicological screening may be required in addition to this program's core exam schedule. These medical tests will be specified by the project-specific health and safety plan and will be authorized by the MSP on the exam appointment protocol. Note: See section D.2 if employee will have an initial assignment at a HAZWOPER site.

B. Types of medical screening and surveillance exams

1. A baseline or preassignment baseline exam will be conducted prior to the start of work assignments requiring medical surveillance.

2. Periodic exam schedules are established by the MSP using the following criteria:

   a. Employees performing the following types of work will receive annual exams: construction activities in the exclusion zone of HAZWOPER sites, field work activities in the exclusion zone of HAZWOPER sites for 30 or more days per year, projects involving exposure to OSHA-regulated materials at or above established action levels.

   b. Employees performing the following types of work will receive biennial exams: field work activities at HAZWOPER sites less than 30 days per year; waste disposal activities; non-HAZWOPER environmental sampling; chemistry laboratory, pilot plant projects, or bench scale operations for 30 or more days per year.

3. Employees currently participating in an examination program will receive exit exams when they leave their work assignment as identified in the Exit Exam Determination. In the event an employee declines the exit exam, the employee will be requested to sign a Waiver of Exit Medical Surveillance Exam.

4. Department of Transportation (DOT) exams will be conducted biennially when an employee is assigned to drive a vehicle with a gross weight rating of more than 10,000 pounds or when driving a placarded vehicle of any size used to transport hazardous chemicals. DOT exam certification can be added to a routine baseline or periodic exam protocol when scheduling with the MSP.

5. When noise levels in the employee's work environment equal or exceed an 8-hour time-weighted average of 85 decibels as measured on the A-scale (dBA), annual audiograms will be performed. For employees involved in construction activities or management of construction, enrollment in this program will be required if more than 50% of their time is spent in an active construction area.

6. Individual radiation dose monitoring will be conducted as required by the site-specific health and safety plan with approval by a Radiation Safety Officer. Personal dosimetry (film badges) are typically required, however, depending on the specific radiation hazard, additional excretory monitoring or thyroid scans may be required.

7. In order to determine an employee's ability to wear a respirator, a medical evaluation will be performed before an employee is fit tested or assigned to wear a respirator.

8. Employees assigned to work environments with airborne concentrations of asbestos fibers at or above the established action level will receive asbestos-specific baseline and annual exams. Exit exams will be performed if an exam has not been performed within the past 6 month period or if an employee has medical complaints related to asbestos exposure.

C. Exam protocols

1. The Medical Screening & Surveillance Exam Protocol identifies the medical exam components of this program.

D. Scheduling of exams

1. The Office or Project Manager, usually with assistance of the local H&S Representative, is responsible for contacting the MSP when baseline, exit, and project specific exams are required. The MSP maintains an employee scheduling database for tracking periodic

exams and will contact the employee for scheduling the month their exam is due. These steps are detailed in the Medical Surveillance Exam Process.

2. Construction Services Division employees hired with an initial assignment to work at a OSHA HAZWOPER site whose work duties require passing a physical exam or who have an essential job function of wearing a respirator, will receive a job offer contingent upon passing a preassignment baseline exam. See HAZWOPER & Respirator Preassignment Baseline Exam Process. In the event of an urgent business necessity a temporary clearance to begin work the day of the exam, issued by the local physician and good for 14 days until the MSP physician final clearance is received, may be requested at the time a baseline exam is scheduled through the MSP.

3. If an exam becomes due during an employee's pregnancy, it is advised to defer the exam until after delivery and the employee returns to work from family/medical leave status.

E. Exam Follow Up

1. Following each exam, the MSP will issue a physician's written opinion (Health Status Medical Report) to the site Health & Safety Representative which will include any medical restrictions and address the employee's ability to use personal protective equipment. See Exam Follow Up Procedures.

2. The MSP will mail the exam invoice to the site H&SR who will approve the charge and forward the invoice to the accounts payable department for payment.

3. The MSP will mail an exam results letter that is confidentially addressed to the employee at their home address within 30 days of the exam date.

F. Emergency Medical Care

1. Preplanning is essential to a prompt and proper response to a medical emergency. Site specific emergency procedures will be provided in the site Health & Safety Plan. See Field First Aid Kit Supply List for recommended supplies. The contents of the first aid kit shall be checked prior to being sent out to each site/project and periodically thereafter to ensure the expended items are replaced.

2. A MSP occupational physician can be reached 24 hours a day for phone consultation at 1-800-455-6155.

3. A workers' compensation claim should be filed by the Human Resource Representative with St. Paul Fire and Marine Insurance (1-800-787-2851) for an injured employee who receives professional medical care or who is disabled from working beyond the initial date of injury.

4. In order to comply with OSHA reporting regulations, immediately notify the OHS or a Division Health & Safety Manager if there is a work-related hospitalization or death.

G. Medical Records

1. Medical records are maintained and preserved in confidential, locked files in the custody of the MSP for at least the duration of employment plus 30 years. Only information regarding the employee's ability to perform the job assignment will be provided to company representatives.

2. Upon request, each employee (or designated representative) will have access to the employee's medical record. Prior to the release of health information to the employee (or designated representative), a specific written consent must be signed by the employee.

3. International records (excluding the United States and Canada) will be maintained in country at the local clinic.

H. Program evaluation

1. The OHS and Division Health & Safety Managers will evaluate this program annually and as needed. Issues to review include program efficacy and efficiency, employee satisfaction, and cost effectiveness.

2. The MSP will prepare an Annual Medical Trending Report specifying the number and types of exams performed and anonymous statistical exam results in group data format.

3. Each employee is mailed a Post-Exam Evaluation by the MSP. Employee feedback regarding the clinic, medical staff, and exam

procedures are reviewed and corrective actions are identified and acted upon as needed.

5. Documentation Summary

The H&SR will file the Medical Surveillance Evaluation and the Health Status Medical Report in the site health & safety records.

6. Resources

A. U.S. OSHA Technical Links - Medical Screening/Surveillance

B. U.S. OSHA Publication 3162 (1999) Screening and Surveillance: A Guide to OSHA Standards

C. Attachment 24-1 WorkCare Medical History Questionnaire

D. Attachment 24-2 Medical Surveillance Evaluation

E. Attachment 24-3 Medical Screening & Surveillance Exam Protocol

F. Attachment 24-4 Medical Surveillance Exam Process

G. Attachment 24-5 HAZWOPER/Respirator Preassignment Baseline Exam Process

H. Attachment 24-6 Exit Exam Determination

I. Attachment 24-7 Waiver of Exit Medical Surveillance Exam

J. Attachment 24-8 Exam Follow Up Procedures

K. Attachment 24-9 Field First Aid Kit Supply List

L. SMS 8 Asbestos Survey and Oversight Operations

M. SMS 17 Hazardous Waste Operations

N. SMS 42 Respiratory Protection

URS SAFETY MANAGEMENT STANDARD

Noise and Hearing Conservation

1. Applicability

This procedure applies to URS Corporation facilities and field operations where URS Corporation personnel may encounter noise exposures that may exceed 85 dBA as an 8 hour Time Weighted Average.

2. Purpose and Scope

The purpose of this procedure is to protect employees from hazardous noise exposures and to prevent hearing loss.

3. Implementation

Office/Lab locations:	High noise is unlikely to be encountered at URS offices, however, if applicable, the implementation of this program is the responsibility of the Office Manager.
Field Activities:	Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. General

The use of hearing protectors in any location where powered or motorized equipment or any other noise source could reasonably be expected to exceed 85 dBA. Use of hearing protectors may only be discontinued when noise levels are verified to be less than 85 dBA through a properly conducted noise survey. Whenever information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the project manager or location manager will be responsible to enforce the proper use of hearing protectors.

B. Hearing Protectors

1. Require that at least two (2) types of hearing protectors are available to employees free of charge, preferably a plug and a muff type.

2. Minimum Noise Reduction Ratings (NRR)

Hearing protectors issued must have the following minimum NRR:

Ear Plug	Muffs
29 dBA	27 dBA

3. Require that hearing protectors are used and thus effectively protect hearing.

C. Noise Surveys

1. Noise surveys must be conducted in a manner that reasonably reflects the exposure of the affected employees. Surveys must be conducted under the supervision of a URS Safety Program Representative.

2. Sound level meters and audio dosimeters used to determine employee exposure to noise sources must be Type II (accurate to within +/- 2 dBA), operated in “slow” response, on the “A” scale, and be calibrated to factory guidelines (including periodic factory recalibration).

D. Noise Controls

Eliminate noise sources to the extent possible. Examples of controls that must be considered follow:

1. Addition or replacement of mufflers on motorized equipment.

2. Addition of mufflers to air exhausts on pneumatic equipment.

3. Following equipment maintenance procedures to lubricate dry bearings.

4. Isolation of loud equipment with newer and quieter models.

E. Audiometric Exams

1. Tests

Details on the medical surveillance program (including audiometric testing) are included in SMS 24.

Audiometric tests shall be performed by a person meeting OSHA’s 1910.95 (g)(3)’s definition. Within 6 months of an employee’s first exposure at or above the action level, a valid baseline audiogram shall be established against which subsequent audiograms can be compared. Testing to establish a baseline audiogram shall be preceded by 14 hours without exposure to noise. Hearing protectors may be used as a substitute for the requirement that

baseline audiogram shall be preceded by 14 hours without exposure to workplace noise. The medical surveillance provider shall notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination. For multi-year projects, an annual audiogram shall be obtained for each employee exposed at or above an 8-hour time-weighted average of 85 decibels.

Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if there is a standard threshold shift (STS). If the annual audiogram shows that an employee has suffered a standard threshold shift, the employer will obtain a retest within 30 days and consider the results in assessing an STS as the annual audiogram. The audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. If an STS has occurred, the medical surveillance provider will notify the employee within 21 days of the determination.

2. Standard Threshold Shifts

   If an employee's test results show a confirmed STS, their hearing protection will be evaluated and refitted, and a medical evaluation may be required.

F. Training

Verify that each employee who must work in a noisy environment is current on the required Hearing Conservation Training. Training must include the following topics:

1. The effects of noise on hearing.
2. The purpose of hearing protectors.
3. The advantages and disadvantages of various types of hearing protectors.
4. The attenuation of various types of hearing protection.
5. The selection, fitting, care, and use of hearing protectors.
6. The purpose of audiometric testing.

7. An explanation of the audiometric testing procedure.

5. Documentation Summary

A. File these records in the Office Safety Filing System:

1. Noise surveys, when applicable.
2. Training Records.

B. File noise surveys, when applicable, in the Project Safety File:

6. Resources

A. U.S. OSHA Standard – Occupational noise exposure – 29 CFR 1910.95

B. U.S. OSHA Construction Standard – Occupational noise exposure – 29 CFR 1926.52

C. U.S. OSHA Technical Links - Noise and Hearing Conservation

D. American Industrial Hygiene Association: The Occupational Environment – Its Evaluation and Control, Chapter 20. Fairfax, VA: 1997

E. National Hearing Conservation Association web site

F. URS SMS 24 Medical Screening and Surveillance

URS **Safety Management Standard**

Personal Protective Equipment

1. Applicability

This program applies to URS Corporation laboratory and field operations where the use of Personal Protective equipment (PPE) is warranted. Refer to SMS 42, "Respiratory Protection", for respiratory hazards. Hearing Protection issues are additionally addressed in SMS 26, "Noise and Hearing Conservation."

2. Purpose and Scope

This procedure provides information on recognizing those conditions that require personal protective equipment as will as selecting personal protective equipment for hazardous activities.

3. Implementation

Shop/Lab Locations - Implementation of this program is the responsibility of the Office Manager.

Field Activities - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Perform hazard assessments for those work activities that are likely to require the use of PPE.

   1. Use Attachment 29-1 to perform the assessment.

   2. Reevaluate completed hazard assessments when the job changes.

B. Eliminate the hazards identified in Attachment 29-1, if possible, through engineering or administrative controls.

C. Select PPE that will protect employees if hazards cannot be eliminated.

   1. See Attachment 29-1 for recommended PPE.

   2. Review Material Safety Data Sheets for chemicals used for PPE recommendations.

   3. If needed, consult with the URS Health and Safety Representative for assistance in selecting PPE.

D. Provide required PPE to employees free of charge (excluding in some instances components of standard work attire such as steel-toed boots), assuring that it fits properly giving them a choice if more than one type is available.

E. Whenever a hazard is recognized, and PPE is required, the employees will be provided with the appropriate PPE. However, when a PPE is not required, and the employee selects to wear his or her own PPE, the project manager shall ensure that the employee is properly trained in the fitting, donning, doffing, cleaning, and maintenance of his or her employee owned equipment.

F. Conduct and document employee training.

1. Train all employees who are required to wear PPE.
2. Require that training includes:
   a. When PPE is necessary to be worn.
   b. What PPE is necessary.
   c. How to properly don, doff, adjust and wear PPE.
   d. Limitations of PPE
   e. Proper care, maintenance, useful life and disposal of PPE.
3. Training must be conducted before PPE is assigned.
4. Refresher training is needed when:
   a. New types of PPE are assigned to the worker.
   b. Worker cannot demonstrate competency in PPE use.
5. Keep written records of the employees trained and type of training provided, including the date of training.

G. Maintain Protective Equipment

1. Check personal protective equipment for damage, cracks, and wear prior to each use. Replace or repair equipment not found in good condition.

2. Wash off contaminated protective equipment with water and mild soap, if necessary, to prevent degradation of the equipment.

H. Periodically inspect worksites where employees are using personal protective equipment, using Attachment 29-2.

1. Field activities – inspect work sites at least monthly.

2. Office locations – inspect work sites semi-annually.

5.0 Documentation Summary

A. Records required in the Project Safety File:

1. Completed Hazard Assessment Certification Forms (Attachment 29-1)

2. Completed Personal Protective Equipment Inspection Sheet (Attachment 29-2)

3. Documentation of employee training.

B. Records required in the Laboratory Safety Filing System:

1. Completed Hazard Assessment Certification Forms (Attachment 29-1)

2. Completed Personal Protective Equipment Inspection Sheet (Attachment 29-2)

3. Documentation of employee training.

6.0 Resources

A. U.S. OSHA Standards - Personal Protective Equipment -29CFR 1910 Subpart I (http://www.osha-slc.gov/SLTC/lead/index.html)

B. U.S. OSHA Construction Standard - Personal Protective Equipment –29 CFR 1926 Subpart E (http://www.osha-slc.gov/OshStd_toc/OSHA_Std_toc_1926_SUBPART_E.html)

C. U.S. OSHA Technical Links - Personal Protective Equipment (http://www.osha-slc.gov/SLTC/personalprotectiveequipment/index.html)

D. Australian Standards SAA HB9-1994 - Occupational Personal Protection

E. American National Standards Institute, ANSI Z89.1-1986, Protective Headwear
(http://www.ansi.org/cat_top.html)

F. American National Standards Institute, ANSI Z87.1 - 1989, Eye and Face Protection
(http://www.ansi.org/cat_top.html)

G. American National Standards Institute, ANSI Z41.1 - 1991, Foot Protection
(http://www.ansi.org/cat_top.html)

H. SMS 40 - Fall Protection

I. Attachment 29-1 Hazard Assessment Form

J. Attachment 29-2 PPE Inspection Form

URS Corporation

URS Corporation Health & Safety Program
HAZARD ASSESSMENT CERTIFICATION FORM

Location:_____ **Job No:**_____

Date : _____ **Assessment Conducted by:** _____

Specific tasks performed at this location: _____

_____

	Are any of the following present during the task?	No	Yes (Hazard Present)	Eliminate Hazard or Use Following PPE
	Overhead Hazards			
1.	Suspended loads that could fall			Hard hat, ANSI Class A, B
2.	Overhead beams or load that could strike head			Hard hat, ANSI Class A, B
3.	Energized wires or equipment that could strike head			Hard hat, ANSI Class B
4.	Employees working above at an elevated site who could drop objects on others below			Hard hat, ANSI Class A, B
5.	Sharp objects or corners at head level			Hard hat, ANSI Class A, B or C
	Eye Hazards			
6.	Chemical splashes or irritating mists			Chemical protective goggles See Attachment 29-3
7.	Excessive dust			Safety glasses or impact goggles
8.	Smoke & fumes			Chemical protective goggles
9.	Welding operations			See Attachment 29-3 and 29 T-1
10.	Lasers/optical radiation			See Attachment 29-3 and Reference F
11.	Projectiles			See Attachment 29-3
12.	Sawing, cutting, chipping, grinding			See Attachment 29-3
	Face Hazards			
13.	Chemical splashes or irritating mists			Face shield if chemical is irritating to the skin or is corrosive. See Attachment 29-3
14.	Welding operations			See Attachment 29-3 and 29-T1
15.	Projectiles			See Attachment 29-3 and face shield
	Hand Hazards			
16.	Chemical exposure			Use resistant gloves as recommended by manufacturer - See Best Chemrest Guide
17.	Sharp edges, splinters, etc.			Leather gloves

Location :_____**Job No:**_____

	Are any of the following present during the task?	No	Yes (Hazard Present)	Eliminate Hazard or Use Following PPE
18.	Temperature extremes - heat			Leather gloves; hot mill gloves; Kevlar gloves, welders' gloves
19.	Temperature extremes - cold			Leather gloves; insulated gloves
20.	Blood, fungus			Nitrile gloves
21.	Exposure to live electrical current			Electrical gloves - See Reference H
22.	Sharp tools, machine parts, etc.			Leather gloves, kevlar gloves
23.	Material handling			Leather gloves
	Foot Hazards			
24.	Heavy materials (greater than 50 pounds) handled by employees			Safety shoes or boots
25.	Potential to crush whole foot			Safety shoes or boots with metatarsal guard
26.	Sharp edges or points - puncture risk			Safety shoes or boots
27.	Exposure to electrical wires			Safety shoes or boots with electrical protection
28.	Unusually slippery conditions			Rubber soled boots or grips
29.	Chemical contamination			Rubber, nitrile boots or boot covers
30.	Wet conditions			Rubber boots or boot covers
31.	Construction/demolition			Safety shoes or boots with metatarsal guard if who foot crushing hazard exists.
	Fall Hazards			
32.	Elevations above 6 feet without guardrails			Full body harness, ANSI A-10.14 - 1991 - See Reference G
33.	Suspended scaffolds, boatswain's chairs, float scaffolds, suspended staging.			ANSI Type II - full body harness - See Reference G
34.	Working in trees			ANSI Type I full body harness - See Reference G
35.	Working in vehicle mounted, elevating work platforms (bucket trucks, pin-on platforms, etc.)			ANSI Type II full body harness - see Reference G
	Water Hazards			
36.	Working on or above water where drowning hazards exist			U.S. Coast Guard approved personal flotation device, Type I, II, or III PFD
	Excessive Heat or Flame			
37.	Full body chemical protective clothing in temperatures greater than 80 degrees			Cooling vest
38.	Work around molten metal or flame			Nomex or kevlar clothing

Location :_____Job No:_____

	Are any of the following present during the task?	No	Yes (Hazard Present)	Eliminate Hazard or Use Following PPE
39.	Welding activities			Welding leathers for those areas that are exposed to flame, spark or molten metal
	Respiratory Hazards			
40.	See SMS for RESPIRATORY PROTECTION for selection guidance			
	Excessive Noise			
41.	Exposure to noise			Ear plugs or muffs
	Body and Leg Protection			
42.	Chemical exposure			Have local DMG H&S representative assist you in proper selection
43.	Using chainsaw, cutting brush			Chainsaw chaps

I certify that the above inspection was performed to the best of my knowledge and ability, based on the hazards present on _____.

_____
Signature

URS	Health and Safety Program PERSONAL PROTECTIVE EQUIPMENT INSPECTION SHEET	Attachment 29-2

Name of Inspector _____ **Date Inspected** _____

	True	False (= Hazard - Needs to be fixed)
Hard Hats		
1. The brim or shell does not show signs of exposure and excessive wear, loss of surface gloss, chalking or flaking.		
2. Suspension system in hard hat does not show signs of deterioration including cracking, tearing or fraying.		
3. The brim or shell is not cracked, perforated or deformed.		
4. Employees use hard hats in marked areas.		
5. Hard hat areas are marked.		
Safety Shoes		
6. Safety shoes used by employees do not show signs of excessive wear.		
7. Safety shoe required areas are marked.		
Work Gloves		
8. Gloves are worn when needed.		
9. Gloves do not show signs of excessive wear such as cracks, scrapes, or lacerations, thinning or discoloration or break through to the skin.		
Protective Clothing		
10. Protective clothing is worn by employees when required.		
Hearing Protection		
11. Noise hazardous areas are marked.		
12. Employees are using earplugs or muffs when using noise hazardous equipment or working in noise hazardous areas.		
Safety Glasses		
13. Eye hazardous areas are marked or posted.		
14. Employees use safety glasses when working in eye hazardous areas or working with eye hazardous equipment.		

REMARKS

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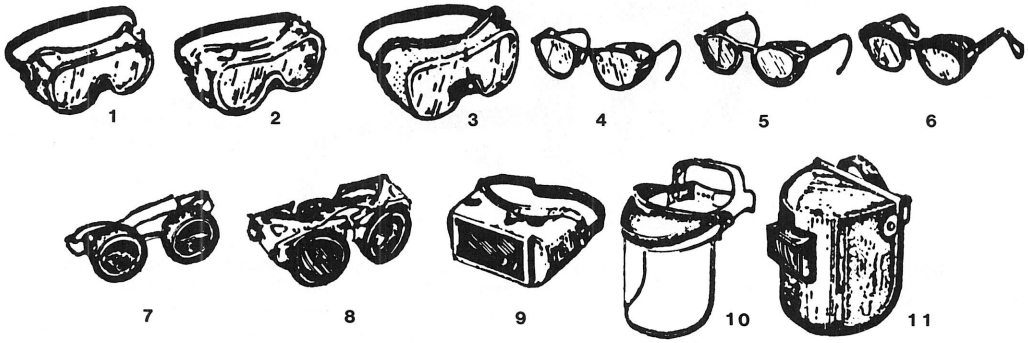
URS Corporation

URS Corporation Health & Safety Program

EYE AND FACE PROTECTOR SELECTION GUIDE



1. **GOGGLES,** Flexible Fitting, Regular Ventilation
2. **GOGGLES,** Flexible Fitting, Hooded Ventilation
3. **GOGGLES,** Cushioned Fitting, Rigid Body

*4. **SPECTACLES,** Metal Frame, with Sideshields
*5. **SPECTACLES,** Plastic Frame, with Sideshields
*6. **SPECTACLES ,** Metal-Plastic Frame, with Sideshields
*7. **WELDING GOGGLES,** Eyecup Type, Tinted Lenses (Illustrated)

7A. **CHIPPING GOGGLES,** Eyecup Type, Clear Safety Lenses (Not Illustrated)

*8. **WELDING GOGGLES,** Coverspec Type, Tinted Lenses (Illustrated)

8A. **CHIPPING GOGGLES,** Coverspec Type, Clear Safety Lenses (Not Illustrated)

*9. **WELDING GOGGLES,** Coverspec Type, Tinted plate Plate Lens

10. **FACE SHIELD,** (Available with Plastic or Mesh Window)
11. **WELDING HELMETS**

APPLICATIONS		
OPERATION	HAZARDS	RECOMMENDED PROTECTORS Bold Type Numbers Slightly Preferred Protection
ACETYLENE-BURNING ACETYLENE-CUTTING ACETYLENE-WELDING	SPARKS, HARMFUL RAYS MOLTEN METAL, FLYING PARTICLES	**7,8,9**
CHEMICAL HANDLING	SPLASH, ACID BURNS, FUMES	**2,10** (For severe exposure add 10 over 2)
CHIPPING	FLYING PARTICLES	**1,3,4,5,6,7A,8A**
ELECTRIC (ARC) WELDING	SPARKS, INTENSE RAYS, MOLTEN METAL	**9,11** (11 in combination with 4,5,6 in tinted lenses, advisable)
FURNACE OPERATIONS	GLARE, HEAT, MOLTEN METAL	**7,8,9** (For severe exposure add 10)
GRINDING-LIGHT	FLYING PARTICLES	**1,3,4,5,6,10**
GRINDING -HEAVY	FLYING PAPTICLES	**1,3,7A,8A** (For severe exposure add 10)
LABORATORY	CHEMICAL SPLASH, GLASS BREAKAGE	**2** (10 when in combination with 4,5,6)
MACHINING	FLYING PARTICLES	**1,3,4,5,6,10**
MOLTEN METALS	HEAT, GLARE, SPARKS, SPLASH	**7,8** (10 in combination with 4,5,6 in tinted lenses)
SPOT WELDING	FLYING PARTICLES, SPARKS	**1,3,4,5,6,10**

* Non-side shield spectacles are available for limited hazard use requiring only frontal protection.

URS SAFETY MANAGEMENT STANDARD

Sanitation

1. Applicability

This procedure applies to URS field operations.

2. Purpose and Scope

The purpose of this program is to provide employees on field assignments with appropriate personal hygiene facilities, including toilets, wash rooms and eating facilities, and to protect employees from unsanitary conditions.

3. Implementation

Field Activities - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Arrange for the installation of adequate toilet and wash facilities during the planning stage of field projects. Note: Mobile crews having transportation readily available to nearby toilet facilities need not be provided with facilities.

1. Provide job sites without sanitary sewer with one of the following:

   a. Privies (where their use will not contaminate ground or surface water).

   b. Chemical toilets.

   c. Combustion toilets.

2. Provide toilets for employees of each sex at field sites according to the following ratio:

Number of Employees	Minimum # of water closets (1)
1 - 15	1
16 - 25	2
36 - 55	3
56 - 80	4
81 - 110	5
111 - 150	6
Over 150	(2)

Footnote (1) *where toilet facilities will not be used by women, urinals may be provided instead of the minimum specified.*
Footnote (2) *1 additional fixture for each additional 40 employees.*

B. Provide a means for washing hands next to toilet areas.

C. Arrange for fresh potable water to be available.

1. Fixed Facilities

   Require backflow prevention devices, testing and administrative controls to be used for all potable water supply branches.

2. Field Sites

   a. Require an adequate supply of potable water to be available.

   b. Water containers must be tightly closed and marked as to the contents. Containers must have a tap and be refilled daily.

D. Maintain existing toilet and wash facilities.

1. Maintain toilets and toilet area in good repair and in a clean and sanitary condition.

2. Provide paper towels and soap or other suitable sanitizing material for washing hands.

3. Locate hand-washing facilities next to or near toilets.

E. Maintain availability and cleanliness of drinking water.

1. Maintain backflow devices in a sanitary condition.

2. Water coolers and water dispensers are to be kept in a sanitary condition and filled only with potable water.

3. Provide fountain-type dispensers or one-use cups at each water dispenser.

F. Maintain lunchrooms in a clean condition.

1. Require microwave ovens to be used for food only.

2. Require refrigerators that are designated for food storage to be used for food only.

3. Do not allow workers to eat or store foods in areas where toxic materials are handled or stored.

4. Periodically clean lunchrooms.

G. Manage waste generated on site.

1. Release sanitary sewage into sanitary sewer lines or to other proper disposal channels.

2. Do not discharge hazardous waste into the sanitary sewer or storm sewer system.

3. Collect garbage and trash daily.

a. Garbage containers located outside buildings should have lids and remained closed. Transport garbage offsite at least weekly.

b. At remote field sites where bears and similar wild animals are a hazard, remove garbage from the site daily (do not let garbage remain on site overnight).

H. Prevent pests and vermin from multiplying on site. Eliminate unsanitary conditions that propagate insects or vermin.

I. Inspect work sites using checksheet provided as Attachment 30-1 for compliance at the beginning of the project and mid -project.

5. Documentation Summary

File completed inspection sheets in the Project Safety File.

6. Resources

A. U.S. OSHA Construction Standard - Sanitation - 29 CFR 1926.51 (http://www.osha-slc.gov/OshStd_data/1926_0051.html)

B. U.S. OSHA General Industry Standard - Sanitation - 29 CFR 1910.141 (http://www.osha-slc.gov/OshStd_data/1910_0141.html)

C. National Interim Primary Drinking Water Regulations 40 CFR 141 (http://www.access.gpo.gov/nara/cfr/waisidx_99/40cfr141_99.html)

D. Attachment 30-1 - Sanitation Inspection Checksheet

E. Queensland Workplace Health and Safety - Code of Practice for Construction Project Amenities

URS	Health and Safety Program **SANITATION INSPECTION SHEET**	Attachment 30-1

Location: _____ **Job No:** _____

Date Inspected: _____ **Name of Inspector:** _____

Note: All "No" notations must be corrected		**Yes**	**No**
Toilets			
1.	Are there an adequate number of toilets on site? 1 – 15 employees = 1 toilet 16 - 35 employees = 2 toilets 36 – 55 employees = 3 toilets 56 – 80 employees = 4 toilets 81 - 110 employees = 5 toilets		
2.	Toilets are in clean condition.		
3.	Toilet paper is provided.		
4.	Toilet areas are clean and sanitary.		
Hand Washing Facilities			
5.	Hand washing facilities are provided near toilets.		
6.	Paper towels and soap are provided.		
Drinking Water			
7.	Drinking water is provided on site.		
8.	Disposable cups are provided or fountain type dispenser is provided.		
9.	Drinking water containers are kept clean and tightly closed or covered.		
Lunch Rooms			
10.	Lunch rooms or eating areas are kept clean.		
11.	Microwaves are used for food only.		
12.	Microwave ovens are kept clean.		
13.	Refrigerators are kept clean.		
14.	Refrigerators are used to store food only.		
Vermin			
15.	Rats, mice and other vermin are not living within buildings.		
16.	Cockroaches and fleas are not thriving within buildings.		

REMARKS:

_____

_____

_____

_____

URS SAFETY MANAGEMENT STANDARD

Work Zone Traffic Control

1. Applicability

This procedure applies to URS field operations involving work performed on roads, highways, and similar areas where motor vehicles may be a hazard.

2. Purpose and Scope

This procedure is intended to protect personnel from the hazards associated with work performed on or next to highways and roads.

3. Implementation

Field Activities - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Review the project in the planning phase to determine if any work will be performed on or adjacent to any road that will disrupt normal traffic flow.

B. Hire a qualified contractor or have an in house Competent Person devise a traffic control plan based on the work to be performed.

1. Competent persons are those who are knowledgeable about the fundamental principles of temporary traffic control and the work activities to be performed.

2. Traffic control plans will be designed to meet requirements as set in the Manual on Uniform Traffic Control Devices (MUTCD) (Resource A) as well as those rules set by state, county and cities in which work is performed.

3. Require that the plan is commensurate with the complexity of the project.

C. Submit the traffic control plan to the road authority for approval.

1. Submissions will be made to the state department of transportation or highways if state or federal highways are impacted as well.

2. Local county representatives.

3. Local city representatives, if within city limits.

4. For U.K. operations, submittal is to be made to County Council or local authority.

D. Decide whether to have qualified in house personnel or contract personnel implement the traffic control plan in the field.

1. Certified flaggers may set up work zones.

   Flaggers must attend an eight-hour work zone traffic control course as taught by an ATSSA certified instructor (or equivalent).

2. Obtain appropriate traffic control equipment as described in Resource A.

3. For U.K. operations, all operative must be trained in accordance with 'New Road and Street Works' Act.

E. Execute the traffic control plan developed for the job site. Require all personnel who work on/or adjacent to the roadway to wear bright orange, strong yellow-green or fluorescent versions of these colors of approved work zone clothing, including:

1. Vests, at a minimum.

2. Coveralls, if desired.

3. Rainwear or other apparel as needed.

B. Require a Competent Person who is certified as a Worksite Traffic Supervisor supervises flaggers at least once a day.

C. Develop a plan for the periodic inspection and maintenance of the Traffic Control Zone utilizing Attachment 32-1.

5. Documentation Summary

Records required in the Project Safety File:

A. Copies of traffic control plans used on site.

B. Training certificates for URS flaggers and Competent Persons.

C. Qualifications of contracted flaggers and Competent Persons.

D. Inspection records.

6. Resources

A. Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) (http://www.ohs.fhwa.dot.gov/)

B. American Traffic Safety Services Association (http://www.atssa.com/)

C. ATTSA Flagger Train the Trainer Program (http://www.flagger.com/)

D. U.K. - Section 7, Road Traffic Act

E. U.K. - 'New Road and Street Works' Act

F. Australian Standards SAA HB81.1-.5 - Field Guide for Traffic Controls at Work on Roads

G. Australian Standards AS1742 - Manual of Uniform Traffic Control Devices

H. Australian Standards SAA HB69.13-1995. Guide to Traffic Engineering Practice - Pedestrian

I. Attachment 32-1 - Traffic Control Inspection Checklist

J. Queensland Workplace Health and Safety - A Guide to Preparing Workplace Health and Safety Plans for Worker Safety Within Road Reserves (http://www.detir.qld.gov.au/hs/guide/gde26.pdf)

URS Corporation

URS Corporation Health & Safety Program
TRAFFIC CONTROL INSPECTION CHECKLIST

Project Name:_____Project Number:_____

Item	Yes	No	How Many?
1. Are any devices missing?			
Do any devices need repair?			
Were all replaced or repaired?			
2. Are any lights(flashers, etc.) not functioning?			
Were they all replaced or repaired?			
3. Are any devices improperly placed?			
Were all positions corrected?			
4. Do any devices need cleaning?			
Were all devices cleaned?			
Additional comments:			

The above check was completed by:_____
(name/title)

on _____ at _____❑ a.m. ❑ p.m.
(date) (time)

URS SAFETY MANAGEMENT STANDARD

Utility Clearances And Isolation

1. Applicability

This procedure applies to URS projects where personnel may encounter subsurface or overhead utilities.

2. Purpose and Scope

Many field activities are conducted near aboveground and underground utilities. The primary purpose of this Standard is to establish operating requirements that will permit employees to work safely in the vicinity of electrical, natural gas, fuel, water, and other utility systems and installations. The secondary purpose is to prevent economic damage to utility systems from operations associated with project-related activities.

The term "utility clearance" includes

A. The positive locating of utility systems in or near the work area.

B. A signed statement by an appropriate representative attesting to the location of underground utilities and/or the positive de-energizing (including lockout) and testing of electrical utilities.

Note that in some cases, utility representatives may deem it appropriate or necessary to use insulating blankets to isolate a power line; this is an acceptable alternative to positive de-energizing (only utility representatives can make the determination).

"Contact" with overhead power lines is considered to occur when equipment is closer to power lines than permitted by the criteria in the table in Section 4.0.C.2.b below. (see note for U.K. operations).

3. Implementation

Field Operations - Implementation of this procedure is the responsibility of the Project Manager.

4. Requirements

A. Time for Completion

Complete utility clearances prior to the start of any work in the area of the utility that could feasibly result in contact with or damage to that utility.

B. Local Regulations

Research local codes and regulations regarding utility locating and isolation requirements. Utility companies and locating services are among the appropriate resources.

C. Overhead Power Lines

1. Proximity to Power Lines

   No work is to be conducted within 50 feet (15 meters) of overhead power lines without first contacting the utility company to determine the voltage of the system. No aspect of any piece of equipment is to be operated within 50 feet (15 meters) of overhead power lines without first making this determination.

2. Operations adjacent to overhead power lines are **PROHIBITED** unless one of the following conditions is satisfied:

   a. Power has been shut off, positive means (such as lockout) have been taken to prevent the lines from being energized, lines have been tested to confirm the outage, and the utility company has provided a signed certification of the outage.

   b. The minimum clearance from energized overhead lines is as shown in the table below, or the equipment will be repositioned and blocked so that no part, including cables, can come within the minimum clearances shown in the table.

MINIMUM DISTANCES FROM POWERLINES	
Powerlines Nominal System kV	Minimum Required Distance
0-50	10 feet (3 meters)
51-100	12 feet (3.6 meters)
101-200	15 feet (4.6 meters)
201-300	20 feet (6.1 meters)
301-500	25 feet (7.6 meters)
501-750	35 feet (10.7 meters)
751-1000	45 feet (13.7 meters)

Note: for U.K. operations, the specific safe distance is determined by the utility company.

   c. The power line(s) has been isolated through the use of insulating blankets which have been properly placed by the utility. If insulating blankets are used, the utility will determine

the minimum safe operating distance; get this determination in writing with the utility representative's signature.

3. All inquiries regarding electric utilities must be made in writing and a written confirmation of the outage/isolation must be received by the Project Manager prior to the start of work.

D. Underground Utilities

1. Do not begin subsurface work (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities and similar obstructions has been conducted. The use of as-built drawings must be confirmed with additional geophysical or other survey.

2. Contact utility companies or the state/regional utility protection service at least two (2) working days prior to excavation activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation.

3. Obtain utility clearances for subsurface work on both public and private property. Clearances are to be in writing, signed by the party conducting the clearance.

4. Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed.

5. Do not conduct mechanical-assisted subsurface work (e.g., powered drill rig, mechanical excavator, etc.) within five (5) feet (1.5 meters) of a confirmed or suspected utility or other subsurface structure. Confirm minimum distances for mechanical-assisted subsurface work with the utility owner, as distances beyond this five foot minimum may be required.

6. Subsurface work within five feet (1.5 meters) of a confirmed or suspected utility or other subsurface structure must be done by hand (e.g., hand auger, shovel) to the point where the obstruction is visually located and exposed. Once the obstruction location is confirmed in this manner, mechanical-assisted work may commence.

7. Reference SMS_13, "Excavation Safety" for additional information regarding subsurface operations.

E. Training

Conduct a site briefing for site employees regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation.

5. Documentation Summary

File these records in the Safety Filing System:

1. Documents requesting utility clearance.
2. Documents confirming utility clearance.
3. Training/briefing documentation of each isolation.

6. Resources

1. Utility Locating Services (typically under "Utility" in the Yellow Pages)
2. NIOSH Alert - Preventing Electrocutions from Contact Between Cranes and Power Lines (http://www.cdc.gov/niosh/crane.html)
3. One Call Utility Locating List (http://www.underspace.com/refs/ocdir.htm)
4. National Utility Locating Contractor's Association (http://www.underspace.com/nu/index.htm)
5. U.K. - Health and Safety Executive GS6

URS SAFETY MANAGEMENT STANDARD

Respiratory Protection

1. Applicability

This program defines responsibilities and procedures and is applicable to URS operations that may require the use of respiratory protection including Immediately Dangerous to Life and Health (IDLH) and emergency conditions. This program also addresses the voluntary use of respirators.

2. Purpose and Scope

The purpose of this procedure is to protect those employees performing operations for which exposures can not be controlled by use of conventional engineering or administrative controls and prior to establishing a negative air exposure assessment, and to require that respiratory protective equipment is selected, used, maintained, and stored in accordance with acceptable practices.

3. Implementation

Laboratory/Office/Shop Locations -	Implementation of this program is the responsibility of the Office Manager.
Field Activities -	Implementation of this program is the responsibility of the Project Manager.
Program Administration-	URS Health and Safety Director is responsible for the development and annual review of this program.

URS Health and Safety Program Representatives are responsible to:

- Assist responsible employees in the implementation of the program.
- Assessing local compliance with the program.

4. Requirements

A. Determine if respirators are needed or going to be used for hazardous jobs before assigning that job to an employee.

1. If the determination is that a potential for respiratory hazards exists with any portion of that job activity then, complete Attachment 42-1.
2. Contact a URS Health and Safety Program Representative if any of the questions in Attachment 42-1 are checked "yes."

3. Follow instructions in Attachment 42-2 for employees who wish to voluntarily use dust masks.

4. Follow all the requirements of this procedure for employees who wish to voluntarily use tight-fitting (e.g., air purifying) respirators.

5. Required respirators will be paid for by URS and will be provided without cost to the employee.

B. Select the proper respirator for the job.

1. For those jobs identified in Attachment 42-1, contact a URS Health and Safety Program Representative for assistance in respirator selection.

2. Contact a URS Health and Safety Program Representative for follow up if there are any problems implementing the recommendations made.

C. Require employees who will use respirators to be medically qualified before fit testing and assigning them a respirator.

1. For program details, refer to SMS 24, Medical Screening and Surveillance.

2. Require that employees have a current and accurate Medical Surveillance form (Attachment 24-2)

3. Obtain a copy of the employee's Health Status Medical Report from the Health and Safety Representative. The consulting occupational physician of the medical service provider following each work related examination issues the Health Status Medical Report. Employees cannot be assigned respirators unless they are medically cleared for respirator use.

D. Require respirator users to receive appropriate training.

1. All respirator users must be trained:

a. Before they are assigned a respirator.

b. Annually thereafter.

c. Whenever a new hazard or job is introduced.

d. Whenever employees fail to demonstrate proper use or knowledge.

2. Training must address, at a minimum, the following:

a. Why the respirator is necessary, and what conditions can make the respirator ineffective.

b. What the limitations and capabilities of the respirators are.

c. How to use respirators effectively in emergency situations.

d. How to inspect, put on and remove, and check the seals of the respirator.

e. What the respirator maintenance and storage procedures are.

f. How to recognize medical signs and symptoms that may limit or prevent effective use of the respirator.

E. Require respirator users to be fit tested.

1. Any employee who has been assigned a reusable respirator must be fit tested on an annual basis (no more than one year may elapse between fit tests), or when the employee is assigned a respirator of a different make, type or size from that previously tested.

2. Fit testing can be performed by contract or in house personnel.

3. Obtain a signed written copy of the fit test results. The fit test results should include:

a. Employee's name and social security number.

b. Respirator brand, model and size fitted for.

c. Date fit tested.

d. Method of fit testing used.

e. Name and signature of fit tester.

f. Statement that fit test protocol met the requirements of 29 CFR 1910.134.

g. Manufacturer and serial number of fit testing apparatus.

A fit test results form is available at Attachment 42-5.

F. Provide qualified employees with respirator(s) and adequate amounts of parts and cartridges.

1. Assign employees whose duties require respirators their own respirator for which they have been fit tested.

2. Provide special eyeglass inserts designed for the respirator if an employee must wear eyeglasses with a full facepiece respirator. Contact lenses may be worn when wearing a full facepiece respirator.

G. Require respirators to be used properly.

1. Prohibit facial hair where the respirator-sealing surface meets the wearer's face.

2. Require employees to perform a positive and negative fit check every time the respirator is put on.

3. Employees will leave the area where respirators are being used:

a. Before removing the facepiece for any reason.

b. To change cartridges.

c. If any of the following is detected:

1. Vapor or gas breakthrough.

2. Leakage around the facepiece.

3. Changes in breathing resistance.

4. Use cartridges with End of Service Life Indicators or determine the respirator cartridge changeout schedule. See Attachment 42-4 for Guidance.

H. Require respirators to be cleaned and stored properly.

1. Clean and disinfect respirators after each use.

2. Store respirators in a plastic bag or case and in a clean location.

3. Inspect respirators before use and after each cleaning.

I. Address issues associated with special use respirators self-contained breathing apparatus; air supply respirators; emergency use respirators).

1. Self Contained Breathing Apparatus

   Inspect self-contained breathing apparatus and other emergency use respirators monthly and after each use in accordance with manufacturer's instructions.

2. Air Supplied Respirators

   a. Air used for atmosphere-supplying respirators must meet or exceed the requirements for Type 1 - Grade D breathing air. Never use oxygen.

      1. A certificate of analysis must accompany bottled air.

      2. Compressors used to supply breathing air must:

         i. Prevent entry of contaminated air into the air supply.

         ii. Minimize moisture content.

         iii. Have suitable in-line sorbent beds and filter to provide appropriate air quality.

         iv. Have a high carbon monoxide alarm that sounds at 10 ppm.

   b. Couplings on air hose lines must be incompatible with other gas systems.

J. Require follow up training and medical surveillance to be provided as directed.

1. Provide follow-up physical examinations as directed by the SMS 24-3, Medical Screening and Surveillance Exam Protocol table.

2. Provide follow-up physicals as directed by the Regional Medical Surveillance Administrator.

3. Provide annual refresher training.

4. Provide annual fit testing.

5. Documentation Summary

A. Laboratory

1. File these records in the Laboratory Safety Filing System

   a. Completed forms:

      1. "Identifying When A Respirator Is Needed" - Attachment 42-1; and,

      2. "Respirator Standard Operating Procedure" - Attachment 42-3.;

   b. Employee Health Status Medical Report includes clearance for respirator use.

   c. Employee Fit Test Records; and,

   d. Employee Respirator Training Records.

2. Send a copy of the following records to the Regional Health and Safety Manager:

   a. Completed "Voluntary Use of Respirators" form - Attachment 42-2.

   b. Employee Fit Test Records.

   c. Employee Respirator Training Records.

B. Field

1. File these records in the Project Health and Safety File:

   a. Completed forms:

      1. "Identifying When A Respirator Is Needed" - Attachment 42-1; and,

2. "Respirator Standard Operating Procedure" - Attachment 42-3.
3. Employee Health Status Medical Report includes clearance for respirator use.;
4. Employee Fit Test Records; and,
5. Employee Respirator Training Records.

2. Send a copy of the following records to the Regional Health and Safety Manager:
   a. Completed "Voluntary Use of Respirators" form - Attachment 42-2;.
   b. Employee Fit Test Records; and,
   c. Employee Respirator Training Records.

6. Resources

A. U.S. OSHA Standard - Respiratory Protection - 29 CFR 1910.134

B. U.S OSHA Technical Links - Respiratory Protection

C. ANSI Z88.6, Respirator Use – Physical Qualifications for Personnel, Current Revision

D. ANSI Z88.2, Respiratory Protection, Current Revision

E. 3M Cartridge Service Life Interactive Program

F. Australian Standards AS/N25 1715 - 1994. Selection, Use, and Maintenance of Respiratory Protection Devices

G. Australian Standards HB9-1994. Occupational Personal Protection

H. AIHA, The Occupational Environment - Its Evaluation and Control

The following documents are PDF files which must be read with Adobe Reader:

I. NIOSH Respirator Decision Logic

J. NIOSH Guide to Industrial Respiratory Protection

K. Attachment 42-1 - Identifying When a Respirator is Needed

L. Attachment 42-2 - Voluntary Use of Respirators

M. Attachment 42-3 - Respirator Standard Operating Procedure

N. Attachment 42-4 - Respiratory Cartridge Change Schedule

O. Attachment 42-5 - Fit Test Results Form

P. Medical Screening and Surveillance Program - SMS 24

URS Corporation

URS Corporation Health & Safety Program
IDENTIFYING WHEN A RESPIRATOR IS NEEDED

Site Location:_____**Date:**_____

Name of Person Performing Evaluation:_____

Project:_____

Answer the questions below for the jobs you are to perform on site. If a "yes" response is checked, consult with a URS Corporation Health and Safety Professional to determine:

- ***if a respirator is truly needed for the job, as well as,***
- ***the type of respirator needed for the job.***

MATERIAL USED OR PROCESS TO BE PERFORMED	YES Respirator may be needed	NO	NOTES
Abrasive Blasting • Abrasive blasting (with any type of grit or material) will be performed. • Employee will fill abrasive blasting pots or perform clean-up activities. • Employee will be in a contained area where abrasive blasting is taking place.			
Acids • Liquid or powder acids will be used in a situation where acid vapors, mists or dust may be breathed.			
Adhesives • Aerosol-propelled adhesives are to be used in areas where there is no or insufficient local exhaust ventilation. • Two-part adhesives (mix part one with two, let set then use) are to be used in areas where there is limited ventilation.			
Alkalis/Bases/Caustics • Powdered alkalis will be used in a situation where an airborne dust may be breathed.			
Asbestos Abatement • Asbestos will be removed, repaired or sampled. • Employees will be inspecting or overseeing areas where asbestos will be removed or disturbed.			

MATERIAL USED OR PROCESS TO BE PERFORMED	YES Respirator may be needed	NO	NOTES
Cleaning Compounds • Degreasers or carbon removers will be used in areas where local exhaust ventilation is not provided. • Aerosol propelled cleaning compounds will be used in areas where there is no local exhaust ventilation. • Degreasers or carbon removers will be used in voids, tanks, or other confined spaces.			
Corrosion Preventive Compounds • Corrosion prevention compounds, including chemical conversion compounds and corrosion inhibitors, will be used in areas where there is no local exhaust ventilation.			
Detergents/Soaps • Ammonia based detergents will be used in large quantity (more than five gallons) in areas where local exhaust ventilation cannot be provided. • Large quantities (5 or 55 gallon containers) of high pH powder detergent/soap will be used in a situation where dust may be breathed.			
Fuels (including regular or unleaded gasoline, kerosene, diesel fuel, JP-5) • Employees will be inside unventilated fuel cells or other confined spaces containing fuels.			
Grinding, Cutting, Sanding • Cutting, grinding or sanding surfaces that have coatings containing lead, cadmium, chromium, zinc or beryllium. • Cutting, grinding or sanding surfaces that are concrete or glass without use of ventilation or water.			
Hazardous Waste Sites • Employees will be performing tasks on a hazardous waste site that requires the use of respirator (as indicated in the site safety & health plan). • Employees will be performing site assessments on potential hazardous waste sites.			
Hydraulic Fluids (including petroleum-based fluids, synthetic fire-resistant fluids, and water based fire resistant fluids) • Hydraulic fluids and the vapors generated will not be exhausted using local exhaust ventilation. • Synthetic fire-resistant fluids or water-based fire-resistant fluids will be used in an area where the air is contaminated with visible mist or spray from hydraulic fluids.			

MATERIAL USED OR PROCESS TO BE PERFORMED	YES Respirator may be needed	NO	NOTES
Inspection Penetrants (including Flouro-finder, water indicating pastes, and penetrant removers) • An aerosol-propelled inspection penetrant will be used in an area where local exhaust ventilation cannot be provided, or in a situation where the solvent vapors can be breathed.			
Lead Abatement Activities • Lead containing materials will be disturbed, removed or sampled. • Employees will be inspecting or overseeing areas were lead will be removed or disturbed.			
Lubricants/Oils • Aerosol lubricants/oils will be sprayed with no immediate exhaust ventilation.			
Oxidizers (materials that give off oxygen including chlorine laundry bleach, calcium hypochlorite, calcium oxide, oxygen candles, lithium hydroxide, hydrogen peroxide, and sodium dichromate) • Oxidizers containing organic chlorine will be used in a situation where the dusts/vapors may be breathed. • Powdered oxidizers will be used in a situation where airborne dust may be breathed.			
Paint Materials (including paints, primers, thinners, enamels, lacquers, strippers, coatings and varnishes) • Paint materials will be spray applied in areas where there is no local exhaust ventilation. • Two part (mix part a with part b, let set, then apply) polyurethane or epoxy polyamide paints will be brush or spray applied. • Paints containing lead, chromium, cadmium, beryllium, and zinc (refer to the MSDS). • Paint materials will be applied in confined spaces.			
Solvents (including hydrocarbon solvents such as acetone, methyl ethyl ketone, toluene, xylene, and alcohols, as well as mixed solutions like antifreeze, heat transfer fluid, turpene, dope and naphtha thinner) • Local exhaust ventilation will not be provided and work will involve breathing solvent vapors. • Solvents will be used within confined spaces. • Solvents will be applied using aerosols.			
Thermal Insulation (including asbestos & non-asbestos materials like pipe lagging, fiberglass insulation, boiler insulation, packing materials and floor/ceiling tiles) • Insulation will be disturbed, removed or sampled.			

MATERIAL USED OR PROCESS TO BE PERFORMED	YES Respirator may be needed	NO	NOTES
Water Treatment Chemicals (includes corrosive chemicals such as tri-sodium phosphate, hardness buffer, tritrating solution, morpholine, caustic soda, citric acid and nitric acid as well as toxic chemicals such as mercuric nitrate, hydrazine, EDTA and sodium nitrate) • Morpholine, EDTA, or harness buffer/titrating solution is to be used in poorly ventilated spaces. • Powdered water treatment chemicals will be used in a situation where chemical dusts may be breathed.			
Welding/Brazing • Welding will be performed in confined spaces. • Welding galvanized metal or stainless steel. • Brazing with cadmium or lead.			
For Any of The Above Listed Activities • A employee will be in the immediate area - within 10 feet of the job or operation, or • Employee will be inside confined space where activities are taking place, or • Employee will be inside a "controlled area" such as found in asbestos abatement, lead abatement, radiation control area, or a hazardous waste site.			
Material Safety Data Sheets • For any chemical product used, a respirator is recommended.			
Product Labels • For any chemical or process that indicates respirators should be used.			
Product Use Instructions For any product used, instructions indicate a respirator should be used.			
Standard Operating Procedures A Standard Operating Procedure indicates the use of a respirator.			

URS Corporation

URS Corporation Health & Safety Program
VOLUNTARY USE OF RESPIRATORS

Instructions: Have the employee that is opting to use a respirator for non-overexposure conditions read this page, then sign on the bottom of the page. Forward a copy of the signed form to the Regional Training Records Administrator, and maintain a copy in the employee's personnel file.

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for employees. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the employee. Sometimes employees may wear respirators to avoid exposures to hazards, even if the amount of the hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your own voluntary use, or if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not pose a hazard.

You should do the following:

1. Read and follow all instructions provided by the manufacture on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.

2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety & Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear o the respirator or respirator packaging. It will tell you what the respirator is designed for and how it will protect you.

3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect you against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, fumes, smoke or very small solid particles.

4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

5. If you have any health conditions (asthma; high blood pressure; emphysema; heart disease) that could be aggravated by using a respirator, you should check with your doctor before using one.

I have read and understand this information on:_____ (date)

Employee's name:_____

Employee's signature:_____

URS Corporation

URS Corporation Health & Safety Program
RESPIRATOR STANDARD OPERATING PROCEDURE

Job Task Reviewed:_____

Date Reviewed:_____

Task Reviewed by:_____

ADMINISTRATIVE PROCEDURES

1. All respirator users must be medically qualified to use respirators. Point of contact for scheduling is the Regional Medical Surveillance Administrator.
2. Respirator users must be trained annually in respirator use and fit tested annually.
3. Respirator will be used only by the person to whom it was issued.
4. Persons using glasses who are required to use a full-face respirator may use contact lenses or eyeglass inserts designed for the respirator.

GUIDANCE FOR SELECTION OF RESPIRATOR & CARTRIDGES/FILTERS

1. _____ respirators are currently being issued and used for the following job activity: _____ _____.
2. The respirator will be equipped with the following cartridges/filters:_____ _____.
3. Filters are to be changed when the breathing resistance increases.
4. Cartridges are to be changed:_____ or when the contaminant you are protecting yourself from can be smelled or tasted.

FIT TESTING & FIT CHECKING

1. Fit testing is required annually. To arrange for fit testing call your local safety representative.
2. Respirator users will "fit check" the respirator every time the respirator is put on:

- **Negative Check** - cover filters/cartridges with palms of hands and breath in, leakage should not be detected around the face seal of the respirator. Do not use if leakage is detected.
- **Positive Check** - cover the exhalation valve cover with palm of hand and blow out slightly, leakage should not be detected around the respirator seal.
- **For Air Supply Respirators** - kink or close off air supply hose and breath in, leakage should not be detected around the face seal of the respirator.

CLEANING & MAINTENANCE OF RESPIRATOR

1. Clean and disinfect respirator after every use.
2. Inspect respirator after every day in use to ensure parts are not missing. Replace missing parts from stock supply.
3. Store clean respirator in labeled plastic bag out of direct sunlight.
4. Do not alter respirator in any way.

URS Corporation

URS Corporation Health & Safety Program
RESPIRATOR CARTRIDGE CHANGE SCHEDULE

A cartridge change schedule must be developed for cartridges or canisters used with air purifying respirators that do not have an End of Service Life Indicator (ESLI). The purpose of this is to prevent contaminants from breaking through the respirator's sorbent cartridge(s), and thereby over-exposing employees. NIOSH has approved ESLIs for only four cartridges or canisters (mercury vapor, carbon monoxide, ethylene oxide, and hydrogen sulfide). Historically we have relied on the warning properties (odor, irritation) of a contaminant to dictate cartridge change. OSHA no longer allows this as the sole basis for changing respirator cartridges. In developing a change schedule the following factors should be considered:

- Contaminants.
- Concentration.
- Frequency of use (continuously or intermittently throughout the shift).
- Temperature and humidity.
- Work rate.
- The presence of potentially interfering chemicals.

The worst case conditions should be assumed to avoid early breakthrough. This must be documented in the project health and safety plan or, in the cases of office or labs, in the site specific Respiratory Protection Program.

Sources of Help

Manufacturers

3M has an interactive “Cartridge Service Life” program that can be downloaded for free (http://www.mmm.com/market/safety/ohes2/index.html)

This program will estimate cartridge service life for 3M products against many contaminants. The program does not evaluate the service life against mixtures (multiple contaminants). Because of the complexity in evaluating mixtures, OSHA offers the following guidance:

- When the individual compounds in the mixture have similar breakthrough times (i.e., within one order of magnitude), service life of the cartridge should be established assuming the mixture stream behaves as a pure system of the most rapidly migrating component with the shortest breakthrough time (i.e., sum up the concentration of the components).
- Where the individual compounds in the mixture vary by 2 odors of magnitude or greater, the service life may be based on the contaminant with the shortest breakthrough time.

Rule of Thumb (*"The Occupational Environment - Its Evaluation and Control)*

- If the chemical's boiling point is >70°C and the concentration is less than 200 ppm you can expect a service life of 8 hours at a normal work rate.
- Service life is inversely proportional to work rate.
- Reducing concentration by a factor of 10 will increase service life by a factor of 5.
- Humidity above 85% will reduce service life by 50 %.

OSHA Interpretation

The OSHA inspection procedures for the respiratory protection standard specifies that where contaminant migration is possible, respirator cartridges/canisters should be changed after each work shift where exposure occurs unless there is objective data to the contrary (desorption studies) showing the performance in the conditions and schedule of use/non-use found in the workplace.

Respiratory Fit Test Record — Attachment 42-5

Name: _____ **Social Security No:** _____

Company/Office:_____ **Last Medical Exam:** _____

Fit Test Date: _____ **Corrective Lenses Needed:** Yes ☐ No ☐

Briefed on fundamental principles of respiratory protection, use, selection, inspection cleaning, maintenance and storage of equipment. Yes ☐ No ☐

Isoamyl acetate odor recognition Yes ☐ No ☐

	RESPIRATOR 1	RESPIRATOR 2	RESPIRATOR 3
Equipment Type	_____	_____	_____
Manufacturer's Name	_____	_____	_____
Model	_____	_____	_____
Size	_____	_____	_____
Facepiece Composition (Rubber/Silicone)	_____	_____	_____

TEST PERFORMED	RESPIRATOR 1	RESPIRATOR 2	RESPIRATOR 3
Negative Pressure Test:	P ☐ F ☐	P ☐ F ☐	P ☐ F ☐
Positive Pressure Test:	P ☐ F ☐	P ☐ F ☐	P ☐ F ☐
Isoamyl Acetate Vapor Test:	P ☐ F ☐	P ☐ F ☐	P ☐ F ☐
Irritant Smoke Test:	P ☐ F ☐	P ☐ F ☐	P ☐ F ☐

This qualitative fit test protocol has been adapted from OSHA Respiratory Protection Standard 29 CFR 1910.134, Appendix A.

_____ _____ _____

Examiner's Name (Please Print) **Examiner's Signature** **Date**

_____ _____

Employee's Signature **Date**

URS

URS SAFETY MANAGEMENT STANDARD

Personal Monitoring (Industrial Hygiene)

1. Applicability

This standard applies to URS operations where employees may be exposed to unacceptable concentrations of hazardous air contaminants.

2. Purpose and Scope

This standard is intended to assist and provide guidance to URS personnel that need to conduct personal industrial hygiene monitoring

Personal monitoring is to be conducted under the following conditions:

A. Where directed by a site-specific health and safety plan.

B. Where employees are exposed to known or suspected human carcinogens.

C. Where regulations require "initial exposure assessments." The only exception to conducting an "initial exposure assessment" where there is a regulatory requirement to do so is when similar exposure assessments have been conducted under similar site conditions within one year prior to the start of work on the current project.

Retain a copy of the referenced initial exposure assessment and place it in the Project Safety File.

2. Implementation

Laboratory Locations - Implementation of this standard is the responsibility of the Laboratory Manager.

Field Activities - Implementation of this standard is the responsibility of the Project Manager.

3. Requirements

A. Procedures for Personal Industrial Hygiene Monitoring

1. Collect samples using the applicable methodologies established by either NIOSH or OSHA. Require the selected laboratory to utilize the applicable analytical methodologies.

2. Document personal monitoring activities using a URS Industrial Hygiene Monitoring Form (Attachment 43-1) and require that all Chain of Custody forms are properly completed.

B. Evaluation of Personal Monitoring Results

1. Require that the analytical results be evaluated by a URS Health and Safety Program Representative.

2. Obtain a written evaluation report from the URS Health and Safety Program Representative. If exposures exceed the Action Level and/or Permissible Exposure Limit for the air contaminant(s) of concern, a verbal report is to be made to the Project Manager immediately, and the evaluation report will include required corrective actions.

3. Evaluation reports are to be completed within five working days of the receipt of the analytical results.

C. Communication of Sample Results and Evaluation

1. Provide copies of the evaluation report to the employee(s) monitored and to employees working in the area for whom the exposures could be representative.

2. Provide a copy of the evaluation report and monitoring data to the Medical Surveillance Administrator.

D. Corrective Actions

Implement required corrective actions immediately.

4. Documentation Summary

Maintain in the Project Safety File:

A. Calibration data

B. Completed IH Monitoring Form(s)

C. Evaluation Report with sample results

D. Relevant prior initial exposure assessments

E. Provide to affected employees:

- Evaluation Report with sample results

F. Provide to the Medical Surveillance Administrator:

- Evaluation Report with sample results
- List of employees affected by the sampling

5. Resources

A. OSHA Analytical Methods

B. OSHA Chemical Sampling Information

C. American Industrial Hygiene Association, The Occupational Environment, Its Evaluation and Control.

D. American Conference of Governmental Industrial Hygienists. Air Sampling Instruments for Evaluation of Atmospheric Contaminants.

E. U.K. - 'Control of Substances Hazardous to Health'

F. NIOSH Analytical Methods

G. Attachment 43-1 - IH Monitoring Form

URS Corporation

URS Corporation Health & Safety Program
INDUSTRIAL HYGIENE MONITORING FORM

Project Information

Name	Date / /
Social Security #	
Project Number	
Project Name and Location	
Weather Conditions	

Sample type	Personal ☐ Area ☐	URS Control Number:	
Sample location:		Pump Manufacturer:	
Sample media:		Pump Model Number:	
Lot Number:		Pump Serial Number:	
Contaminant sampled:		Analytical Method:	

Sample Information

Sample I.D. Number	Sample Location	Pump Number	Flow Rate	Start Time	Stop Time	Elapsed Time (mins)	Volume (liters)

PPE Used

Corresponding Photographs

Sample I.D. Number	Photo Number, Roll No., Exposure No.	DESCRIPTION

Site Activities Description/Comments:
(Continue on reverse side if necessary

URS SAFETY MANAGEMENT STANDARD

Back Injury Prevention

1. Applicability

This procedure applies to URS operations where personnel perform manual lifting.

2. Purpose and Scope

The purpose of this procedure is to prevent back injuries to URS personnel.

3. Implementation

Office Locations - Implementation of this procedure is the responsibility of the Office Manager.

Field Activities - Implementation of this procedure is the responsibility of the Project Manager.

4. Requirements

A. Safe Lifting Practices in the Office

1. Require that personnel receive the training described in (C) below.
2. Evaluate all assignments that involve lifting, such as moving boxes of files and paper, computer equipment, and the like to see that the task can be completed without risk of back injury to assigned personnel.
3. Provide material handling devices, such as carts and dollies, to assist in the safe moving of materials.
4. Obtain outside assistance, such as contract movers, if the job cannot be safely accomplished by URS personnel.
5. Require that heavier items are stored on lower shelving units.

B. Safe Lifting Practices in the Field

1. Recognize that field assignments tend to be lifting-intensive, and that URS has a duty to provide the means by which personnel can perform lifting duties without risk of injury.
2. Require that personnel receive the training described in (C) below.

3. Evaluate all field assignments that involve lifting to see that the tasks can be completed without risk of back injury to assigned personnel.

4. Provide material handling devices, such as carts, dollies, trucks with lift gates, to assist in the safe moving of materials. If required, assign additional personnel to the task.

5. Direct field personnel not to assist in lifting tasks that are normally undertaken by subcontractor personnel.

6. Contact a URS Health and Safety Program Representative when assistance is necessary to evaluate a lifting task that may pose a back injury risk to assigned personnel.

C. Training

1. Require that personnel who may have lifting as part of their duties receive training that includes the following topics:

   a. Showing personnel how to avoid unnecessary physical stress and strain.

   b. Teaching personnel to become aware of what they can comfortably handle without undue strain.

   c. Instructing personnel on the proper use of equipment.

   d. Teaching personnel to recognize potential hazards and how to prevent or correct them.

2. This training must be completed prior to an employee being assigned to a task that involves lifting.

D. Office Moves and Relocations

1. Utilize professional movers (who are appropriately insured) to move office furniture such as desks, file cabinets, and bookcases, even if such a move is only between offices or cubicles at a particular location (on-site move).

2. Utilize professional movers for intensive moving of file boxes and other heavy materials.

E. Material Packaging

1. Use only smaller size (<18") file ("Banker") boxes for file storage, as the larger (>18") boxes are awkward and readily overloaded.

2. Use only smaller coolers for field samples, as the larger coolers are awkward and readily overloaded.

5. Documentation Summary

File the following documents in the Office Health and Safety File

- Training rosters

File the following documents in the Project Health and Safety File

- Training rosters

6. Resources

A. Work Practices Guide for Manual Lifting, NIOSH

URS SAFETY MANAGEMENT STANDARD

Subcontractor Health and Safety Requirements

1. Applicability

This procedure is applicable to subcontractors retained by URS to perform construction (including drilling and excavation), alteration, demolition, and/or repair activities utilizing their own workforce or equipment. This procedure is applicable to the operations of subcontractors and sub-subcontractors of any tier.

This procedure does not apply to third party contractor operations where there is no subcontract relationship between the contractor and URS Corporation. Health and safety issues regarding third party contractor operations are governed by project specific contracts and are not covered by this standard.

2. Purpose and Scope

This procedure provides guidelines on the pre-evaluation of subcontractor safety programs. t also provides guidance on contractual risk management, subcontractor safety performance on the job site, and the responsibilities of the Project Manager with respect to subcontractor jobsite safety performance.

It is recommended that each URS Corporation subcontractor be evaluated at least annually using Attachment 46-1, “Subcontractor Safety Evaluation Form,” in order to perform work on any new URS Corporation projects.

3. Implementation

Field Activities - Implementation of this procedure is the responsibility of the Project Manager.

4. Guidelines

A. Pre qualification of Subcontractor - The Project Manager shall complete the following procedures for all subcontractors retained on projects covered by this standard (the PM should also require subcontractors to follow these procedures with respect to pre-qualification of sub-subcontractors of any tier):

1. Request all subcontractor candidates to complete the attached “Subcontractor Health and Safety Evaluation Form” (Attachment 46-1).

2. Conduct an assessment of each subcontractor’s qualifications with respect to the subcontractor health and safety evaluation criteria contained in Attachment 46-2.

3. Verify that subcontractors meet the insurance requirements as stated in Attachment 46-2 or as approved by Counsel.

4. If the subcontractor has been successfully evaluated within the last 12 months, that evaluation may be substituted.

5. For long term projects, this evaluation should be updated within 12 months of the previous evaluation.

B. Contractual and Risk Management Requirements of Subcontractors

1. Ensure that subcontractor is contractually bound to comply with applicable client and URS Corporation Health and Safety Program requirements.

2. Ensure that subcontractor is contractually bound to develop additional safety procedures for work that is exclusive to their activities on the site and for which they may have superior knowledge.

3. Assess compliance of subcontractor's insurance with the URS Corporation subcontract requirements (including, but not limited to, necessary types and amounts of coverage, URS Corporation additional insured endorsement, etc.).

4. Ensure that URS Corporation has the right in its subcontract, without liability to the subcontractor, to stop the subcontractor's work in the event of any violations of the applicable Health & Safety Plan.

C. Subcontractor Safety Representative

1. Require each subcontractor to appoint a Subcontractor Safety Representative (SSR) who:

   a. Is knowledgeable of the subcontractor's activities.

   b. Understands the safety requirements of the subcontractor's activities.

   c. Has the ability to recognize and the authority to correct safety deficiencies and execute a stop work order should an imminent danger arise.

d. Has the responsibility for the administration of the subcontractor Health and Safety Program.

e. Will serve as the direct contact with URS Corporation regarding resolution of Health and Safety issues.

D. Communication

1. Provide the SSR with information regarding Site Safety Program including but not limited to:

   a. Client Requirements.

   b. URS Corporation Site Safety Program.

   c. Site Hazard Communication Program.

   d. Site Emergency Action Plan.

   e. Any additional safety information from other contractors or subcontractors working on the site.

2. Provide SSR with name of URS Corporation project contact and alternate for addressing site Health and Safety issues.

3. Require the participation of subcontractors in all Site Safety Briefings.

4. Require subcontractor compliance with all safety directives and/or stop work orders issued by the URS Corporation site representatives.

E. Subcontractor Safety Performance

1. To the extent reasonable in light of URS Corporation's scope of work under the client contract, visit the site and periodically observe subcontractors operations (i.e., conduct spot checks) to assess whether subcontractor appears to be conducting its operations in accordance with applicable health and safety requirements. Periodically review any required subcontractor health and safety written documentation for compliance with applicable requirements.

2. In the event that deficiencies are observed immediately bring them to the attention of the SSR for resolution.

3. In the event of observation of an “Imminent Danger” situation (i.e. involving a situation that could result serious injury or death), immediately contact the SSR and stop the work.

4. Investigate all injuries/illnesses related to subcontractor operations to identify causes and effect corrective actions.

5. In the event of serious and/or continuing subcontractor breaches of applicable health and safety requirements contact legal counsel to assess whether formal contractual action is appropriate under the subcontract.

5. Documentation Summary

A. File in the Project Safety File

1. Subcontractor Health and Safety Evaluation Form.

2. Applicable and current Insurance Certificates.

3. Names and telephone numbers of SSR for each subcontractor.

4. Verification of Health and Safety documents transmitted to subcontractors and received from subcontractors.

5. Identified safety deficiencies as applicable for subcontractors and verification of correction of conditions.

6. All other safety related documentation between URS Corporation and subcontractor such as training certifications, etc.

7. Subcontractor safety plan, incident reports and resolution reports.

6. Resources

A. Federal OSHA Workplace Injury and Illness statistics (http://www.osha.gov/oshstats/work.html)

B. Managing Subcontractor Safety, Prepared by The Construction Industry Institute, Safety Task Force, Publication 13-1, The University of Texas at Austin, Austin, Texas, 1991 (http://www.construction-institute.org/)

C. American National Standard Construction and Demolition Operations -- Safety and Health Program Requirements for Multi-Employer Projects,

ANSI A10.33-1992, National Safety Council, Itasca, Illinois 60143-3201 (http://www.nsc.org)

D. "Liability, OSHA and the Safety of Outside Contractors," Professional Safety, American Society of Safety Engineers, January 1993 (http://www.asse.org)

E. "Proactive Construction Management; Dealing With the Problem of Subcontractor Safety," Professional Safety, American Society of Safety Engineers, January 1990 (http://www.asse.org)

F. "Design Professional Liability Under OSHA," Presented by Thomas F. Holt, Jr., HWAC Lawyer's Roundtable, June 14, 1995 (to be Published) (http://www.hwac.org)

G. “Occupational Injury and Illness Rates by SIC”, Bureau of Labor Statistics, U. S. Department of Labor (http://stats.bls.gov/sahome.html)

H. Attachment 46-1 - Subcontractor Safety Evaluation Form

I. Attachment 46-2 - Subcontractor Evaluation Criteria

URS	Health and Safety Program **SUBCONTRACTOR SAFETY EVALUATION FORM**	Attachment 46-1 Revised: 5/9/01

It is the policy of URS to provide a safe and healthful environment for all of its employees through the prevention of occupational injuries and illnesses. As such, URS considers safety as paramount and requests the following information of all subcontractors.

Company Name	
Company Address	
Submitted By	
Title	
Phone	
Fax	
Type of services performed	
Standard Industrial Classification (SIC) Code	
Number of employees in company	
Date of submittal	

SAFETY PERFORMANCE DATA

1. Has your company performed work as a subcontractor to URS previously? ❑ Yes ❑ No

If yes, explain the nature of the work, project location and project date, URS Project Manager and telephone number.

2. Worker Compensation Experience Information

a) List you Interstate Worker Compensation Experience Modification Rate (EMR) for the last three full years below:

Year	EMR	Carrier	Policy Number

Intrastate (List statistics for highest EMR state)

Year	EMR	Carrier	Policy Number

b) We require verification of your EMR. Please attach the endorsement page from your policy listing your EMR, or have your insurance carrier or broker provide this information on their letterhead.

c) If your EMR is 1.0 or exceeds 1.0 for any one or more years above, please explain:

3. Workplace Injuries and Illnesses

	YEAR	YEAR	YEAR
PROVIDE THE FOLLOWING INFORMATION:			
A. Number of Fatalities[1]			
B. Number of cases that involved days away from work, or days of restricted work activity, or both (Totals from Columns 2 and 9)			
C. Number of cases involving recordable cases without lost or restricted workdays (Totals from Columns 6 and 13)			
D. Total Recordable Cases (Sum of Items A, B, and C above for each given year)			

[1] Attach description of Event

	YEAR	YEAR	YEAR
PROVIDE THE FOLLOWING INFORMATION:			
E. Total hours worked			
F. OSHA Total Recordable Incident Rate[2]			
G. OSHA Lost Workday Case Incident Rate[3]			

4. Describe any workplace safety regulatory agency (e.g. OSHA) citation and violation the Company has received in the past three years. Explain the nature of the citation, classification, and final fine. Describe the resolution of any serious violations. Please feel free to attach separate statements where more space is required.

Year	Number of Citations	Final Fine Amount

Citation Statement

Year	Number of Citations	Final Fine Amount

Citation Statement

[2] Incident Rate (Item F) = $\frac{\text{Total Cases (Item D)} \times 200{,}000}{\text{Total hours worked (Item E)}}$

[3] Lost Workday Case Incident rate = $\frac{\text{Total Lost Workday Cases (Item B)} \times 200{,}000}{\text{Total hours worked (Item E)}}$

5. Has your company received any Willful violations? ❑ Yes ❑ No

6. Does your company maintain a written Health and Safety program? ❑ Yes ❑ No
   If yes please include a copy of the Table of Contents.

7. Does your firm have a safety officer? ❑ Yes ❑ No
   If yes, please provide name and telephone number

Name

Telephone

8. Is your company capable of preparing safety procedures specific to the work proposed for this project? ❑ Yes ❑ No

RISK MANAGEMENT / INSURANCE DATA

1. Does your firm have insurance coverage for commercial liability and automobile liability without limits of at least $1,000,000? ❑ Yes ❑ No
   (Note that certain URS client contracts require insurance in excess of the levels noted above. Inability to supply insurance at levels required by URS' client contract could result in disqualification.)

2. Are you able to provide URS with insurance certificates naming URS and if requested, URS' client as an additional insured? ❑ Yes ❑ No

3. Please provide proof of current Worker's Compensation and Employers Liability Insurance coverage (attach certificate).

VERIFICATION OF DATA

Please have an officer of the Company sign below certifying that the information provided in this document is current and correct.

Name

Title

Signature _____

Date _____

Misrepresentation of data requested is grounds for immediate termination of contracts and disqualification from future consideration.

URS Use Only

Date Received: _____

Evaluated by: _____
Project Manager

Referrals only required as per Attachment 2

Submitted to Health and Safety Rep for evaluation: H&S Rep_____
Pass
Fail
Submitted to Counsel for evaluation: Counsel_____
Pass
Fail

Final Evaluation

Project Manager: _____

Pass

Signature: _____

Fail

Date: _____

URS	Health and Safety Program **SUBCONTRACTOR EVALUATION CRITERIA**	Attachment 46-2

Prior to engaging a subcontractor on a project, Project Managers are strongly recommended to ensure that the contractor has an effective safety program, is capable of conducting it's operations in a safe manner and has appropriate insurance coverage. The following guidelines shall be followed in determining whether the subcontractor may be used on a URS Corporation project.

GENERAL INFORMATION

The contractor must be able to complete the header section on Page 1 of the questionnaire including their Standard Industrial Classification. For assistance determining the SIC for a business refer to the Standard Industrial Classification Manual online at http://www.osha.gov/oshstats/sicser.html.

SAFETY PERFORMANCE DATA RESPONSES

The numbers in this section directly correspond to the questions in Attachment 46-1.

1. If yes, check safety performance history with previous URS Corporation Project Manager if unknown.

2. For any EMR listed as greater than 1.0 the contractor has failed the evaluation. Further consideration may not occur without referral to URS Corporation Health and Safety Program Professional in your Region for further assessment.

   If all EMRs listed are 1.0 or below, continue with evaluation.

3. Determine the most recent OSHA Incident Rate and Lost Workday Case Rate for the subcontractors SIC. This may be done online at http://www.osha.gov/oshstats/work.html.

   For rates in excess of the published averages the subcontractor has failed the evaluation. Further consideration may not occur without referral to URS Corporation Health and Safety Program Professional in your Region for further assessment.

   If the rates are at or below the average for the subcontractors SIC, continue with the assessment.

4. Determine the subcontractor's citation history at http://www.osha.gov/cgi-bin/est/est1. Compare the published data to the contractor questionnaire. The subcontractor must explain any discrepancies.

   Look for large numbers of serious and repeat violations. If the suggests a problem request information and refer to URS Corporation Health and Safety Program Professional in your Region for further assessment.

5. If subcontractor answers yes to willful violations request a detailed explanation and refer to URS Corporation Health and Safety Program Professional in your Region for further assessment.

6. For small subcontractors a no answer is not unexpected and may be acceptable with good EMR and OSHA statistics. Generally some minimal program is expected depending on the breadth and complexity of the work. Contact URS Corporation Health and Safety Program Professional in your Region for further assessment if you have any questions or doubts.

7. See 6.

8. It is expected that a subcontractor being hired to perform services on the project site should be the best prepared to address safety issues for their operations, especially when specialty work is being conducted or for work in which the subcontractor possesses superior knowledge of their operations.

   A 'no' answer should be referred to the URS Corporation Health and Safety Program Professional in your Region for further assessment.

RISK MANAGEMENT/INSURANCE DATA

1. The inability to provide insurance coverage at or above $1,000,000 requires referral to Counsel.

2. Proof of Workers Compensation Insurance is required. Refer any questions to Counsel.

3. Ability to provide Insurance Certificates naming URS Corporation as an additional insured is required. Refer any questions to Counsel.

URS SAFETY MANAGEMENT STANDARD

DOT Shipping

1. Applicability

Office and field operations that ship hazardous materials (HazMat) must follow this Hazardous Material Shipping Program.

Hazardous materials may include, but are not limited to, compressed gases, laboratory reagents, field samples, hazardous wastes, and materials used for bench scale and pilot plant operations.

2. Purpose and Scope

This program was designed to provide a framework for compliance with the requirements of the U.S. Department of Transportation (DOT) 49 CFR and the International Air Transportation Association (IATA) for shipping hazardous materials by land or air.

3. Implementation

Office Locations - The Office Manager is responsible for implementing this program at company locations/facilities.

Field Activities - The Project Manager is responsible for compliance and implementation of this program at project sites.

4. Requirements

A. Staffing

Each project or location must ensure that awareness and function specific trained individuals are involved in the process of preparing hazardous materials for shipment.

Each location where HazMat shipping occurs or where HazMat employees are assigned must identify a local or regional Shipping Specialist.

B. General Procedures

1. Select the best way to ship the HazMat item based on the quantity, hazard(s), and mode of transportation (e.g., air, land, water).

2. Ensure package contents are compatible.

3. Package, mark, and label according to applicable regulations.

4. Complete the bill of lading or shipper's declaration for dangerous goods according to applicable regulations.

5. Follow hazard communication requirements:

    a. Send a copy of the appropriate Emergency Response Guidebook page or material safety data sheet (MSDS) with each shipment.

    b. Include the 24-hour emergency response phone number (CHEMTREC 800-424-9300 domestic, 703-527-3887 international) on the shipping paperwork.

C. Placarding Requirements

1. Placards must be offered to drivers if the amount of hazardous materials being shipped exceeds 1,000 pounds.

2. For extremely hazardous materials (e.g., severe explosives and toxics), any amount requires placarding.

3. "Limited quantities" are excepted from placarding.

4. URS employees transporting hazardous materials meeting DOT tracking and shipping requirements will obtain the proper Commercial Drivers License and endorsement.

D. Training

1. Require employees who package, prepare paperwork, load and/or unload, and transport hazardous materials be trained to the appropriate level of activity:

    a. Training is required prior to performing HazMat shipping activities.

    b. Training is required when regulatory changes impact current procedures and every 2 years.

    c. General awareness training is required for everyone who is involved in HazMat shipping. This training includes:

        1. Recognizing hazardous materials

        2. Penalties for not complying

3. Basic regulatory requirements

d. Function specific training is required to ensure employees can perform the specific HazMat jobs safely and in compliance with applicable regulations.

e. Driver's may be exempt from function specific training if the DOT's Materials of Trade (MOT) exception applies to the shipment. (See Attachment 48-1 for information on this exception).

E. Special Requirements

1. Some countries and transporters have more stringent requirements than DOT or IATA. For example, the United Parcel Service (UPS) publishes its own Guide for Shipping Ground and Air Hazardous Materials. URS shipping training and this program may not meet these additional requirements.

2. Contact the applicable shipping company or a URS Health and Safety Program Representative if you are unsure or suspect there may be additional, special requirements on a shipment.

3. For international shipments an expediter may be required to ensure needed materials are not held in customs. It may be advisable to purchase hazardous materials once you arrive in your destination country.

5. Documentation

All files must be kept in a central location.

A. Training records

1. Sign-up sheet with list of employee names, date, management certification.

2. Successfully completed tests.

3. Outline of course materials.

6. Resources

A. 49 Code of Federal Regulations, Parts 171-180, Subchapter C--Hazardous Materials Regulations.

B. Dangerous Goods Regulations. International Air Transport Association. 40th Edition. Effective January 1, 1999.

C. International Maritime Dangerous Goods Code. International Maritime Organization, Amendment 29-98.

D. DOT Office of Hazardous Materials Safety

E. URS HazMat Shipping Support Helpline 800.381.0664

F. Attachment 48-1 - Materials of Trade Summary

MATERIALS OF TRADE (MOTs) SUMMARY

The Department of Transportation (DOT) adopted the "Materials of Trade" or "MOTs" exception for companies that are not in the business of transporting chemicals. Because URS is in the business of environmental sampling and other field services, URS is able to use this exception. The exception is found in the Code of Federal Regulations: 49 CFR 173.6.

The MOTs exception allows URS Corporation employees to transport certain amounts of chemicals aboard their vehicles without preparing hazardous material paperwork or packaging the hazardous material in specification boxes using hazard labels and required markings.

MOTs must be packaged in the manufacturer's original packaging, or a packaging of equal or greater strength or integrity. Gases must be in DOT specification cylinders. If the inner container (such as the bottle) is secured against movement inside the vehicle (if it is kept in a cabinet or tool box), then no outer packaging (such as a cardboard box) is required. The MOT must be marked with a common name or the technical name.

No hazardous material training is required, except that the driver must be familiar with the MOTs exception. The driver is not allowed to exceed total aggregate weight of 440 pounds of MOTs aboard the vehicle.

The hazardous material classes and quantities of HAZMAT items typically transported by URS field can be transported as MOTs:

- The inner container of a Packing Group II and III material in Class 3, 8, 9, Division 4.1, 5.1, 5.2, 6.1, or ORM-D cannot exceed 66 pounds or 8 gallons each.
- A Division 2.1 or 2.2 cylinder cannot exceed 220 pounds.
- The inner container of a Packing Group II or II material in Division 4.3 cannot exceed 1 ounce.

Be careful not to exceed the 440-pound upper limit weight restriction.

URS **SAFETY MANAGEMENT STANDARD**

Injury / Illness / Incident Reporting

1. Applicability

This procedure applies to URS Corporation offices and field operations.

2. Purpose and Scope

The purpose of this procedure is to provide guidance for the timely reporting of work related injuries, illness, and incidents.

3. Implementation

Office Locations - Implementation of this program is the responsibility of the employee's Supervisor.

Field Activities - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Reporting: All employees shall immediately notify their appropriate level of management (line, project, and/or office) of a reportable incident. A reportable incident includes the following:

1. An injury to any URS employee, subcontractor, client representative, or private citizen, even if the injury does not require medical attention;

2. An injury to a member of the public occurring on a URS work site or possibly resulting from a URS or subcontractor activity or involving URS or subcontractor property, equipment, or resource;

3. Illness resulting from suspected chemical exposure;

4. Chronic or re-occurring conditions such as back pain or cumulative trauma disorders (example: carpal tunnel syndrome);

5. Fire, explosion, or flash;

6. Any vehicle accidents occurring on site, while traveling to or from client locations, or with any company-owned or leased vehicle;

7. Property damage resulting from any URS or subcontractor activity;

8. Structural collapse or potential structural hazards;

9. Unexpected release or imminent release of a hazardous material;

10. Unexpected chemical exposures to workers or the public;

11. A safety related complaint from the public regarding URS activities.

12. Any other significant occurrence that could impact safety.

B. Actions: The following actions will be taken following a reportable incident:

1. Employees:

   a. If necessary, suspend operations and secure and/or evacuate the area;

   b. Immediately notify your supervisor and/or project manager

   c. Record information pertaining to the incident (e.g., time, date, location, name and company of person(s) involved, description of event, and actions taken);

   d. Assist with incident investigation as directed by management;

   e. Implement corrective actions as directed by management;

   f. *Do not* discuss the incident with members of the news media or legal representatives (except URS legal counsel or your personal legal advisor) unless directed to do so by URS management;

   g. *Do not* make statements pertaining to guilt, fault, or liability.

2. Line/Project Management:

   a. Review circumstances of the incident with applicable employee(s);

   b. Notify local Health and Safety representative. If incident involves and an injury/illness of a URS employee, also notify the local Human Resources Representative;

   c. Complete and distribute injury/incident report within 24 hours. (Note: If the employee is unable to complete the

report, another company employee, line manager, project manager, or local health and safety representative may complete the report.);

d. Review and verify that necessary corrective actions are identified and implemented;

e. Discuss with department or project staff the circumstances surrounding the incident and corrective actions taken.

3. Local Health And Safety Representative

   a. Assist with incident evaluation;

   b. With management, identify cause(s) of incident and identify corrective actions needed to avoid recurrence;

   c. Review injury/incident report for completeness and accuracy;

4. Local Human Resources Representative

   a. Report work-related injuries and illness to worker compensation carrier

      AIG Claim Services @ 1-877-366-8423

5. Corporate Health and Safety Management

   The Occupational Health Specialist (OHS), Corporate Health and Safety Director, and Construction Services Division Safety and Health Director will review all reported incidents (U.S.-based employees only) to determine OSHA reporting and recording requirements. All decisions will be based strictly on current Federal OSHA guidelines.

   a. Official records (including required reports, logs, for all reported incidents will be maintained at one central location by the OHS.

   b. The OHS will send each establishment any required government report for their establishment following receipt of an incident report.

c. Each January the OHS will prepare and distribute, to each URS establishment, the appropriate government injury/illness reports. These reports will summarize all required government information for incidents that occurred during the preceding calendar year. Each establishment will post these reports in a prominent location for the time specified by current regulations.

5. Documentation Summary

A. File these records in the Office Safety File:

1. Attachment 49-1 - Incident Report Form
2. Maintain OSHA 200 Log.

B. File these records in the Project Health and Safety File

1. Attachment 49-1 - Incident Report Form
2. Maintain OSHA 200 Log if applicable for Project.

6. Resources

A. U. S. OSHA

http://www.osha.gov/

URS	Health and Safety Program **INCIDENT REPORT FORM**	Attachment 49-1 Revised: 5/08/01

ADMINISTRATIVE INFORMATION:

URS Division/Company: _____

Project Office: _____

Project Number: _____

Date/Time of Incident: _____ _____

Location/Client: _____ _____

FOR INJURIES / ILLNESSES:

Name of Injured Employee _____

Job Title _____

Phone Number _____ Age _____

Sex ☐ Male ☐ Female

See a Doctor? ☐ Yes ☐ No
If yes, attach a doctor's report.

Describe Injury:

TYPE OF INCIDENT **(Check all applicable items)**			
☐ Illness	☐ Injury	☐ Fire, Explosion, Flash	☐ Unexpected Exposure
☐ Property Damage	☐ Vehicular Accident	☐ Other (describe):	

DESCRIPTION OF INCIDENT: (Describe the facts contributing to the incident. Identify individuals involved, witnesses, and their affiliations. Attach additional sheets, drawings, or photographs as needed.)

URS	Health and Safety Program **INCIDENT REPORT FORM**	Attachment 49-1 Revised: 5/08/01

PREPARED BY:

Name: _____

Date: _____

Signature: _____

Reporter must deliver this report to the operating unit health and safety representative within 24 hours of the reported incident for medical treatment cases and within 5 days for other incidents.

REVIEWED BY:

_____

Supervisor Date

_____

Health and Safety Representative Date

DISTRIBUTION:

- Division Health and Safety Manager
- Project File
- Occupational Health Specialist (Fax 512-419-6413)
- Local Human Resources (Injury / Illness cases only)

CORRECTIVE ACTONS (*For Internal Use Only*):

URS SAFETY MANAGEMENT STANDARD

Drilling Safety Guidelines

1. Applicability

This program applies to URS projects in which truck-mounted, or other engine powered, drill rigs are used. It is applicable to URS employees and URS owned rigs. For drill rigs operated by contractors, the primary responsibility for drilling safety is with the drilling contractor.

2. Purpose and Scope

The purpose of these guidelines is to provide an overview for working safely around drilling operations with truck-mounted and other engine-powered drill rigs. The procedure addresses off-road movement of drill rigs, overhead and buried utilities, use of augers, rotary and core drilling, and other drilling operations and activities.

3. Implementation

Field Activities: Drill rig safety and maintenance is the responsibility of the drill rig operator. URS employees are responsible for their own safety including recognizing and avoiding drill rig hazards. URS employees that observe a drill rig condition believed to be unsafe shall advise the drill rig operator of the unsafe condition.

4. Safety Guidelines

A. General Guidelines

URS technicians, geologists, engineers, or other field staff assigned to observe drilling operations or collect soil samples should observe the following guidelines:

- Require a meeting at project start-up regarding the drill rig operator responsibility for rig safety and any site and equipment specific safety requirements
- Set up any sample tables and general work areas for the URS field staff to the side of the drill rig (preferably 10 meters away) and not directly behind the rig.
- URS engineers, technician, and geologists shall not assist the drillers with the drilling equipment or supplies and shall not at any time operate the drill rig controls.

B. Movement of Drill Rigs

Before moving a rig, the operator must do the following:

- To the extent practical, walk the planned route of travel and inspect it for depressions, gullies, ruts, and other obstacles.
- Check the brakes of the truck/carrier, especially if the terrain along the route of travel is rough or sloped.
- Discharge all passengers before moving on rough or steep terrain.
- Engage the front axle (on 4x4, 6x6, etc. vehicles) before traversing rough or steep terrain.

Driving drill rigs along the sides of hills or embankments should be avoided; however, if side-hill travel becomes necessary, the operator must conservatively evaluate the ability of the rig to remain upright while on the hill or embankment. The possibility must be considered that the presence of drilling tools on the rig may reduce the ability of the rig to remain upright (raises the center of mass of the rig).

Logs, ditches, road curbs, and other long and horizontal obstacles should be normally approached and driven over squarely, not at an angle.

When close lateral or overhead clearance is encountered, the driver of the rig should be guided by another person on the ground.

Loads on the drill rig and truck must be properly stored while the truck is moving, and the mast must be in the fully lowered position.

After the rig has been positioned to begin drilling, all brakes and/or locks must be set before drilling begins. If the rig is positioned on a steep grade and leveling of the ground is impossible or impractical, the wheel of the transport vehicle should be blocked and other means of preventing the rig from moving or topping over employed.

C. Buried and Overhead Utilities

The location of overhead and buried utility lines must be determined before drilling begins, and the locations should be noted on boring plans and/or assignment sheets.

When overhead power lines are close by, the drill rig mast should not be raised unless the distance between the rig and the nearest power line is at least 20 feet (7 meters) or other distance as required by local ordinances, whichever is greater. The drill rig operator or assistant should walk completely around the rig to make sure that proper distance exists.

When the drill rig is positioned near an overhead line, the rig operator should be aware that hoist lines and power lines can be moved towards each other by wind. When necessary and approved by the Project

Manager (PM), the utility and/or power lines may be shielded, shut down, or moved by the appropriate personnel.

For additional information, please refer to SMS #34 “Utility Clearances and Isolation”.

D. Clearing the Work Area

Before a drill rig is positioned to drill, the area on which the rig is to be positioned should be cleared of removable obstacles and the rig should be leveled if sloped. The cleared/leveled area should be large enough to accommodate the rig and supplies.

E. Safe Use of Augers

Never place hands or fingers under the bottom of an auger flight or drill rods when hoisting the augers or rods over the top of another auger or rod in the ground or other hard surfaces, such as the drill rig platform.

Never allow feet to get under the auger or drill rod while they are being hoisted.

When the drill is rotating, stay clear of the drill string and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.

Move auger cuttings away from the auger with a long-handled shovel or spade; never use hands or feet.

Never clean an auger attached to the drill rig unless the transmission is in neutral or the engine is off, and the auger has stopped rotating.

Do not wear loose clothing or jewelry while working near the drill rig. Long hair must be pulled back to avoid entanglement with moving parts.

Hearing protection is required when working near an operating drill rig.

F. Safe Use of Hand Tools

Regulations regarding hand tools should be observed in addition to the guidelines provided below:

- Each tool should be used only to perform tasks for which it was originally designed.
- Damaged tools should be repaired before use or discarded.
- Safety goggles or glasses should be worn when using a hammer or chisel. Nearby co-workers and by-standers should be required to wear safety goggles or glasses also, or move away.

- Tools should be kept cleaned and stored in an orderly manner when not in use.

G. Safe use of Wire Line Hoists, Wire Rope, and Hoisting Hardware

Safety rules described in Title 29 Code of Federal Regulations (CFR) 1926.552 and guidelines contained in the Wire Rope User's Manual published by the American Iron and Steel Institute shall be used whenever wire line hoists, wire rope, or hoisting hardware are used. The driller should provide written reports (upon request) documenting inspections of equipment.

H. Traffic Safety

Drilling in streets, parking lots or other areas of vehicular traffic requires definition of the work zones with cones, warning tape, etc. and compliance with local police requirements.

I. Fire Safety

- Fire extinguishers (type ABC) shall be kept on or near drill rigs for fighting small fires.
- If methane or other flammable gases or vapors are suspected in the area, a combustible gas indicator (CGI) shall be used to monitor the air near the borehole with all work to stop at 20 percent of the Lower Explosive Limit (LEL).
- Work shall stop during lightning storms.

J. Protective Gear

1. Minimum Protective Gear

Items listed below should be worn by all staff working within 30 feet (10 meters) of drilling activities.

- Hearing Protection;
- Hard Hat;
- Eye Protection (safety glasses, goggles, or face-shield)
- Safety Shoes (shoes or boots with steel toes)

2. Other Gear

Items listed below should be worn when conditions warrant their use. Some of the conditions are listed after each item.

- **Safety Harnesses and Lifelines:** Safety harnesses and lifelines shall be worn by all persons working on top of an elevated derrick beam or mast. The lifeline should be secured at a position that will allow a person to fall no more than six feet (2 meters). OSHA Fall Protection (1926 Subpart M) requirements apply.
- **Life Vests**: Use for work over water.

5. Resources

A. International Association of Drilling Contractors Safety Alerts http://iadc.org/alerts.htm

B. Fall Protection - SMS 040

C. Hearing Conservation - SMS 026

D. Subcontractor Health and Safety Requirements - SMS - 046

E. Utility Clearances and Isolation - SMS 034

APPENDIX C

Safety Plan Compliance Agreement and Medical Emergency Contact Sheet

SAFETY PLAN COMPLIANCE AGREEMENT AND
MEDICAL EMERGENCY CONTACT SHEET

I, _____, have received a copy of the Health and Safety Plan for this Project. I have reviewed the plan, understand it, and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the health and safety requirements specified in the plan.

SIGNED: _____ _____
Signature Date

Firm: URS Corp.

This brief Medical Emergency Contact Sheet will be kept in the Support Zone during site operations. It is in no way a substitute for the Medical Surveillance Program requirements of the URS Health and Safety Program. This data sheet will accompany injured personnel when medical assistance or transport to hospital facilities is necessary.

Emergency Contact: _____ Phone #:_____

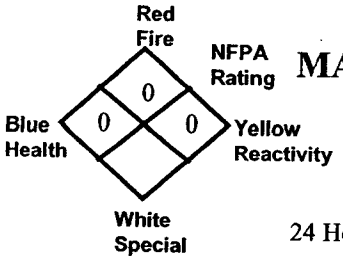
Relationship: _____

Do you wear contact lenses? _____

APPENDIX D

Material Safety Data Sheets

Alconox ®



MATERIAL SAFETY DATA SHEET

Alconox, Inc.
30 Glenn Street. Suite 309
White Plains, NY 10603

24 Hour Emergency Number – Chem-Tel (800) 255-3924

I. IDENTIFICATION

Product Name (as appears on label)	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 1999
Chemical Family:	Anionic Powdered Detergent
Manufacturer Catalog Numbers for sizes	1104, 1125, 1150, 1101, 1103 and 1112

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.

IV. FIRE AND EXPLOSION DATA

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO_2, foam
Special Fire fighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO_2 on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	Material should be stored in a dry area to prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH BUT NO WARRANTY IS EXPRESSED OR IMPLIED.

General Information

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Item Name: GASOLINE,AUTOMOTIVE
Company's Name: NAVAJO REFINING CO
Date MSDS Prepared: 11MAR92
Safety Data Review Date: 28JUL93
Hazard Characteristic Code: F2

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: GASOLINE
Ingredient Sequence Number: 01
Percent: 100
NIOSH (RTECS) Number: LX3300000
CAS Number: 8006-61-9
OSHA PEL: 300 PPM/500 STEL
ACGIH TLV: 300 PPM/500STEL;9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: METHYL TERT-BUTYL ETHER (SARA III) (CONTAINED IN GASOLINE)
Ingredient Sequence Number: 02
Percent: 10-11
NIOSH (RTECS) Number: KN5250000
CAS Number: 1634-04-4
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: DENATURED ALCOHOL (CONTAINED IN GASOLINE)
Ingredient Sequence Number: 03
Percent: 6-10
NIOSH (RTECS) Number: AZ0875400
OSHA PEL: 1000 PPM (ETHANOL)
ACGIH TLV: 1000 PPM (ETHANOL)
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: BENZENE (SARA III) (CONTAINED IN GASOLINE)
Ingredient Sequence Number: 04
Percent: 1-5
NIOSH (RTECS) Number: CY1400000
CAS Number: 71-43-2
OSHA PEL: 1PPM/5STEL;1910.1028
ACGIH TLV: 10 PPM; A2; 9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: ETHYL BENZENE (SARA III) (CONTAINED IN GASOLINE)

Ingredient Sequence Number: 05
Percent: 1-3
NIOSH (RTECS) Number: DA0700000
CAS Number: 100-41-4
OSHA PEL: 100 PPM/125 STEL
ACGIH TLV: 100 PPM/125STEL 9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: CYCLOHEXANE (SARA III) (CONTAINED IN GASOLINE)
Ingredient Sequence Number: 06
Percent: 1
NIOSH (RTECS) Number: GU6300000
CAS Number: 110-82-7
OSHA PEL: 300 PPM
ACGIH TLV: 300 PPM, 9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: TOLUENE (SARA III) (CONTAINED IN GASOLINE)
Ingredient Sequence Number: 07
Percent: 1-5
NIOSH (RTECS) Number: XS5250000
CAS Number: 108-88-3
OSHA PEL: 200 PPM/150 STEL
ACGIH TLV: 50 PPM; 9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: XYLENES (O-,M-,P- ISOMERS) (SARA III) (CONTAINED IN GASOLINE)
Ingredient Sequence Number: 08
Percent: 4-6
NIOSH (RTECS) Number: ZE2100000
CAS Number: 1330-20-7
OSHA PEL: 100 PPM/150 STEL
ACGIH TLV: 100 PPM/150STEL;9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: CUMENE (SARA III) (CONTAINED IN GASOLINE)
Ingredient Sequence Number: 09
Percent: 1
NIOSH (RTECS) Number: GR8575000
CAS Number: 98-82-8
OSHA PEL: S, 50 PPM
ACGIH TLV: S, 50 PPM; 9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: 1,2,4-TRIMETHYLBENZENE (SARA III) (CONTAINED IN GASOLINE)
Ingredient Sequence Number: 10
Percent: 1

NIOSH (RTECS) Number: DC3325000
CAS Number: 95-63-6
OSHA PEL: 25 PPM
ACGIH TLV: 25 PPM; 9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: GASOLINE CONTAINS EITHER INGREDIENT 2: METHYL-TERT-BUTYL ETHER OR INGREDIENT 3: DENATURED ETHANOL.
Ingredient Sequence Number: 11
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE
Other Recommended Limit: NOT APPLICABLE

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Physical/Chemical Characteristics

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Appearance And Odor: CLEAR LIQUID, AROMATIC ODOR, WITH DISTINCT ETHER SMELL.
Boiling Point: 90-440F
Vapor Pressure (MM Hg/70 F): 465-698
Vapor Density (Air=1): 3-4
Specific Gravity: 0.7-0.8
Solubility In Water: SLIGHT.
Percent Volatiles By Volume: 100
Autoignition Temperature: 830F

==========

Fire and Explosion Hazard Data

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Flash Point: -45F,-43C
Flash Point Method: CC
Lower Explosive Limit: 1.4
Upper Explosive Limit: 7.6
Extinguishing Media: USE CARBON DIOXIDE, FOAM, DRY CHEMICAL, HALON. DO NOT USE DIRECT WATER STREAM.
Special Fire Fighting Proc: WEAR FIRE FIGHTING PROTECTIVE EQUIPMENT AND A FULL FACED SELF CONTAINED BREATHING APPARATUS. COOL FIRE EXPOSED CONTAINERS WITH WATER SPRAY.
Unusual Fire And Expl Hazrds: EXTREMELY FLAMMABLE. VAPORS CAN TRAVEL ALONG GROUND AND FLASHBACK EXPLOSIVELY. CONTAINERS MAY BURST WITH HEAT OF FIRE. COMBUSTION MAY GENERATE TOXIC GASES.

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Reactivity Data

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Stability: YES
Cond To Avoid (Stability): HIGH HEAT, OPEN FLAMES AND OTHER SOURCES OF IGNITION.
Materials To Avoid: STRONG OXIDIZING AGENTS, HALOGENS, STRONG ACIDS AND ALKALIES.
Hazardous Decomp Products: CARBON OXIDES AND VARIOUS HYDROCARBONS WHEN BURNED.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT APPLICABLE

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Health Hazard Data

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LD50-LC50 Mixture: TLV FOR GASOLINE IS 300 PPM.

Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: ACUTE: IRRITATION, CENTRAL NERVOUS SYSTEM EFFECTS. GASOLINE IF SWALLOWED, MAY BE ASPIRATED INTO LUNGS, RESULTING IN PULMONARY EDEMA AND CHEMICAL PNEUMONITIS. CHRONIC: BENZENE IS A CONFIRMED CARCINOGEN AND MAY PRODUCE BLOOD CHANGES. PROLONGED EXPOSURE TO HIGH CONCENTRATIONS HAS CAUSED KIDNEY AND LIVER CANCER IN RAT/MICE
Carcinogenicity - NTP: YES
Carcinogenicity - IARC: YES
Carcinogenicity - OSHA: YES
Explanation Carcinogenicity: BENZENE IS A CONFIRMED CARCINOGEN BY NTP, IARC AND OSHA.
Signs/Symptoms Of Overexp: EYES/SKIN: IRRITATION. INHALATION: COUGHING, HEADACHE, DIZZINESS, MENTAL CONFUSION, BLURRED VISION, SLURRED SPEECH, WEAKNESS, RESPIRATORY ARREST, CONVULSIONS, COMA. INGESTION: IRRITATION OF GASTROINTESTINAL SYSTEM, VOMITING, SAME SYMPTOMS AS INHALATION.
Med Cond Aggravated By Exp: INDIVIDUALS WITH A HISTORY OF SKIN, RESPIRATORY OR CENTRAL NERVOUS SYSTEM DISORDERS MAY BE AT INCREASED RISK FROM EXPOSURE.
Emergency/First Aid Proc: EYES: FLUSH WITH PLENTY OF WATER FOR 15 MINUTES. SEE DOCTOR. SKIN: REMOVE CONTAMINATED CLOTHING AND SHOES. WASH WITH SOAP AND WATER. SEE DOCTOR. INHALATION: REMOVE VICTIM TO FRESH AIR. GIVE OXYGEN/CPR IF NEEDED. SEE DOCTOR. IF LIQUID IS IN LUNGS (ASPIRATED), SEEK MEDICAL CARE. INGESTION: DO NOT INDUCE VOMITING. GIVE 1-2 GLASSES OF WATER. SEE DOCTOR IMMEDIATELY.

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: ELIMINATE IGNITION SOURCES. VENTILATE AREA. USE NON-SPARKING TOOLS. WEAR PROPER PROTECTIVE EQUIPMENT. STOP LEAK AND CONTAIN SPILL. ABSORB IN NON-FLAMMABLE ABSORBENT AND PLACE INTO APPROPIATE DISPOSAL CONTAINER AND SEAL. WASH AREA WITH PLENTY OF WATER
Neutralizing Agent: NOT APPLICABLE
Waste Disposal Method: CONSULT YOUR LOCAL ENVIRONMENTAL OFFICER. DISPOSE OF IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.
Precautions-Handling/Storing: STORE IN COOL, DRY, WELL VENTILATED PLACE, AWAY FROM HEAT, IGNITION SOURCES AND INCOMPATIBLE MATERIALS. KEEP CONTAINERS CLOSED WHEN NOT IN USE.
Other Precautions: AVOID BREATHING VAPORS, AND EYE AND SKIN CONTACT. USE ONLY WITH ADEQUATE VENTILATION. DO NOT SIPHON BY MOUTH. BOND AND GROUND CONTAINERS DURING TRANSFER. PROTECT CONTAINERS FROM PHYSICAL DAMAGE.

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Control Measures

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Respiratory Protection: NIOSH/MSHA RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE APPROPIATE FOR EXPOSURE OF CONCERN OR SCBA IF TLV IS EXCEEDED.
Ventilation: SUFFICIENT MECHANICAL (GENERAL) AND/OR LOCAL EXHAUST VENTILATION. USE EXPLOSION-PROOF EQUIPMENT.
Protective Gloves: VITON, NITRILE, PVA.
Eye Protection: SAFETY GLASSES WITH SIDE SHIELDS.
Other Protective Equipment: FULL BODY LONG-SLEEVED GARMENTS TO PREVENT REPEATED OR PROLONGED SKIN CONTACT. EYE WASH STATION AND SAFETY SHOWER.
Work Hygienic Practices: AVOID CONTACT WITH EYES AND SKIN. DO NOT BREATHE VAPORS. WASH

· THOROUGHLY AFTER HANDLING. LAUNDER CONTAMINATED CLOTHING.
Suppl. Safety & Health Data: THESE PRECAUTIONS ARE FOR NORMAL USES AND CONDITIONS. WHERE SPECIAL OR UNUSUAL CONDITIONS EXIST, CONSULT AN INDUSTRIAL HYGIENIST. RCRA CLASSIFICATION IGNITABLE (D001). EP TOXIC (U019).

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HEXANE

Synonyms: Hexanes,Normal Hexane; Hexyl Hydride
CAS No.: 110-54-3 (n-hexane) , Molecular Weight: 86.18 , Chemical Formula: $CH_3(CH_2)_4CH_3$

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0
Contact Rating: 2 - Moderate

Inhalation: Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.
Ingestion: May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
Skin Contact: May cause redness, irritation, with dryness, cracking.
Eye Contact: Vapors may cause irritation. Splashes may cause redness and pain.
Chronic Exposure: Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.
Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

Flash point: -23C (-9F) CC Autoignition temperature: 224C (435F) Flammable limits in air % by volume: lel: 1.2; uel: 7.7 Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame. Explosion: Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.

Airborne Exposure Limits: N-Hexane [110-54-3]: -OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA) -ACGIH Threshold Limit Value (TLV): 50 ppm (TWA) other isomers of hexane -ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

Physical and Chemical Properties
Appearance: Clear, colorless liquid.
Odor: Light odor.
Solubility: Insoluble in water.
Specific Gravity: 0.66
Boiling Point: ca. 68C (ca. 154F)
Melting Point: ca. -95C (ca. -139F)
Vapor Density (Air=1): 3.0
Vapor Pressure (mm Hg): 130 @ 20C (68F)
Evaporation Rate (BuAc=1): 9

Ecological Information

Environmental Fate: When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.

Environmental Toxicity:

No information found.

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MSDS Material Safety Data Sheet

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HYDROCHLORIC ACID (10%-33%)

MSDS Number: H3886 --- *Effective Date: 11/17/99*

1. Product Identification

Synonyms: This MSDS applies to the concentrated standard used to make laboratory solutions and any solution that contains more than 10% but less than 33% Hydrochloric acid. For diluted product, see MSDS for Hydrochloric Acid (less than 10%). For saturated solution
CAS No.: 7647-01-0
Molecular Weight: 36.46
Chemical Formula: HCl in H2O
Product Codes:
J.T. Baker: 0323, 0327, 4654, 4657, 4658, 5618, 5619
Mallinckrodt: 2608, 2609, 2625, H151, H168, V024, V035, V328

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hydrogen Chloride	7647-01-0	10 - 33%	Yes
Water	7732-18-5	67 - 90%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Corrosive! Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death.
Ingestion:
Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea, and in severe cases, death.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. May react with metals or heat to release flammable hydrogen gas.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Water or water spray. Neutralize with soda ash or slaked lime.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out.

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6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB(R) or TEAM(R) 'Low Na+' acid neutralizers are recommended for spills of this product.

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7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Hydrochloric acid:
- OSHA Permissible Exposure Limit (PEL):
5 ppm (Ceiling)
- ACGIH Threshold Limit Value (TLV):

5 ppm (STEL/Ceiling)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Pungent odor.
Solubility:
Infinitely soluble.
Density:
1.05 @ 15C (59F)
pH:
For HCL solutions: 0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N)
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
101 - 103C (214 - 217F)
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes. Thermal oxidative decomposition produces toxic chlorine fumes and explosive hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.
Conditions to Avoid:
Heat, direct sunlight.

11. Toxicological Information

Hydrochloric acid: Inhalation rat LC50: 3124 ppm/1H; Oral rabbit LD50: 900 mg/kg. Investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hydrogen Chloride (7647-01-0)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to biodegrade. When released into the soil, this material may leach into groundwater.
Environmental Toxicity:
This material is expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

International (Water, I.M.O.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Hydrogen Chloride (7647-01-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Hydrogen Chloride (7647-01-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hydrogen Chloride (7647-01-0)	5000	500*	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hydrogen Chloride (7647-01-0)	5000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2R
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations

(CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Avoid breathing vapor or mist.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
No changes.
Disclaimer:
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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

Praxair™ Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name: Isobutylene (MSDS No. P-4614-B)	**Trade Name:** Isobutylene
Chemical Name: 2-Methylpropene	**Synonyms:** Isobutene, methylpropene
Formula: C_4H_8	**Chemical Family:** Alkene
Telephone: **Emergencies:** 1-800-645-4633* **CHEMTREC:** 1-800-424-9300* **Routine:** 1-800-PRAXAIR	**Company Name:** Praxair, Inc. 39 Old Ridgebury Road Danbury, CT 06810-5113

** Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information, contact your supplier, Praxair sales representative, or call 1-800-PRAXAIR (1-800-772-9247).*

2. Composition/Information on Ingredients

For custom mixtures of this product, request an MSDS for each component. See section 16 for important information about mixtures.

INGREDIENT	CAS NUMBER	% BY WT	OSHA PEL	ACGIH TLV-TWA
Isobutylene	115-11-7	>99%*	None currently established	None currently established

** The symbol > means "greater than;" the symbol <, "less than."*

3. Hazards Identification

EMERGENCY OVERVIEW

DANGER! Flammable liquid and gas under pressure.
Can form explosive mixtures with air.
May cause frostbite.
May cause dizziness and drowsiness.
Self-contained breathing apparatus may be required by rescue workers.
Odor: Mildly sweetish

THRESHOLD LIMIT VALUE: None currently established. (ACGIH, 1997).

EFFECTS OF A SINGLE (ACUTE) OVEREXPOSURE:

INHALATION–May be mildly irritating to mucous membranes. At high concentrations, may cause drowsiness. At very high concentrations, may act as an asphyxiant and cause headache, drowsiness, dizziness, excitation, excess salivation, vomiting, and unconsciousness. Lack of oxygen can kill.

SKIN CONTACT–No harm expected from gas. Liquid may cause frostbite, a cryogenic injury resembling a burn.

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SWALLOWING–An unlikely route of exposure, but frostbite of the lips and mouth may result from contact with the liquid.

EYE CONTACT– Liquid may cause frostbite.

EFFECTS OF REPEATED (CHRONIC) OVEREXPOSURE: Repeated or prolonged exposure may cause dermatitis.

OTHER EFFECTS OF OVEREXPOSURE: This product is an asphyxiant. Lack of oxygen can kill.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: The defatting properties of isobutylene may aggravate an existing dermatitis.

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION: None known.

CARCINOGENICITY: Isobutylene is not listed by NTP, OSHA, or IARC.

4. First Aid Measures

INHALATION: Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician.

SKIN CONTACT: For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). In case of massive exposure, remove clothing while showering with warm water. Call a physician.

SWALLOWING: An unlikely route of exposure. This product is a gas at normal temperature and pressure.

EYE CONTACT: Immediately flush eyes thoroughly with warm water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. See a physician, preferably an ophthalmologist, immediately.

NOTES TO PHYSICIAN: *This material may be a cardiac sensitizer; avoid the use of epinephrine. There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.*

5. Fire Fighting Measures

FLASH POINT (test method):	-105°F (–76°C) TCC	
AUTOIGNITION TEMPERATURE:	869°F (465°C) @ 1 atm	
FLAMMABLE LIMITS IN AIR, % by volume:	**LOWER:** 1.8%	**UPPER:** 9.6%

EXTINGUISHING MEDIA: CO_2, dry chemicals, water spray, or fog.

SPECIAL FIRE FIGHTING PROCEDURES: DANGER! Flammable liquid and gas under pressure. Evacuate all personnel from danger area. Immediately cool cylinders with water spray from maximum distance taking care not to extinguish flames. Remove ignition sources if without risk. If flames are accidentally extinguished, explosive re-ignition may occur. Use self-contained breathing apparatus. Stop flow of gas if without risk while continuing cooling water spray. Remove all cylinders from area of fire if without risk. Allow fire to burn out. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Flammable gas. Forms explosive mixtures with air and oxidizing agents. Heat of fire can build pressure in cylinder and cause it to rupture. Isobutylene cylinders are equipped with a pressure-relief device. (Exceptions may exist where authorized by DOT.) No part of a cylinder should be subjected to a temperature higher than 125°F°(52 C). If venting or leaking isobutylene catches fire, do not extinguish flames. Flammable vapors may spread from leak, creating an explosive re-ignition hazard. Vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with approved explosion meter.

HAZARDOUS COMBUSTION PRODUCTS: Carbon monoxide, carbon dioxide

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: DANGER! Flammable liquid and gas under pressure. Forms explosive mixtures with air. (See section 5.) Immediately evacuate all personnel from danger area. Use self-contained breathing apparatus where needed. Remove all sources of ignition if without risk. Reduce vapors with fog or fine water spray. Shut off flow if without risk. Ventilate area or move leaking cylinder to well-ventilated area. Flammable gas may spread from leak. Before entering area, especially confined areas, check atmosphere with an appropriate device.

WASTE DISPOSAL METHOD: Prevent waste from contaminating the surrounding environment. Keep personnel away. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your local supplier for assistance.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation. Separate cylinders from oxygen and other oxidizers by at least 20 ft (6.1 m) or use a barricade of noncombustible material. This barricade should be at least 5 ft (1.53 m) high and have a fire resistance rating of at least ½ hour. Firmly secure cylinders upright to keep them from falling or being knocked over. Isobutylene cylinders designed to accept a valve protection cap must be provided with a cap. Screw cap firmly in place by hand. Post "No Smoking or Open Flames" signs in storage and use areas. There must be no sources of ignition. All electrical equipment in storage areas must be explosion-proof. Storage areas must meet national electric codes for Class 1 hazardous areas. Store only where temperature will not exceed 125°F (52°C). Store full and empty cylinders separately. Use a first-in, first-out inventory system to prevent storing full cylinders for long periods.

PRECAUTIONS TO BE TAKEN IN HANDLING: Protect cylinders from damage. Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. All piped systems and associated equipment must be grounded. Electrical equipment must be non-sparking or explosion-proof. Leak check with soapy water; never use a flame. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Open valve slowly. If valve is hard to open, discontinue use and contact your supplier. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit. For other precautions in using isobutylene, see section 16.

8. Exposure Controls/Personal Protection

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST–Use an explosion-proof local exhaust system.

MECHANICAL (general)–Inadequate. See SPECIAL.

SPECIAL–Use only in a closed system.

OTHER–None

RESPIRATORY PROTECTION: Use a respirator acceptable to NIOSH and OSHA. Respiratory protection must conform to OSHA rules as specified in 29 CFR 1910.134.

SKIN PROTECTION: Wear work gloves when handling cylinders, neoprene gloves where contact with product may occur.

EYE PROTECTION: Select in accordance with OSHA 29 CFR 1910.133.

OTHER PROTECTIVE EQUIPMENT: Metatarsal shoes for cylinder handling, protective clothing where needed. Select in accordance with OSHA 29 CFR 1910.132 and 1910.133. Regardless of protective equipment, never touch live electrical parts.

9. Physical and Chemical Properties

MOLECULAR WEIGHT:	56.108
LIQUID DENSITY at 70°F (21.1°C) and vapor pressure:	0.59108
SPECIFIC GRAVITY (Air = 1) at 70°F (21.1°C) and 1 atm:	1.997
VAPOR PRESSURE at 70°F (21.1°C):	23.85 psig (164.44 kPa)
SOLUBILITY IN WATER:	Negligible
PERCENT VOLATILES BY VOLUME:	100
EVAPORATION RATE (Butyl Acetate = 1):	High
BOILING POINT at 1 atm:	19.59°F (-6.9844°C)
FREEZING POINT at 1 atm:	-220.61°F (-140.34°C)

APPEARANCE, ODOR, AND STATE: Colorless gas at normal temperature and pressure; odor of coal gas (mildly sweetish).

10. Stability and Reactivity

STABILITY: ☐ **Unstable** ☒ **Stable**

INCOMPATIBILITY (materials to avoid): Oxidizing agents, halogens, acids

HAZARDOUS DECOMPOSITION PRODUCTS: Thermal decomposition or burning may produce carbon dmonoxide and carbon dioxide.

HAZARDOUS POLYMERIZATION: ☐ **May Occur** ☒ **Will Not Occur**

CONDITIONS TO AVOID: Elevated temperatures and/or the presence of a catalyst

11. Toxicological Information

See section 3.

12. Ecological Information

No adverse ecological effects expected. This product does not contain any Class I or Class II ozone-depleting chemicals. This product is not listed as a marine pollutant by DOT.

13. Disposal Considerations

WASTE DISPOSAL METHOD: Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier.

14. Transport Information

DOT/IMO SHIPPING NAME: Isobutylene

HAZARD CLASS: 2.1	**IDENTIFICATION NUMBER:** UN 1055	**PRODUCT RQ:** Not applicable
SHIPPING LABEL(s):	FLAMMABLE GAS	
PLACARD (when required):	FLAMMABLE GAS	

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, nonventilated compartment of a vehicle can present serious safety hazards.

Shipment of compressed gas cylinders that have been filled without the owner's consent is a violation of federal law [49 CFR 173.301(b)].

15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, state, and local regulations.

U.S. FEDERAL REGULATIONS:

EPA (ENVIRONMENTAL PROTECTION AGENCY)

CERCLA: COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 (40 CFR Parts 117 and 302):

Reportable Quantity (RQ): None

SARA: SUPERFUND AMENDMENT AND REAUTHORIZATION ACT:

SECTIONS 302/304: Require emergency planning based on Threshold Planning Quantity (TPQ) and release reporting based on Reportable Quantities (RQ) of extremely hazardous substances (40 CFR Part 355):

Threshold Planning Quantity (TPQ): None.
Extremely Hazardous Substances (40 CFR 355): None.

SECTIONS 311/312: Require submission of MSDSs and reporting of chemical inventories with identification of EPA hazard categories. The hazard categories for this product are as follows:

IMMEDIATE: Yes
DELAYED: Yes
PRESSURE: Yes
REACTIVITY: No
FIRE: Yes

SECTION 313: Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR Part 372.

Isobutylene does not require reporting under Section 313.

40 CFR 68: RISK MANAGEMENT PROGRAM FOR CHEMICAL ACCIDENTAL RELEASE PREVENTION: Requires development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

Isobutylene is listed as a regulated substance in quantities of 10,000 lbs (4536 kg) or greater.

TSCA: TOXIC SUBSTANCES CONTROL ACT: Isobutylene is listed on the TSCA inventory.

OSHA: OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR 1910.119: PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Isobutylene is not listed in Appendix A as a highly hazardous chemical. However, any process that involves a flammable gas on site in one location, in quantities of 10,000 lbs (4536 kg) or greater is covered under this regulation unless the gas is used as a fuel.

STATE REGULATIONS:

CALIFORNIA: Isobutylene is not listed by California under the SAFE DRINKING WATER TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

PENNSYLVANIA: Isobutylene is subject to the PENNSYLVANIA WORKER AND COMMUNITY RIGHT-TO-KNOW ACT (35 P.S. Sections 7301-7320).

16. Other Information

Be sure to read and understand all labels and instructions supplied with all containers of Isobutylene.

OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE: ***Flammable liquid and gas under pressure.*** Use piping and equipment adequately designed to withstand pressures to be encountered. Use only in a closed system. Use only spark-proof tools and explosion-proof equipment. Keep away from heat, sparks, and open flame. ***Gas can cause rapid suffocation due to oxygen deficiency.*** Store and use with adequate ventilation. Close cylinder valve when not in use; keep closed even when empty. ***Never work on a pressurized system.*** If there is a leak, blow the system down in an environmentally safe manner in compliance with all federal, state, and local laws, then repair the leak. ***Never ground a compressed gas cylinder or allow it to become part of an electrical circuit.***

NOTE: *Prior to using any plastics, confirm their compatibility with isobutylene.*

MIXTURES: When you mix two or more gases or liquefied gases, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Remember, gases and liquids have properties that can cause serious injury or death.

HAZARD RATING SYSTEMS:

NFPA RATINGS:		**HMIS RATINGS:**	
HEALTH	= 1	HEALTH	= 0
FLAMMABILITY	= 4	FLAMMABILITY	= 4
REACTIVITY	= 0	REACTIVITY	= 0
SPECIAL	= SA (CGA recommends this to designate Simple Asphyxiant.)		

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED:	CGA-510
PIN-INDEXED YOKE:	Not applicable
ULTRA-HIGH-INTEGRITY CONNECTION:	Not applicable

Use the proper CGA connections. **DO NOT USE ADAPTERS.** See CGA pamphlet V-1 listed below.

Ask your supplier about free Praxair safety literature as referred to in this MSDS and on the label for isobutylene. Further information about isobutylene can be found in the following pamphlets published by the Compressed Gas Association, Inc. (CGA), 1725 Jefferson Davis Highway, Arlington, VA 22202-4102, Telephone (703) 412-0900.

AV-1	*Safe Handling and Storage of Compressed Gases*
P-1	*Safe Handling of Compressed Gases in Containers*
P-14	*Accident Prevention in Oxygen-Rich, Oxygen-Deficient Atmospheres*
SB-2	*Oxygen-Deficient Atmospheres*
V-1	*Compressed Gas Cylinder Valve Inlet and Outlet Connections*
—	*Handbook of Compressed Gases, Third Edition*

Praxair asks users of this product to study this MSDS and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

Praxair MSDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current Praxair MSDSs for these products, contact your Praxair sales representative or local distributor or supplier. If you have questions regarding Praxair MSDSs, would like the form number and date of the latest MSDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (**Phone:** 1-800-PRAXAIR; **Address:** Praxair Call Center, Praxair, Inc., PO Box 44, Tonawanda, NY 14150-7891).

Praxair is a trademark of Praxair Technology, Inc.

PRAXAIR

Praxair, Inc.
39 Old Ridgbury Road
Danbury, CT 06810-5113

Printed in USA

Praxair™ Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name:	Methane (MSDS No. P-4618-C)	**Trade Name:**	Methane
Chemical Name:	Methane	**Synonyms:**	Marsh Gas, Methyl Hydride, Fire Damp, Sewer Gas
Formula:	CH_4	**Chemical Family:**	Alkanes
Telephone:	**Emergencies:** 1-800-645-4633* **CHEMTREC** 1-800-424-9300* Routine: 1-800-PRAXAIR	**Company Name:**	Praxair, Inc. 39 Old Ridgebury Road Danbury CT 06810-5113

*Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information contact your supplier, Praxair sales representative, or call 1-800-PRAXAIR (1-800-772-9247).

2. Composition / Information on Ingredients

For custom mixtures of this product request a Material Safety Data Sheet for each component. See Section 16 for important information about mixtures.

INGREDIENT NAME	CAS NUMBER	PERCENTAGE *	OSHA PEL	ACGIH TLV
Methane	74-82-8	>99%	None currently established	Simple asphyxiant

*The symbol ">" means greater than.

3. Hazards Identification

EMERGENCY OVERVIEW

DANGER! Flammable high-pressure gas.
May form explosive mixtures with air.
May cause dizziness and drowsiness.
Self-contained breathing apparatus may be required by rescue workers.
Odor: None

THRESHOLD LIMIT VALUE: Simple asphyxiant (ACGIH, 1997)

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EFFECTS OF A SINGLE (ACUTE) OVEREXPOSURE:

INHALATION–Asphyxiant. Effects are due to lack of oxygen. Moderate concentrations may cause headache, drowsiness, dizziness, excitation, excess salivation, vomiting, and unconsciousness. Lack of oxygen can kill.

SKIN CONTACT–No harm expected.

SWALLOWING–An unlikely route of exposure.

EYE CONTACT–No harm expected.

EFFECTS OF REPEATED (CHRONIC) OVEREXPOSURE: No harm expected.

OTHER EFFECTS OF OVEREXPOSURE: Methane is an asphyxiant. Lack of oxygen can kill.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: The toxicology and the physical and chemical properties of Methane suggest that overexposure is unlikely to aggravate existing medical conditions.

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION: None known.

CARCINOGENICITY: Methane is not listed by NTP, OSHA, or IARC.

4. First Aid Measures

INHALATION: Remove to fresh air. Give artificial respiration if not breathing. If breathing is difficult, qualified personnel may give oxygen. Call a physician.

SKIN CONTACT: Wash with soap and water.

SWALLOWING: An unlikely route of exposure. This product is a gas at normal temperature and pressure.

EYE CONTACT: Flush eyes with warm water. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly.

NOTES TO PHYSICIAN: *There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.*

5. Fire Fighting Measures

FLASH POINT (test method)	-306°F (-187.8°C) TCC	**AUTOIGNITION TEMPERATURE**	999°F (537.2°C)

FLAMMABLE LIMITS IN AIR, % by volume	**LOWER**	5%	**UPPER**	15%

EXTINGUISHING MEDIA: CO_2, dry chemical, water spray, or fog.

SPECIAL FIRE FIGHTING PROCEDURES:
DANGER! Flammable high-pressure gas. Evacuate all personnel from danger area. Immediately spray cylinders with water from maximum distance until cool, taking care not to extinguish flames. Remove sources of ignition if without risk. Remove all cylinders fire area if without risk; continue cooling water spray while moving cylinders. Do not extinguish any flames emitted from cylinders; stop flow of gas if without risk, or allow flames to burn out. Self-contained breathing apparatus may be required by rescue workers. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Flammable gas. Forms explosive mixtures with air and oxidizing agents. Heat of fire can build pressure in cylinder and cause it to rupture. No part of a cylinder should be subjected to a temperature higher than 125°F°(52 C). Methane cylinders are equipped with a pressure-relief device. (Exceptions may exist where authorized by DOT.) If venting or leaking Methane catches fire, do not extinguish flames. Flammable gas may spread from leak, creating an explosive re-ignition hazard. Vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with an appropriate device.

HAZARDOUS COMBUSTION PRODUCTS: Carbon monoxide, carbon dioxide

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
DANGER! Flammable high-pressure gas. Forms explosive mixtures with air. (See section 5.) Immediately evacuate all personnel from danger area. Use self-contained breathing apparatus where needed. Remove all sources of ignition if without risk. Reduce vapors with fog or fine water spray. Shut off flow if without risk. Ventilate area or move cylinder to a well-ventilated area. Flammable vapors may spread from leak. Before entering area, especially confined areas, check atmosphere with an approved device.

WASTE DISPOSAL METHOD: Prevent waste from contaminating the surrounding environment. Keep personnel away. Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your local supplier for assistance.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation. Separate Methane cylinders from oxygen, chlorine, and other oxidizers by at least 20 feet or use a barricade of non-combustible material. This barricade should be at least 5 feet high and have a fire resistance rating of at least ½ hour. Firmly secure cylinders upright to keep them from falling or being knocked over. Screw valve protection cap firmly in place by hand. Post "No Smoking or Open Flames" signs in storage and use areas. There must be no sources of ignition. All electrical equipment in storage areas must be explosion-proof. Storage areas must meet national electric codes for Class 1 hazardous areas. Store only where temperature will not exceed 125°F (52°C). Store full and empty cylinders separately. Use a first-in, first-out inventory system to prevent storing full cylinders for long periods. For full details and requirements, see NFPA 50A, published by the National Fire Protection Association.

PRECAUTIONS TO BE TAKEN IN HANDLING: Protect cylinders from damage. Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. All piped Methane systems and associated equipment must be grounded. Electrical equipment must be non-sparking or explosion-proof. Leak check

system with soapy water; never use a flame. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Open valve slowly. If valve is hard to open, discontinue use and contact your supplier. For other precautions in using Methane, see section 16.

8. Exposure Controls/Personal Protection

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST–An explosion-proof local exhaust system is acceptable. See SPECIAL.

MECHANICAL (general)–Inadequate; see SPECIAL.

SPECIAL–Use only in a closed system.

OTHER–None

RESPIRATORY PROTECTION: Respiratory protection must conform to OSHA rules as specified in 29 CFR 1910.134.

SKIN PROTECTION: Wear work gloves for cylinder handling and to prevent exposure to liquid.

EYE PROTECTION: Select in accordance with OSHA 29 CFR 1910.133.

OTHER PROTECTIVE EQUIPMENT: Metatarsal shoes for cylinder handling. Select in accordance with OSHA 29 CFR 1910.132 and 1910.133. Regardless of protective equipment, never touch live electrical parts.

9. Physical and Chemical Properties

MOLECULAR WEIGHT: 16.042	**EXPANSION RATIO:** Not applicable
SPECIFIC GRAVITY (air=1): At 60°F (15.6°C) and 1 atm: .55491	**SOLUBILITY IN WATER:** vol/vol at 100°F (37.8°C): Slight
GAS DENSITY: At 60°F (15.6°C) and 1 atm: 0.04235 lbs/ft^3 (.6784 kg/m^3)	**VAPOR PRESSURE:** At 70°F (21.1°C): Not applicable
PERCENT VOLATILES BY VOLUME: 100	**EVAPORATION RATE (Butyl Acetate=1):** High
BOILING POINT (1 atm): -258.68°F (-161.48°C)	**pH:** Not applicable
FREEZING POINT (1 atm): -296.7°F (-182.61°C)	

APPEARANCE, ODOR, AND STATE: Colorless, odorless gas at normal temperature and pressure.

10. Stability and Reactivity

STABILITY:	**Unstable**		**Stable**	**X**

INCOMPATIBILITY (materials to avoid): Oxidizing agents. Mixtures with bromine pentafluoride, chlorine and yellow mercuric oxide, nitrogen trifluoride, liquid oxygen, or oxygen difluoride may explode.

HAZARDOUS DECOMPOSITION PRODUCTS: Thermal decomposition and burning may produce CO/CO_2. At temperatures exceeding 700°C and in the absence of oxygen or air, methane may decompose to form hydrogen.

HAZARDOUS POLYMERIZATION:	**May Occur**		**Will Not Occur**	**X**

CONDITIONS TO AVOID: None known.

11. Toxicological Information

No information available.

12. Ecological Information

No adverse ecological effects expected. Methane does not contain any Class I or Class II ozone-depleting chemicals. Methane is not listed as a marine pollutant by DOT.

13. Disposal Considerations

WASTE DISPOSAL METHOD: Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier.

14. Transport Information

DOT/IMO SHIPPING NAME: Methane, compressed	**HAZARD CLASS:** 2.1
IDENTIFICATION NUMBER: UN 1971	**PRODUCT RQ:** Not applicable
SHIPPING LABEL(s): FLAMMABLE GAS	**PLACARD (When required):** FLAMMABLE GAS

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, nonventilated compartment of a vehicle can present serious safety hazards.
Shipment of compressed gas cylinders that have been filled without the owner's consent is a violation of federal law [49 CFR 173.301(b)].

15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, state, and local regulations.

U.S. FEDERAL REGULATIONS:

EPA (Environmental Protection Agency)

CERCLA: Comprehensive Environmental Response, Compensationand Liability Act of 1980 (40 CFR Parts 117 and 302):

Reportable Quantity (RQ): None

SARA: Superfund Amendment and Reauthorization Act:

- **SECTIONS 302/304:** Require emergency planning based on Threshold Planning Quantity (TPQ) and release reporting based on Reportable Quantities (RQ) of extremely hazardous substances (40 CFR Part 355):

  Threshold Planning Quantity (TPQ): None.
  Extremely Hazardous Substances (40 CFR 355): None.

- **SECTIONS 311/312:** Require submission of Material Safety Data Sheets (MSDSs) and chemical inventory reporting with identification of EPA hazard categories. The hazard categories for this products are as follows:

IMMEDIATE: Yes	PRESSURE: Yes
DELAYED: No	REACTIVITY: No
	FIRE: Yes

- **SECTION 313:** Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR Part 372.

  Methane does not require reporting under Section 313.

40 CFR 68: Risk Management Program for Chemical Accidental Release Prevention: Requires development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

Methane is listed as a regulated substance in quantities of 10,000 lbs (4553 kg) or more.

TSCA: Toxic Substances Control Act: Methane is listed on the TSCA inventory.

OSHA (OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION):

29 CFR 1910.119: Process Safety Management of Highly Hazardous Chemicals: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Methane is not listed in Appendix A as a highly hazardous chemical; however, any process that involves a flammable gas on site in one location, in quantities of 10,000 lbs (4553 kg) or more is covered under this regulation unless the gas is used as fuel.

STATE REGULATIONS:

CALIFORNIA: This product is not listed by California under the Safe Drinking Water Toxic Enforcement Act of 1986 (Proposition 65).

PENNSYLVANIA: This product is subject to the Pennsylvania Worker and Community Right-To-Know Act (35 P.S. Sections 7301-7320).

16. Other Information

Be sure to read and understand all labels and instructions supplied with all containers of this product.

SPECIAL PRECAUTIONS: ***Flammable high-pressure gas.*** May form explosive mixtures with air. Use piping and equipment adequately designed to withstand pressures to be encountered. Use only in a

closed system. Use only spark-proof tools and explosion-proof equipment. Ground all equipment***Store and use away from oxygen and oxidizing agents.*** Keep away from heat, sparks, and open flame. ***Gas can cause rapid suffocation due to oxygen deficiency.*** Store and use with adequate ventilation. Close cylinder valve after each use; keep closed even when empty***Never work on a pressurized system.*** If there is a leak, blow the system down in an environmentally safe manner in compliance with all federal, state, and local laws, then repair the leak. ***Never ground a compressed gas cylinder or allow it to become part of an electrical circuit.***

NOTE: *Prior to using any plastics, confirm their compatibility with methane.*

MIXTURES: When you mix two or more gases or liquefied gases, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist, or other trained person when you evaluate the end product. Remember, gases and liquids have properties that can cause serious injury or death.

Be sure to read and understand all labels and instructions supplied with all containers of this product.

HAZARD RATING SYSTEMS:

NFPA RATINGS:		**HMIS RATINGS:**	
HEALTH	= 1	HEALTH	= 0
FLAMMABILITY	= 4	FLAMMABILITY	= 4
REACTIVITY	= 0	REACTIVITY	= 0
SPECIAL	= SA (CGA recommends this to designate simple asphyxiant)		

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED:	CGA-350
PIN-INDEXED YOKE:	None
ULTRA-HIGH-INTEGRITY CONNECTION:	Not assigned (CGA-724 anticipated)

Use the proper CGA connections. **DO NOT USE ADAPTERS.**
Additional limited-standard connections may apply. See CGA Pamphlet V-1.

Ask your supplier about free Praxair safety literature as referenced on the label for this product; you may also obtain copies by calling 1-800-PRAXAIR. Further information about Methane can be found in the following pamphlets published by the Compressed Gas Association, Inc. (CGA), 1725 Jefferson Davis Highway, Arlington, VA 22202-4102, Telephone (703) 412-0900.

AV-1	*Safe Handling and Storage of Compressed Gases*
P-1	*Safe Handling of Compressed Gases in Containers*
P-14	*Accident Prevention in Oxygen-Rich, Oxygen-Deficient Atmospheres*
SB-2	*Oxygen-Deficient Atmospheres*
V-1	*Compressed Gas Cylinder Valve Inlet and Outlet Connections*
---	*Handbook of Compressed Gases, Third Edition*

Praxair asks users of this product to study this Material Safety Data Sheet (MSDS) and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents and contractors of the information on this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

Praxair MSDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current Praxair MSDSs for these products, contact your Praxair sales representative or local distributor or supplier. If you have questions regarding Praxair MSDSs, would like the form number and date of the latest MSDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (**Phone:** 1-800-PRAXAIR; **Address:** Praxair Call Center, Praxair, Inc., PO Box 44, Tonawanda, NY 14150-7891).

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Praxair, Inc.
39 Old Ridgebury Road
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PRAXAIR

Printed in USA

METHANOL- MATERIAL SAFETY DATA SHEET

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24 Hour EMERGENCY CONTACT

U.S- CHEMTREC 1-800-424-9300

CANADA- ANUTEC 613-996-6666

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION----------Up to Table of Contents

Matheson Tri-Gas, Inc.

The telephone numbers listed below are emergency numbers, please contact your local branch for routine inquiries.

USA
959 Route 46 East
Parsippany, New Jersey
07054-0624 USA
Phone: 973-257-1100

CANADA
530 Watson Street
Whitby, Ontario
L1N 5R9 Canada
Phone: 905-668-3570

SUBSTANCE: METHANOL

SYMBOL: CH_4O

TRADE NAMES/SYNONYMS:
METHANOL; WOOD ALCOHOL; METHYL HYDROXIDE; CARBINOL; MONOHYDROXYMETHANE; WOOD SPIRIT; WOOD NAPHTHA; METHYLOL; COLONIAL SPIRIT; COLUMBIAN SPIRIT; PYROXYLIC SPIRIT; STCC 4909230; UN 1230; RCRA U154; CH4O; MAT14280; RTECS PC1400000

CHEMICAL FAMILY: hydroxyls, aliphatic

CREATION DATE: Jan 24 1989
REVISION DATE: Mar 16 1999

2. COMPOSITION, INFORMATION ON INGREDIENTS----------Up to Table of Contents

COMPONENT: METHANOL

CAS NUMBER: 67-56-1

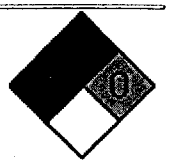
EC NUMBER (EINECS): 200-659-6

EC INDEX NUMBER: 603-001-00-X

PERCENTAGE: 100.0

3. HAZARDS IDENTIFICATION----------Up to Table of Contents

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

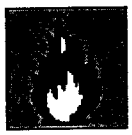


WHMIS CLASSIFICATION: BD2

EC CLASSIFICATION (ASSIGNED):
F Highly Flammable
T Toxic

R 11-23/25

EC Classification may be inconsistent with independently-researched data.


F

T

EMERGENCY OVERVIEW:

Color: colorless

Physical Form: liquid

Odor: sweet odor

Major Health Hazards: skin irritation, eye irritation, central nervous system depression

Physical Hazards: Flammable liquid and vapor. Vapor may cause flash fire.

POTENTIAL HEALTH EFFECTS:

INHALATION:
Short Term Exposure: same as effects reported in short term ingestion, irritation, ringing in the ears, digestive disorders, symptoms of drunkenness, visual disturbances, nerve damage
Long Term Exposure: same as effects reported in short term ingestion, headache

SKIN CONTACT:
Short Term Exposure: same as effects reported in short term ingestion, irritation, symptoms of drunkenness, nerve damage
Long Term Exposure: same as effects reported in short term exposure

EYE CONTACT:
Short Term Exposure: irritation, eye damage
Long Term Exposure: same as effects reported in short term exposure

INGESTION:
Short Term Exposure: nausea, vomiting, diarrhea, difficulty breathing, irregular heartbeat, headache, drowsiness, symptoms of drunkenness, disorientation, hearing loss, blindness, bluish skin color, lung congestion, nerve damage, convulsions, coma
Long Term Exposure: same as effects reported in short term exposure

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

4. FIRST AID MEASURES----------Up to Table of Contents

INHALATION:

Remove from exposure immediately. Use a bag valve mask or similar device to perform artificial respiration (rescue breathing) if needed. Get medical attention.

SKIN CONTACT:
Remove contaminated clothing, jewelry, and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention, if needed.

EYE CONTACT:
Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains. Get medical attention immediately.

INGESTION:
If vomiting occurs, keep head lower than hips to help prevent aspiration. Get medical attention, if needed.

ANTIDOTE:
ethanol, oral; calcium gluconate/glucose, intravenous. 4-methylpyrazole, oral, intravenous.

5. FIRE FIGHTING MEASURES----------Up to Table of Contents

FIRE AND EXPLOSION HAZARDS:
Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive.

EXTINGUISHING MEDIA:
alcohol resistant foam, carbon dioxide, regular dry chemical, water

Large fires: Use alcohol-resistant foam or flood with fine water spray.

FIRE FIGHTING:
Move container from fire area if it can be done without risk. Dike for later disposal. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck, evacuation radius: 800 meters (1/2 mile).

FLASH POINT:
52 F (11 C) (CC)

LOWER FLAMMABLE LIMIT:
6.0%

UPPER FLAMMABLE LIMIT:
36.0%

AUTOIGNITION:
725 F (385 C)

FLAMMABILITY CLASS (OSHA):
IB

6. ACCIDENTAL RELEASE MEASURES----------Up to Table of Contents

AIR RELEASE:
Reduce vapors with water spray.

SOIL RELEASE:
Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal.

WATER RELEASE:
Cover with absorbent sheets, spill-control pads or pillows. Remove trapped material with suction hoses.

OCCUPATIONAL RELEASE:
Avoid heat, flames, sparks and other sources of ignition. Do not touch spilled material. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny

entry. Reportable Quantity (RQ): Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE----------Up to Table of Contents

Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION----------Up to Table of Contents

EXPOSURE LIMITS:

METHANOL:
METHYL ALCOHOL (METHANOL):
200 ppm (262 mg/m3) OSHA TWA (skin)
250 ppm (328 mg/m3) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
200 ppm (262 mg/m3) ACGIH TWA (skin)
250 ppm (328 mg/m3) ACGIH STEL
200 ppm (262 mg/m3) NIOSH recommended TWA (skin)
250 ppm (328 mg/m3) NIOSH recommended STEL

VENTILATION: Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.
2000 ppm
Any supplied-air respirator.
5000 ppm
Any supplied-air respirator.
6000 ppm
Any supplied-air respirator with a full facepiece.
Any self-contained breathing apparatus with a full facepiece.
Any supplied-air respirator with a full facepiece.
Escape -
Any appropriate escape-type, self-contained breathing apparatus.
For Unknown Concentrations or Immediately Dangerous to Life or Health -
Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.
Any self-contained breathing apparatus with a full facepiece.

9. PHYSICAL AND CHEMICAL PROPERTIES----------Up to Table of Contents

PHYSICAL STATE: liquid

APPEARANCE: clear

COLOR: colorless

ODOR: sweet odor

MOLECULAR WEIGHT: 32.04

MOLECULAR FORMULA: C-H3-O-H

BOILING POINT: 149 F (65 C)

FREEZING POINT: -137 F (-94 C)

VAPOR PRESSURE: 97.25 mmHg @ 20 C

VAPOR DENSITY (air=1): 1.11

SPECIFIC GRAVITY (water=1): 0.7914

WATER SOLUBILITY: soluble

PH: Not available

VOLATILITY: Not available

ODOR THRESHOLD: 100 ppm

EVAPORATION RATE: 4.6 (butyl acetate=1)

VISCOSITY: 0.59 cP @ 20 C

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SOLVENT SOLUBILITY:
Soluble: ether, benzene, alcohol, acetone, chloroform, ethanol

10. STABILITY AND REACTIVITY----------Up to Table of Contents

REACTIVITY:
Stable at normal temperatures and pressure.

CONDITIONS TO AVOID:
Avoid heat, flames, sparks and other sources of ignition. Minimize contact with material. Avoid inhalation of material or combustion by-products. Keep out of water supplies and sewers.

INCOMPATIBILITIES:
halo carbons, combustible materials, metals, oxidizing materials, halogens, metal carbide, bases, acids

HAZARDOUS DECOMPOSITION:
Thermal decomposition products: oxides of carbon

POLYMERIZATION:
Will not polymerize.

11. TOXICOLOGICAL INFORMATION----------Up to Table of Contents

METHANOL:

IRRITATION DATA:
20 mg/24 hour(s) skin-rabbit moderate; 40 mg eyes-rabbit moderate; 100 mg/24 hour(s) eyes-rabbit moderate

TOXICITY DATA:
64000 ppm/4 hour(s) inhalation-rat LC50; 15800 mg/kg skin-rabbit LD50; 5628 mg/kg oral-rat LD50

LOCAL EFFECTS:
Irritant: skin, eye

ACUTE TOXICITY LEVEL:
Slightly Toxic: dermal absorption, ingestion
Relatively Non-toxic: inhalation

TARGET ORGANS:
nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:
eye disorders, kidney disorders, skin disorders and allergies

MUTAGENIC DATA:
Available.

REPRODUCTIVE EFFECTS DATA:
Available.

12. ECOLOGICAL INFORMATION----------Up to Table of Contents

ECOTOXICITY DATA:

FISH TOXICITY:
74.3 ug/L 96 hour(s) LC50 (Mortality) Gudgeon (Gobio gobio)

INVERTEBRATE TOXICITY:
383 ug/L 48 hour(s) EC50 (Immobilization) Water flea (Daphnia magna)

ALGAL TOXICITY:
200-480 ug/L 8 hour(s) (Population) Algae,phytoplankton,algal mat (Algae)

PHYTOTOXICITY:
0.1 ug/L 21 week(s) (Biochemical) Eelgrass (Zostera marina)

OTHER TOXICITY:
3.2 ug/L 3-21 day(s) (Chlorophyl) Aquatic community (Aquatic community)

FATE AND TRANSPORT:

BIOCONCENTRATION:
1200 ug/L 48 hour(s) BCF (Residue) Bluegill (Lepomis macrochirus) 2.7 ug/L

ENVIRONMENTAL SUMMARY:
Highly toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS----------Up to Table of Contents

Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): U154. Dispose in accordance with all applicable regulations.

14. TRANSPORT INFORMATION----------Up to Table of Contents

U.S. DOT 49 CFR 172.101. SHIPPING NAME-UN NUMBER; HAZARD CLASS; PACKING GROUP; LABEL:
Methanol-UN1230; 3; II; Flammable liquid; Poison

15. REGULATORY INFORMATION----------Up to Table of Contents

U.S. REGULATIONS:
TSCA INVENTORY STATUS: Y

TSCA 12(b) EXPORT NOTIFICATION: Not listed

CERCLA SECTION 103 (40CFR302.4): Y
Methanol: 5000 LBS RQ

SARA SECTION 302 (40CFR355.30): N

SARA SECTION 304 (40CFR355.40): N

SARA SECTION 313 (40CFR372.65): Y
Methanol

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40CFR370.21):
ACUTE: Y
CHRONIC: N
FIRE: Y
REACTIVE: N
SUDDEN RELEASE: N

OSHA PROCESS SAFETY (29CFR1910.119): N

STATE REGULATIONS:
California Proposition 65: N

EUROPEAN REGULATIONS:

EC NUMBER (EINECS): 200-659-6

EC RISK AND SAFETY PHRASES:

R 11	Highly flammable.
R 23/25	Toxic by inhalation and if swallowed.
S 1/2	Keep locked-up and out of reach of children.
S 7	Keep container tightly closed.
S 16	Keep away from sources of ignition - No smoking.
S 24	Avoid contact with skin.
S 45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

CONCENTRATION LIMITS:
C>=20% T R 23/25
3%<=C<20% Xn R 20/22

16. OTHER INFORMATION----------Up to Table of Contents

Matheson Tri-Gas makes no express or implied warranties, guarantees or representations regarding the product or the information herein, including but not limited to any implied warranty of merchantability or fitness for use. Matheson Tri-Gas shall not be liable for any personal injury, property or other damages of any nature, whether compensatory, consequential, exemplary, or otherwise, resulting from any publication, use or reliance upon the information herein.

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MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

NITRIC ACID, 50-70%

MSDS Number: N3660 --- ***Effective Date: 07/13/00***

1. Product Identification

Synonyms: Aqua Fortis; Azotic Acid; Nitric Acid 50%; Nitric Acid 65%; nitric acid 69-70%
CAS No.: 7697-37-2
Molecular Weight: 63.01
Chemical Formula: HNO3
Product Codes:
J.T. Baker: 411D, 412D, 5371, 5555, 5801, 5826, 5876, 9597, 9598, 9600, 9601, 9602, 9603, 9604, 9606, 9607, 9616, 9617
Mallinckrodt: 1409, 2703, 2704, 412D, 6623, H988, H993, H998, V069, V077, V336, V561, V633, V650

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Nitric Acid	7697-37-2	50 - 70%	Yes
Water	7732-18-5	30 - 50%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 3 - Severe (Oxidizer)
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Yellow (Reactive)

Potential Health Effects

Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison.

Inhalation:
Corrosive! Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract.
Ingestion:
Corrosive! Swallowing nitric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth and lung damage. Long-term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, eye disease, or cardiopulmonary diseases may be more susceptible to the effects of this substance.

---

4. First Aid Measures

Immediate first aid treatment reduces the health effects of this substance.
Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.
Explosion:
Reacts explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc. Reacts with most metals to release hydrogen gas which can form explosive mixtures with air.
Fire Extinguishing Media:
Water spray may be used to keep fire exposed containers cool. Do not get water inside container.
Special Information:
Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

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6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB(R) or TEAM(R) 'Low Na+' acid neutralizers are recommended for spills of this product.

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7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
2 ppm (TWA), 4 ppm (STEL)
-ACGIH Threshold Limit Value (TLV):
2 ppm (TWA); 4 ppm (STEL)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Nitric acid is an oxidizer and should not come in contact with cartridges and canisters that contain oxidizable materials, such as activated charcoal. Canister-type respirators using sorbents are ineffective.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Colorless to yellowish liquid.
Odor:
Suffocating, acrid.
Solubility:
Infinitely soluble.
Specific Gravity:
1.41
pH:
1.0 (0.1M solution)
% Volatiles by volume @ 21C (70F):
100 (as water and acid)
Boiling Point:
122C (252F)
Melting Point:
-42C (-44F)
Vapor Density (Air=1):
2-3
Vapor Pressure (mm Hg):
48 @ 20C (68F)
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic nitrogen oxides fumes and hydrogen nitrate. Will react with water or steam to produce heat and toxic and corrosive fumes.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A dangerously powerful oxidizing agent, concentrated nitric acid is incompatible with most substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.
Conditions to Avoid:
Light and heat.

11. Toxicological Information

Nitric acid: Inhalation rat LC50: 244 ppm (NO2)/30M; Investigated as a mutagen, reproductive effector. Oral (human) LDLo: 430 mg/kg.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Nitric Acid (7697-37-2)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 150LB

International (Water, I.M.O.)

Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 150LB

International (Air, I.C.A.O.)

Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 150LB

---

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Nitric Acid (7697-37-2)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Nitric Acid (7697-37-2)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Nitric Acid (7697-37-2)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Nitric Acid (7697-37-2)	1000	No	No
Water (7732-18-5)	No	No	No

```
Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: Yes Pressure: No
Reactivity: No          (Mixture / Liquid)
```

Australian Hazchem Code: 2PE
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0** Other: **Oxidizer**
Label Hazard Warning:
POISON! DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor or mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep from contact with clothing and other combustible materials.
Do not store near combustible materials.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 1.
Disclaimer:
****

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM HYDROXIDE

MSDS Number: S4034 --- *Effective Date: 08/20/98*

1. Product Identification

Synonyms: Caustic soda; lye; sodium hydroxide solid; sodium hydrate
CAS No.: 1310-73-2
Molecular Weight: 40.00
Chemical Formula: NaOH
Product Codes:
J.T. Baker: 3718, 3721, 3722, 3723, 3728, 3734, 3736, 5045, 5565
Mallinckrodt: 7001, 7680, 7708, 7712, 7772, 7798

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Hydroxide	1310-73-2	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)

Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: White Stripe (Store Separately)

Potential Health Effects

Inhalation:
Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat or runny nose. Severe pneumonitis may occur.
Ingestion:
Corrosive! Swallowing may cause severe burns of mouth, throat, and stomach. Severe scarring of tissue and death may result. Symptoms may include bleeding, vomiting, diarrhea, fall in blood pressure. Damage may appears days after exposure.
Skin Contact:
Corrosive! Contact with skin can cause irritation or severe burns and scarring with greater exposures.
Eye Contact:
Corrosive! Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent impairment of vision, even blindness.
Chronic Exposure:
Prolonged contact with dilute solutions or dust has a destructive effect upon tissue.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician, immediately. Wash clothing before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
Perform endoscopy in all cases of suspected sodium hydroxide ingestion. In cases of severe esophageal corrosion, the use of therapeutic doses of steroids should be considered. General supportive measures with continual monitoring of gas exchange, acid-base balance, electrolytes, and fluid intake are also required.

---

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Hot or molten material can react violently with water.
Can react with certain metals, such as aluminum, to generate flammable hydrogen gas.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Adding water to caustic solution generates large amounts of heat.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Keep unnecessary and unprotected people away from area of spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. Do not flush caustic residues to the sewer. Residues from spills can be diluted with water, neutralized with dilute acid such as acetic, hydrochloric or sulfuric. Absorb neutralized caustic residue on clay, vermiculite or other inert substance and package in a suitable container for disposal. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

---

7. Handling and Storage

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities. Always add the caustic to water while stirring; never the reverse. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product. Do not store with aluminum or magnesium. Do not mix with acids or organic materials.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Permissible Exposure Limit (PEL):
2 mg/m3 Ceiling
- ACGIH Threshold Limit Value (TLV):
2 mg/m3 Ceiling
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most

recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a half-face dust/mist respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece dust/mist respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:

White, deliquescent pellets or flakes.

Odor:

Odorless.

Solubility:

111 g/100 g of water.

Specific Gravity:

2.13

pH:

13 - 14 (0.5% soln.)

% Volatiles by volume @ 21C (70F):

0

Boiling Point:

1390C (2534F)

Melting Point:

318C (604F)

Vapor Density (Air=1):

> 1.0

Vapor Pressure (mm Hg):

Negligible.

Evaporation Rate (BuAc=1):

No information found.

---

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage. Very hygroscopic. Can slowly pick up moisture from air and react with carbon dioxide from air to form sodium carbonate.

Hazardous Decomposition Products:

Sodium oxide. Decomposition by reaction with certain metals releases flammable and explosive

hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Sodium hydroxide in contact with acids and organic halogen compounds, especially trichloroethylene, may causes violent reactions. Contact with nitromethane and other similar nitro compounds causes formation of shock-sensitive salts. Contact with metals such as aluminum, magnesium, tin, and zinc cause formation of flammable hydrogen gas. Sodium hydroxide, even in fairly dilute solution, reacts readily with various sugars to produce carbon monoxide. Precautions should be taken including monitoring the tank atmosphere for carbon monoxide to ensure safety of personnel before vessel entry.
Conditions to Avoid:
Moisture, dusting and incompatibles.

11. Toxicological Information

Irritation data: skin, rabbit: 500 mg/24H severe; eye rabbit: 50 ug/24H severe; investigated as a mutagen.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sodium Hydroxide (1310-73-2)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SODIUM HYDROXIDE, SOLID
Hazard Class: 8
UN/NA: UN1823

Packing Group: II
Information reported for product/size: 300LB

International (Water, I.M.O.)

Proper Shipping Name: SODIUM HYDROXIDE, SOLID
Hazard Class: 8
UN/NA: UN1823
Packing Group: II
Information reported for product/size: 300LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Sodium Hydroxide (1310-73-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sodium Hydroxide (1310-73-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sodium Hydroxide (1310-73-2)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sodium Hydroxide (1310-73-2)	1000	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
Reactivity: Yes (Pure / Solid)

Australian Hazchem Code: 2R
Poison Schedule: S6
WHMIS:
- This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **1**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED.

CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.

Label Precautions:

Do not get in eyes, on skin, or on clothing.
Do not breathe dust.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 10.

Disclaimer:

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APPENDIX E

Calibration/Site Safety Briefing

CALIBRATION/SITE SAFETY BRIEFING

DAILY INSTRUMENT CALIBRATION CHECK SHEET

Date	Instrument	Battery Check OK?	Zero Adjust OK?	Calibration Gas (ppm)	Reading (ppm)	Calibrated By

FIELD MONITORING ACTIVITY LOG

Date	Activity Monitored	Time	Location	Reading	Action	Reading By

Safety Issues	**Discussed** Yes	No
Tasks	_____	_____
Protective Clothing/Equipment	_____	_____
Chemical and Physical Hazards	_____	_____
Control Methods	_____	_____
Air Monitoring Action Levels and Requirements	_____	_____
Nearest Phone/Communications	_____	_____
Hospital Name/Address/Directions	_____	_____
Additional Topics (incidents, actions taken, etc.)	_____	_____

Meeting conducted by:_____ Date: _____

Attendees' Names (print)	**Signatures**
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

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ABBREVIATIONS AND ACRONYMS

ARAR	applicable or relevant and appropriate requirement
DOT	Department of Transportation
EPA	U.S. Environmental Protection Agency
IDW	investigation-derived waste
NPD	North Pacific Division
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
SAP	sampling and analysis plan
SI	site investigation
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

Investigation-derived waste (IDW) generated during the former North Pacific Division (NPD) laboratory site investigation (SI) will be stored, handled, and disposed of according to this IDW Plan. This IDW Plan describes expected types of IDW (Section 2), storage and handling procedures (Section 3), and evaluation of IDW to determine disposal methods and disposal options (Section 4).

The SI is being conducted by URS on behalf of the Seattle District of the U.S. Army Corps of Engineers (USACE). This IDW plan follows guidelines set forth and regulations referenced in *Management of Investigation-Derived Wastes During Site Inspections* (USEPA 1991). Although this document is promulgated for use by U.S. Environmental Protection Agency (EPA) site managers of Superfund investigations, it includes the most applicable or relevant and appropriate requirements (ARARs) for IDW generated at the former NPD laboratory site.

According to EPA guidelines, the most important elements of managing IDW include:

- Leaving a site in no worse condition than existed prior to the investigation
- Removing wastes that pose an immediate threat to human health or the environment
- Complying with federal and state ARARs to the extent practicable
- Careful planning and coordination for IDW management
- Minimizing the quantity of generated wastes

To comply with the above elements, the following steps will be taken at the site:

- Groundwater, soil, and decontamination water will be containerized pending the results of analytical testing.
- Containerized IDW will be characterized and disposed of appropriately by a waste disposal contractor.

2.0 EXPECTED TYPES OF INVESTIGATION-DERIVED WASTE

The sampling methods employed during this SI will generate IDW that may include soil, decontamination water, temporary microwell development water, microwell and monitoring well purge water, personal protective equipment (PPE), and disposable equipment. In addition, drums from the landfill containing concrete, and on-site buckets of soil from the Umatilla Army Depot Borrow Pit will be disposed of by a waste disposal contractor. Based on the site history and on results of past investigations, potential contaminants in IDW may include volatile organic compounds, semivolatile organic compounds, pesticides, polychlorinated biphenyls, metals, and petroleum hydrocarbons.

2.1 SOIL

Soil samples will be collected from Geoprobe® direct-push soil borings. A limited amount of soil cuttings will be generated during Geoprobe® activities. It is anticipated that less than one 55-gallon drum of soil cuttings will be generated during this investigation.

Surface soil samples will be collected at locations not accessible by the Geoprobe® rig. Sediment will be collected from the base of the concrete wastewater sump. These sampling methods will not produce waste soil.

Four exploratory trenches will be excavated in the landfill. Excavated soil will be temporarily placed on plastic sheeting. After completion of each trench, the excavated soil will be returned to the respective trench. Therefore, trenching activities will not produce IDW.

2.2 DEVELOPMENT AND SAMPLING PURGE WATER

Five temporary microwells will be installed. After installation, the microwells will be developed by pumping. It is anticipated that less than one 55-gallon drum of development purge water may be generated during development.

Following development, each of the five temporary microwells and six existing monitoring wells will be sampled. Prior to sampling, the microwells and wells will be purged using low-flow techniques that will limit the volume of purge water generated during sampling. One round of groundwater samples will be collected. It is estimated that approximately 100 gallons of sampling purge water may be generated during this investigation.

2.3 DECONTAMINATION FLUIDS

Sampling equipment including stainless steel spoons and bowls, down-hole drilling equipment, submersible pumps, and nondisposable PPE will be decontaminated between each use and/or at the end of each work day. Decontamination water will be obtained from a source approved by the USACE. The decontamination water will contain a minimum of phosphate-free detergent (Liquinox), and trace quantities of soil. Approximately 200 gallons of this solution may be generated during this investigation.

Methanol and hexane will be used during the decontamination process. Approximately 1 gallon of each fluid may be generated during this investigation. A detailed description of decontamination procedures is included in the Sampling and Analysis Plan (SAP).

2.4 EXISTING ON-SITE CONTAINERS

There are approximately five drums partially exposed at the northern toe of the landfill. Contents of these drums are expected to be hardened concrete. The drums are anticipated to be 35 gallons in size and have sensors arrayed around the outside.

Thirty-three 5-gallon buckets containing soil samples from the Umatilla Army Depot Borrow Pit are currently stored at the site.

2.5 PERSONAL PROTECTIVE EQUIPMENT AND DISPOSABLE SAMPLING EQUIPMENT

Disposable PPE used during sample collection and handling may include Tyvek® or paper coveralls and latex or nitrile gloves. Each member of the field crew may use one pair of Tyvek® or paper coveralls and several pairs of latex or nitrile gloves per day.

Disposable sampling equipment may include Teflon®-lined polyethylene tubing, plastic bags, and/or glass sample jars that will not be submitted to a laboratory. These items may contain small quantities of soil or groundwater and will, therefore, be decontaminated prior to disposal.

3.0 HANDLING AND STORAGE OF INVESTIGATION-DERIVED WASTE

This section describes handling and storage procedures for the IDW described in Section 2. As advocated in the EPA guidelines (EPA 1991), the procedures are designed to minimize the amount of waste generated and to manage containerized waste in a protective manner until disposal options are evaluated.

3.1 SOIL

IDW soil generated during this SI will be retained in Department of Transportation (DOT)-approved 55-gallon steel drums. Sampling personnel will record the approximate volume of cuttings and the boring location number for each batch of cuttings retained in the drums.

Each drum containing cuttings will be clearly labeled with the quantity of materials contained, the date the drum was filled, the project number, the name and phone number of the USACE project manager, and sample location numbers from which the soil originated. The information will be entered on weatherproof labels affixed to the side of the drum. Label information, along with copies of field documentation related to the drum contents, will be kept in the project file.

The drums will be stored at a staging area in the former oil storage building, as designated by the USACE. Prior to storage, the outside of the drums will be cleaned and dried and covered with heavy duty plastic sheeting. The drums will remain in this location until laboratory analysis is complete and IDW disposal options are evaluated as described in Section 4. The estimated maximum time that the drums will be left on site is 3 months.

3.2 DEVELOPMENT AND SAMPLING PURGE WATER

During development and sampling of temporary microwells and existing monitoring wells, IDW water will be contained in DOT-approved 55-gallon steel drums. The drums will be labeled and stored in the same manner as drums that contain soil. All of the water will be stored at the designated staging area until laboratory analysis is complete and IDW disposal options are evaluated as described in Section 4.

3.3 DECONTAMINATION FLUIDS

Down-hole Geoprobe® equipment will be decontaminated between each boring to remove excess soil from the drilling rods and to avoid cross-contamination between borings. Sampling

equipment such as split spoons, stainless steel spoons and bowls, and submersible pumps will also be cleaned between uses.

This equipment will be washed and rinsed in or above a large plastic tub or other suitable container in order to retain detergent, rinse water, and the small amount of sediment that is removed from the equipment. The water will be transferred to DOT-approved 55-gallon steel drums. These drums will be stored at the designated staging area until laboratory analysis is complete and IDW disposal options are evaluated as described in Section 4.

IDW methanol and hexane resulting from the decontamination process will be retained in stainless steel bowls and allowed to evaporate, away from personnel and sampling areas. If conditions are not favorable for evaporation, then these wastes will be disposed of by the waste disposal contractor.

3.4 EXISTING ON-SITE CONTAINERS

Each drum encountered in the landfill will be removed and staged within the landfill fenced area. The excavation equipment will be used to excavate and move the drums to the staging area. It is anticipated that up to five more drums may be uncovered during exploratory trenching. If so, these drums will be removed and staged in the same manner. A representative composite sample of the contents of these drums will be collected for profiling using a hammer and chisel. These drums will be stored at the designated staging area until laboratory analysis is complete and IDW disposal options are evaluated as described in Section 4.

The buckets containing soil from the Umatilla Army Depot Borrow Pit are currently stored in the former soil storage building at the site. Composite samples of the contents of these drums will be collected and analyzed to facilitate waste stream profiling. These drums will be stored in this building or at the designated staging area until laboratory analysis is complete and IDW disposal options are evaluated as described in Section 4.

3.5 PERSONAL PROTECTIVE EQUIPMENT AND DISPOSABLE SAMPLING EQUIPMENT

PPE, disposable equipment, and plastic sheeting used during trenching will be decontaminated if necessary and double-bagged after use or at the end of each work day. The disposal bags will be tied shut and disposed of at a nearby solid waste transfer station.

4.0 EVALUATION TO DETERMINE PROPER DISPOSAL

Containerized soil, decontamination water, microwell development water, sampling purge water, and landfill drum contents (concrete) will be evaluated by a waste disposal contractor for proper disposal methods. The first step in evaluating IDW includes characterizing the waste to determine the types and concentrations of contaminants that it contains. Based on the results of characterization, appropriate treatment and/or disposal options may then be selected.

The IDW will be characterized based on laboratory analysis of soil and groundwater samples, as described in the SAP. When the concentration of a substance is the criterion that determines whether or not it is regulated, the highest concentration detected in the soil and groundwater samples will be used to conservatively characterize the drummed soil, decontamination water, groundwater, or concrete that may be represented by the high concentration sample.

When the above evaluations are complete, disposal options for containerized IDW will be selected based on the evaluation results. If laboratory analysis of soil or groundwater samples representing a set of containerized waste does not contain detectable concentrations of contaminants or if detected contaminants are not regulated, the waste may be left on site or transported and disposed of off site by the waste disposal contractor. Soil may be spread around the site near the location of the boring from which it originated. Similarly, if laboratory tests indicate that decontamination water and groundwater are nonhazardous, the water may be disposed of at a nearby sewer manhole that is connected to a sanitary treatment system. Drums containing concrete will be transported and disposed of off site by the waste disposal contractor.

If laboratory analyses indicate that soil or water IDW is a Resource Conservation and Recovery Act (RCRA) hazardous waste or subject to land disposal restrictions, the IDW will be transported and disposed of off site at an appropriate disposal or treatment facility by the waste disposal contractor.

5.0 REFERENCES

U.S. Environmental Protection Agency (USEPA). 1991. *Management of Investigation-Derived Wastes During Site Inspections.* Office of Emergency and Remedial Response Directive 9345.3-02. EPA Document 540-G-91-009. May 1991.

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ABBREVIATIONS AND ACRONYMS

ASTM	American Society for Testing and Materials
bgs	below ground surface
CLP	Contract Laboratory Program
DCQCR	daily chemical quality control report
DEQ	Oregon Department of Environment Quality
DQO	data quality objective
EBS	environmental baseline survey
EPA	U.S. Environmental Protection Agency
ERGO	Environmental Review Guide for Operations
FSP	field sampling plan
HSP	Health and Safety Plan
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NAD	North American Datum of 1983
NGDV	National Geodetic Vertical Datum of 1929
NPD	North Pacific Division
NWTPH-Dx	Northwest total petroleum hydrocarbons–diesel extended
OAR	Oregon Administrative Rules
ODEQ	Oregon Department of Environmental Quality
PA	preliminary assessment
PCB	polychlorinated biphenyl
PM	project manager
ppm	parts per million
QA	quality assurance
QAM	quality assurance manager
QAPP	quality assurance project plan
RCRA	Resource Conservation and Recovery Act
SAP	sampling and analysis plan
SI	site investigation
SVOC	semivolatile organic compound
TCA	1,1,1-trichloroethane
TPH	total petroleum hydrocarbon
URS	URS Corporation and subsidiaries
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
VOC	volatile organic compound

1.0 INTRODUCTION

URS, on behalf of the Seattle District of the U.S. Army Corps of Engineers (USACE), is conducting a site investigation (SI) at the former USACE North Pacific Division (NPD) laboratory, located in Troutdale, Oregon (Figure 1-1). URS is performing this work under contract number DACA67-98-D-1005, delivery order number 73. This Work Plan defines the objectives of the investigation and explains the work to be performed to meet these project objectives.

1.1 OBJECTIVES

The objectives of this SI are to confirm that no contaminated soil remains at locations where soil removal activities were conducted previously, and to verify that past laboratory activities have not adversely impacted soil or groundwater quality beneath the site. This SI is designed to address outstanding issues identified by the U.S. Environmental Protection Agency (EPA) and Oregon Department of Environmental Quality (DEQ) at the former NPD laboratory site.

The purpose of this SI at the former NPD laboratory site is to complete a consistent sampling and analysis scope that can be used to fill the data gaps left following previous investigations. Soil, sediment, groundwater and concrete samples will be collected for the following purposes:

- To collect the data required to better define the type and extent of groundwater, soil, sediment, and concrete contamination
- To determine if previous removal of contaminated soil was complete
- To determine if pole-mounted transformers have adversely impacted the soil around the existing transformer pad
- To evaluate any adverse impacts to the environment from past laboratory activities
- To determine the concentration of any contamination in the Umatilla Army Depot Borrow Site soils

1.2 SCOPE

To meet these objectives, the scope of work for this SI consists of the following components:

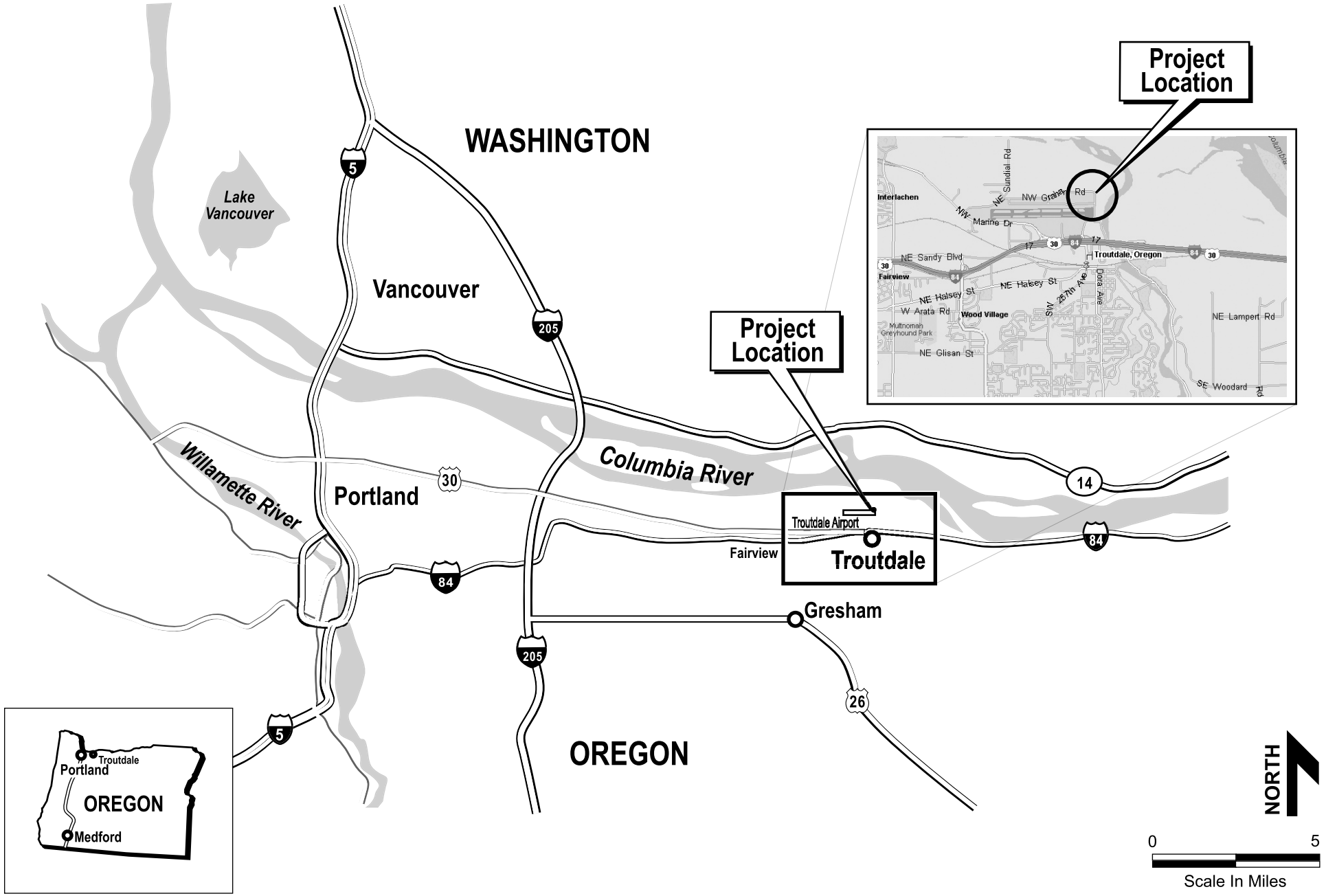
- Collect soil samples either manually or using a Geoprobe® direct-push technique
- Install temporary groundwater microwells using the Geoprobe® technique
- Sample groundwater from temporary microwells and existing monitoring wells
- Excavate and sample exploratory trenches in the landfill
- Remove and dispose of drums of concrete in the landfill
- Collect soil samples from buckets containing material from the Umatilla Army Depot Borrow Site

Details of these work items are provided in the overview of the sampling and analysis program (Section 5.2).

1.3 WORK PLAN CONTENTS

In accordance with USACE guidance EM 200-1-3 (USACE 2001), this Work Plan is intended to serve as the "umbrella" document for the SI. It addresses each of the topics listed in EM 200-1-3 and scope of work for this project. This Work Plan has been organized in the following sections:

1. Introduction
2. Project Organization and Responsibilities
3. Background Information
4. Previous Investigations
5. Investigation Rationale and Approach
6. Data Review, Presentation and Interpretation
7. Data Management and Reporting
8. References



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MANAGEMENT PLAN FOR
SITE INVESTIGATION
Former NPD Laboratory
Troutdale, Oregon

Figure 1-1
Site Location

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Key USACE and URS positions and personnel assigned to this project are described in this section. Key USACE and URS personnel and contractor contact information is presented in Table 2-1.

2.1 USACE PROJECT MANAGER: MICHAEL GROSS (PORTLAND DISTRICT)

The USACE PM will maintain specific project management authority throughout the life of the project and is responsible for overall management and execution of the project to include project quality, cost, and schedule. Specific tasks include the following:

- Providing the project team with funding for each task
- Tracking and reporting to the USACE Northwest Division financial expenditures, obligations, and schedule
- Facilitating the resolution of issues arising during the project

2.2 USACE TECHNICAL TEAM LEADER: MAMIE BROUWER (SEATTLE DISTRICT)

The Technical Team Leader is the primary point-of-contact for this investigation and is responsible for keeping the USACE PM informed of project schedule, budget, and changes. Ms. Brouwer has overall responsibility for achieving the technical objectives of this project. Responsibilities will also include development of data quality objectives (DQOs), selection of analytical methods and laboratories, approval of quality assurance/quality control procedures, and review of daily field reports.

She will work closely with the URS PM, will be immediately notified if problems occur, and will approve changes to the Sampling and Analysis Plan (SAP) if such changes are warranted. In the event that changes are needed, she will immediately notify the USACE PM, discuss the proposed changes with him and furnish a description of the changes to him.

2.3 URS CONTRACT MANAGER: DAVE HADDOCK

The Contract Manager is responsible for URS' total project performance. While the Contract Manager will not direct the daily activities of the project, he will coordinate closely with the URS Project Manager to ensure that the project is completed successfully.

2.4 URS PROJECT MANAGER: JANETTE RAU

The URS Project Manager (PM) has overall responsibility for implementing URS' project activities and monitoring the project progress. Ms. Rau is responsible for planning, scheduling, cost control, and completion of project tasks. She also has overall responsibility for the development and implementation of this management plan, for monitoring the quality of the technical and managerial aspects of the project, interfacing with the USACE, and ensuring the timeliness of all project deliverables.

2.5 URS QUALITY ASSURANCE MANAGER AND PROJECT CHEMIST: LORI RASCHKE

As URS Quality Assurance Manager (QAM) for this project, Ms. Raschke is responsible for the quality of all sampling and analysis activities associated with this SI. She will oversee all aspects of the sampling and analysis events to ensure that the appropriate procedures and methods are used to meet the programs' QA objectives. Ms. Raschke also will be responsible for laboratory oversight and will direct the quality review of analytical data. She will work closely with the URS Project Manager and the laboratories.

2.6 URS FIELD INVESTIGATION MANAGER: JANETTE RAU

The Field Investigation Manager is responsible for the overall performance of the field operations including adherence to the SAP, scheduling, liaison with USACE representatives and URS subcontractors, and sample logging and custody. Ms. Rau also will function as the Site Safety Officer and will be responsible for the safe operation of the field teams. She will be responsible for the implementation of the Health and Safety Plan (HSP), review its contents with all personnel, confirm that all personnel have received the required health and safety training, determine personal protection levels, provide necessary personal protective equipment and supplies, and correct any unsafe work practices.

2.7 URS DATABASE MANAGER: CRYSTAL NEIRBY

The Database Manager is responsible for ensuring that project data are properly organized and imported into the project database.

2.8 URS HEALTH AND SAFETY OFFICER: HEATHER BOGE

The Health and Safety Officer will prepare the HSP for all field activities being performed for this SI. Ms. Boge will work directly with the Project Manger and has the responsibility to monitor and verify that the work is performed in accordance with the HSP. She will advise the Project Manager regarding health and safety issues, but will function independently.

2.9 LABORATORY AND CONTRACTOR SERVICES

Table 2-1 includes all subcontractors and the services they will provide for this project**.**

Table 2-1
Project Personnel and Contractor Contact Information

Name	Role	Contact Information
USACE – Portland District Michael Gross	Project Manager	333 SW First Avenue Portland, OR 97024-3495 Phone: 503-808-4913 Fax: 503-808-4905
USACE – Seattle District Mamie Brouwer	Technical Leader and POC	4735 E. Marginal Way S. Seattle, WA 98134 Phone: 206-764-3577 Fax: 206-764-3706
Mt. Hood Community College Don Wallace	Site contact	26000 SE Stark Street Gresham, OR 97030 Phone: 503-491-6997 Fax: 503-491-7676 Pager: 503-441-0640
URS Dave Haddock	Contract Manager	1501 Fourth Avenue, Suite 1400 Seattle, WA 98101 Phone: 206-438-2137 Fax: 206-438-2699
URS Janette Rau	Project Manager and POC	1501 Fourth Avenue, Suite 1400 Seattle, WA 98101 Phone: 206-438-2283 Fax: 206-438-2699
URS Lori Raschke	QA Manager and Project Chemist	1501 Fourth Avenue, Suite 1400 Seattle, WA 98101 Phone: 206-438-2282 Fax: 206-438-2699
URS Crystal Neirby	Database Manager	1501 Fourth Avenue, Suite 1400 Seattle, WA 98101 Phone: 206-438-2248 Fax: 206-438-2699
URS Heather Boge	Health and Safety Officer	1501 Fourth Avenue, Suite 1400 Seattle, WA 98101 Phone: 206-438-2034 Fax: 206-438-2699
URS Andrew Zabel	Field support	1501 Fourth Avenue, Suite 1400 Seattle, WA 98101 Phone: 206-438-2374 Fax: 206-438-2699
Sound Analytical Services, Inc. Dawn Werner	Analytical laboratory for groundwater, soil, sediment, and concrete samples	5755 8th Street East Fife, WA 98424 Phone: 253-922-2310 Fax: 253-922-5047
Southwest Research Institute Joseph Brewer	Analytical laboratory to perform analysis for chemical agents breakdown products	6220 Culebra Road San Antonio, TX 70228 Phone: 210-684-5111

Table 2-1 (Continued)
Project Personnel and Contractor Contact Information

Name	Role	Contact Information
Geo-Tech Explorations, Inc.	Drilling contractor	19700 SW Teton Tualatin, OR 97062 Phone: 503-692-6400 Fax: 503-692-4759
Olson Engineering, Inc.	Surveying contractor	1111 Broadway Vancouver, WA 98660 Phone: 360-695-1385 Fax: 360-695-8117
Envirotech Systems Incorporated	Waste disposal contractor	3601 121st Street SW Lynnwood, WA 98037 Phone: 206-363-9000 Fax: 425-513-5839

Notes:
POC - point of contact

3.0 SITE BACKGROUND AND SETTING

This section describes the former NPD laboratory site location and setting (Section 3.1), history (Section 3.2), geology (Section 3.4), and hydrogeology (Section 3.5).

3.1 SITE LOCATION, DESCRIPTION, AND TOPOGRAPHY

The former NPD laboratory facility is located on 6.43 acres of property in the city of Troutdale, in Multnomah County, Oregon (Figure 1-1). The property is located within the southwest quadrant of Section 24, Township 1 North, Range 3 East (USGS 1993). In its present configuration the site consists of a northern parcel and a southern parcel of land divided by Graham Road. The area is primarily industrial, and the area is zoned for general manufacturing.

Present structures on the southern parcel consist of a 65,000-square-foot building that formerly housed the USACE NPD materials testing laboratory and a warehouse (Figure 3-1). There are two small buildings to the east of the main building. These buildings were used for storage of hazardous materials and oil drums. There is a small fenced enclosure with a concrete pad adjacent to the east side of the building (former electrical transformer enclosure); six pole-mounted transformers sit directly above it. There are two large mobile trailers north of the main building currently used by Mt. Hood Community College. The southern parcel is bordered to the north and east by Northwest Graham Road, and to the south by the Troutdale Airport. To the west is a warehouse occupied by the U.S. Forest Service. Land to the east is occupied by the new City of Troutdale wastewater treatment plant and a construction contractor.

The northern parcel is undeveloped and occupied by a landfill, covering approximately one-third of an acre. It is bordered to the north, east, and west by undeveloped land owned by the Reynolds Metals Company, and to the south by Northwest Graham Road.

3.2 GENERAL SITE HISTORY

The NPD laboratory operated at 1491 Graham Road from 1949 until the spring of 1997. The laboratory was used as a materials testing facility for the entire duration of operation. In 1979, the NPD property was divided by an easement for the extension of Northwest Graham Road. In 1986, the laboratory expanded operations within the warehouse facility, and began analyzing samples from hazardous and toxic waste sites. Hazardous and toxic samples were analyzed until the cessation of operations in 1997. In addition to the permanent buildings, mobile trailers have been located at the site. The trailers once housed the USACE Portland Resident Office, and now

house Mt. Hood Community College. Results of previous investigations at the site will be discussed in Section 4 of this report.

The main building has several sink and floor drains that lead to a common drain header exterior to the building and then to the concrete sump located on the east side of the building. All drains, except for those from the lavatories and freeze/thaw room, discharged to this sump. The lavatory drains discharged directly to the sanitary sewer, and freeze/thaw drains discharged directly to the drainage ditch. The sump discharged into the drainage ditch, which runs along the eastern margin of the site. In 1996, the effluent from the sump and lavatories was connected to the local sewer system. In addition, there are two concrete raceways that served as floor drains within the building and that discharged directly into the drainage ditch until they were blocked in 1996. The soils within the drainage ditch are coarse-grained and highly permeable, which generally promotes infiltration of the discharge into the underlying soils. The drainage ditch dead ends just north of the property.

The drainage ditch reportedly received untreated discharges from the laboratory materials testing operations (Tetra Tech 1999). The discharges included wastewater generated during washing and testing of soils, aggregate, and concrete, and from wet chemistry water quality testing. This wastewater had typical concrete admixtures such as lignins and sulfates. The reagents associated with water quality testing included large quantities of mercury and silver salts. These reagents were routinely flushed down the drains. Other discharges flushed down the sink drains included acids and bases, and trace amounts of laboratory solvents such as methylene chloride, acetone, and hexane. Dilute solutions of metals (less than 1 part per million [ppm]), and indicator dyes such as methylene blue and green were also disposed of in the sinks. Samples received from hazardous and toxic waste sites were containerized and appropriately disposed of off site.

A dry well existed in the southeast portion of the site from 1950 until 1999, when it was removed and surrounding soil was excavated. It was used for waste disposal from 1950 until 1981. The dry well was constructed of approximately 20 inches of gravel overlying the native soil and a 9-inch vertical, open-ended, concrete pipe. The gravel layer extended beyond the vertical pipe for an unknown extent. Viscous wastes were poured directly into the dry well for disposal. The wastes included oil-based paint and asphalt samples that had been dissolved in solvents. Polychlorinated biphenyls (PCBs), lead, chromium, and cadmium may have been in the paints tested at the lab. A zinc powder was used in paint testing at the lab. The solvents used included ether, benzene, and 1,1,1-trichloroethane (TCA) mixed with alcohol. In addition, trichloroethene may have been used as a solvent prior to the late 1970s. Asphalt tested may have contained PCBs and oils. Disposal of these materials in the dry well was discontinued some time between 1980 and 1981. A conservatively estimated total of 45 gallons of dissolved paint and asphalt samples were disposed of in the dry well between 1950 and 1981 when the practice ended.

A 10,000-gallon underground storage tank located west of the main building was decommissioned and removed in 1993. The tank was used to store oil for the boiler-fired heating system in the building. Approximately 10 cubic yards of contaminated soil were excavated during the tank removal activities.

The northern portion the site property historically was used as a landfill for disposal of residual bulk materials, such as gravel aggregate and concrete, that had been tested. The landfill also was used to dispose of solid waste material such as steel drums of hardened concrete, asphaltic paper, and fiberglass insulation. The landfill was unlined and all material was placed directly over native soil. Structural concrete test pours were conducted in 1952 southeast of the landfill, and in the early 1980s southwest of the landfill. Landfill activities ceased in 1994.

3.3 GEOLOGY

The NPD laboratory site is located near the confluence of the Sandy and Columbia Rivers. The site is in the Columbia River floodplain and has been protected from 500-year floods by USACE levees. The area is described as Quaternary-age alluvium, including catastrophic flood deposits underlain by the Pleistocene Cascadian conglomerate, a volcaniclastic conglomerate derived from the uplifted Cascade Range (Tetra Tech 1999).

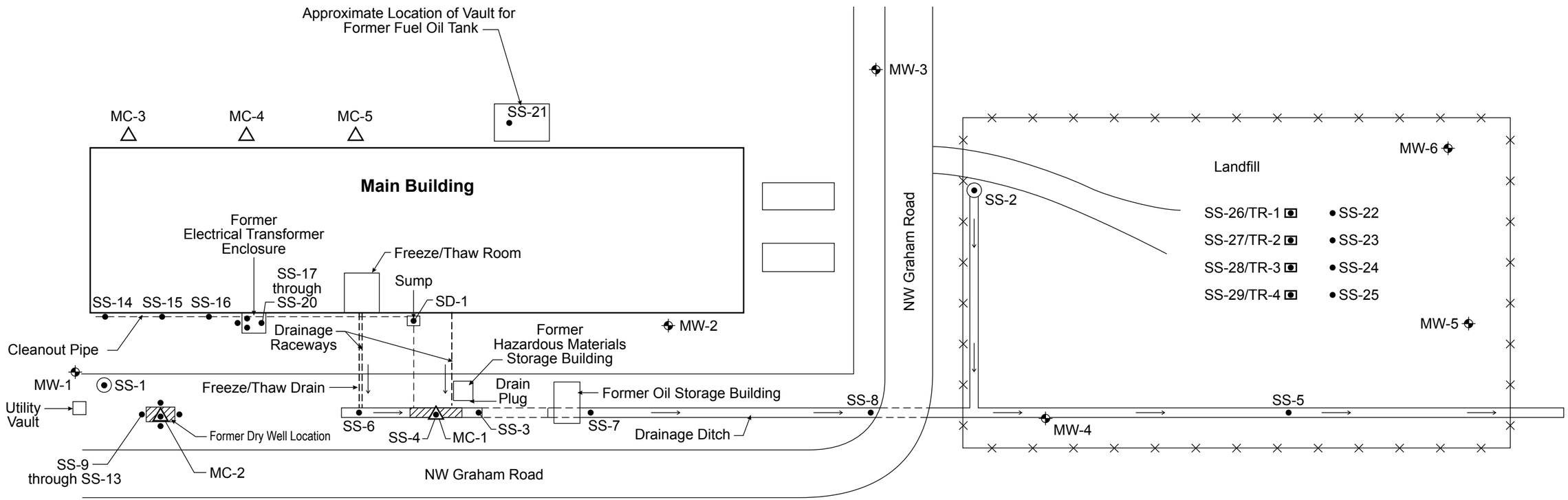
Soil in the area is classified as the Faloma silt loam (USDA 1983). This soil is poorly drained, and is characteristic of the floodplains of the Columbia River. Permeability reportedly increases with depth (Tetra Tech 1999). According to boring logs from the monitoring well installations (Tetra Tech 1998), subsurface soils predominantly consist of brown, coarse-grained, well-graded, well-rounded sand. The sand becomes coarser with depth. Cobbles and silt occasionally can be encountered.

3.4 HYDROGEOLOGY

According to a study of the adjacent Reynolds Metals site, located approximately 1/4 mile north-northwest of the former NPD laboratory site, the project area is underlain by two aquifers (CH2M HILL 1996). The upper aquifer is in unconsolidated sedimentary deposits and extends to a depth of 250 feet below ground surface (bgs). The deeper sand and gravel aquifer is hydraulically connected with the upper aquifer. The unconformable contact between the two aquifers is permeable.

Groundwater studies conducted at the site indicate that a shallow unconfined aquifer is found at a depth ranging between 3 and 12 feet bgs throughout the wet season (Tetra Tech 1998). However, the water table can be as high as 1 foot below ground surface in the peak wet season.

Due to the site's proximity to the Sandy and Columbia Rivers, groundwater levels are highly variable. The groundwater flow direction is toward the north-northwest (Tetra Tech 1999). The surface drainage trends to the north toward the Columbia River. The site is at approximately 30 feet above sea level (USGS 1993) and generally has a flat topography.



LEGEND

	Fence	MW-1	Existing groundwater monitoring well
	Subsurface feature	SS-3	Proposed soil or sediment sampling location
	Former soil removal area	MC-1	Proposed groundwater microwell location
	Direction of flow	TR-1	Proposed exploratory trench location
		SS-1	Proposed background soil sampling location

NOTE

Proposed sampling and trench locations may be adjusted in the field depending on site conditions.

0 80 160

Scale in Feet

SOURCE: Tetra Tech: Final Cleanup Report – Soil Removal and Groundwater Sampling NPD Laboratory, Troutdale, Oregon, 1999.

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MANAGEMENT PLAN FOR SITE INVESTIGATION
Former NPD Laboratory
Troutdale, Oregon

Figure 3-1
Site Layout and Proposed Sampling Locations

grfx\urs\jobs\53F0074212 NPD Lab\NPD Sampling Loc.ai

4.0 PREVIOUS INVESTIGATIONS

4.1 PRELIMINARY ASSESSMENT - 1991

A preliminary assessment (PA) was conducted for the former NPD laboratory site in 1991 by the USACE (USACE 1991). The former NPD laboratory had been identified as a large quantity generator under the Resource Conservation and Recovery Act (RCRA) regulations in 1991 for disposal of methanol from the concrete freeze/thaw test apparatus. The PA documented past and current waste handling and disposal practices of the laboratory. Based on the results of the PA, the EPA recommended no further action at the site. This finding was rescinded by the EPA in October 2000.

4.2 UNDERGROUND STORAGE TANK REMOVAL – 1993

Martech USA Inc. was tasked by the USACE to remove one 10,000-gallon underground storage tank (UST) located near the main building at the site. The UST was buried within a concrete vault with sand to a depth of six feet. Approximately half of the tank and vault were above ground. The tank reportedly was used to store No. 5 fuel oil for heating purposes.

In March, 1991, the tank was removed from service and the remaining fuel (3,401 gallons) were emptied from the tank by another party. Martech USA Inc. removed the tank in 1993. The final confirmation sampling analytical results identified diesel-range petroleum hydrocarbon contamination in the subsurface soils located within the concrete vault at maximum concentrations of 1,830 mg/kg. As a result, a total of 10 cubic yards of petroleum contaminated soils were excavated from the vault and transported offsite for disposal. The excavation was backfilled and compacted to grade. Confirmation samples indicated that the contamination was limited to within the concrete vault (USACE 1998).

4.3 ENVIRONMENTAL REVIEW GUIDE FOR OPERATIONS (ERGO) - 1994

In 1994, an internal compliance assessment was performed for the Portland District USACE by Woodward-Clyde Consultants (Woodward-Clyde 1995), under the Environmental Review Guide for Operations (ERGO) program. The assessment included a site visit and a review of all past and present waste management procedures and identified several areas of concern:

- Solid waste disposal in the unlined landfill on the northern portion of the property
- Collection of wastewater from the laboratory drains into the sump, and subsequent discharge of wastewater to the drainage ditch

- Disposal of viscous chemical waste in the shallow dry well

The associated report made several recommendations to prevent further impact of soil and water at the NPD laboratory site:

- Discontinue any of the above practices still taking place
- Connect the sump to the sanitary sewer system
- Characterize and dispose of all waste and samples still stored on the site
- Properly abandon an unused water well present on the site

All of the recommendations were implemented and no further actions were taken at that time.

4.4 PRELIMINARY SITE CHARACTERIZATION - 1995

In 1995, the USACE implemented a limited soil sampling program to assess the potential impacts of laboratory disposal practices to the drainage ditch and dry well area. One surface soil sample was collected from the drainage ditch and analyzed for the presence of metals, volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). Arsenic and chromium were detected at concentrations that exceeded EPA screening levels.

Two samples were collected from the dry well area, including one in a tar layer at the base of the gravel, and the other from the native soil beneath the tar and gravel. These samples were analyzed for the presence of metals, VOCs, SVOCs, and PCBs. The results indicated that chromium, Aroclor®-1260, TCA, toluene, and bis(2-ethylhexyl)phthalate were detected in the tar sample at concentrations greater than EPA screening levels. Oil-range hydrocarbons and mercury also were detected.

4.5 ENVIRONMENTAL BASELINE SURVEY (EBS) - 1997

In 1997, Tetra Tech, Inc., was contracted by the USACE to conduct an EBS of the NPD laboratory site to determine whether adverse impacts to the environment had occurred as a result of laboratory activities. Soil and groundwater samples were collected and analyzed for VOCs, SVOCs, and RCRA priority pollutant metals at the sump, drainage ditch, drywell area, and landfill (Tetra Tech 1997).

The most significant impacts to the environment identified were elevated metal concentrations, at levels higher than background levels, in the drainage ditch soil and in four groundwater

samples (Table 4-1). The study did not include any remedial action, but identified several areas of concern for further action.

4.6 GROUNDWATER SURVEY - 1998

Six monitoring wells were installed at the site to investigate the metals identified in groundwater in the 1997 EBS (Tetra Tech 1997). Tetra Tech sampled each well in April and May of 1998 (Tetra Tech 1998). Results of the April sampling indicated that total arsenic, lead, and cadmium concentrations exceeded EPA screening levels. The May results indicated that total arsenic and lead concentrations exceeded EPA screening levels only in shallow samples collected from the northern portion of the site. Dissolved metals were not detected above screening levels in groundwater samples collected from either sampling event. Based on these findings, Tetra Tech recommended one additional sampling event be conducted to document groundwater quality following the dry well and drainage ditch soil removal.

4.7 SOIL REMOVAL AND GROUNDWATER SAMPLING - 1999

Tetra Tech, under contract to the USACE, conducted soil removals in the drainage ditch and dry well area (Tetra Tech 1999). Approximately 30 cubic yards of soil were removed from the drainage ditch and disposed of offsite. No obvious signs of contamination were noted by field personnel. The total excavation measured 5 feet east to west, 40 feet north to south and averaged 4 feet deep. Concrete cores were encountered during the excavation. Some were removed from the site and disposed of as investigation-derived waste. Other cores remained in place in the drainage ditch. Groundwater was encountered at 4 feet bgs during the excavation.

Twenty-five cubic yards of soil were removed from the dry well area and disposed of offsite. The dry well excavation was centered on the former dry well and measured 8 feet east to west, 14 feet north to south, and 5.5 feet deep. Soil samples were collected from the sidewalls and bottom of the excavation to confirm that all contaminated soil had been removed. Subsurface structures of a brick wall with an approximately 1.5-inch horizontal pipe were noted and left in place. Staining was evident in the gravel at 2.5 feet bgs, but no other evidence of contamination was apparent. The tar layer that had been encountered in 1995 was not encountered in 1999.

Samples of groundwater that pooled in the excavations and from the groundwater monitoring wells were collected. No contaminants were detected above screening levels in the grab soil samples collected from the dry well area and drainage ditch soils. Metals in standing water collected from the drainage ditch and groundwater from monitoring wells exceeded screening levels.

The USACE entered into DEQ's independent cleanup pathway in August 1999. In December 1999, DEQ reviewed and commented on previous investigations and cleanup actions taken at the site.

Table 4-1
Contaminants Detected During the 1997 EBS

Area Investigated	Analysis		
	VOCs	SVOCs	Leachable Metals
Wastewater Collection Sump (soil)	ND	ND	ND
Sump-area Groundwater[a]	ND	ND	Barium, chromium, and lead
Drainage Ditch (soil)	NA	ND	Arsenic and mercury (total)
Drainage Ditch-area Groundwater[a]	ND	ND	Ten EPA CLP-list metals detected.
Dry Well[b] (soil)	ND	ND	ND
Dry Well-area Groundwater[a]	ND	ND	11 CLP-list metals detected below MCLs
Landfill (soil)	ND	ND	ND
Landfill-area Groundwater[a]	ND	ND	14 CLP-list total metals were detected below MCLs
Groundwater Monitoring wells	NA	NA	Total arsenic, cadmium, and lead

[a]Groundwater samples were analyzed for total and dissolved metals.
[b]Aroclor® 1260 and heavy-oil-range hydrocarbons also were detected in this sample.

Notes:
CLP - Contract Laboratory Program
MCL - maximum contaminant level
NA - not analyzed
ND - not detected

Table 4-2
Contaminants Detected During the 1999 Soil Removal and Groundwater Sampling

Area Investigated	Analysis			
	Diesel-range TPH	**PCBs**	**Total Metals[a]**	**Leachable Metals[b]**
Soil and Standing Water				
Drainage ditch (soil)	NA	NA	None exceeded Oregon industrial screening values concentration	ND
Standing water from the drainage ditch	NA	NA	Total lead and mercury greater than EPA MCLs. Dissolved arsenic less than EPA MCLs.	Not applicable
Dry well (soil)	Less than Oregon UST soil matrix value	ND	NA	NA
Area Investigated	**Alkalinity**	**Anions**	**Total Metals[c]**	**Dissolved Metals[c]**
Groundwater				
Groundwater monitoring wells	Calcium carbonate detected in concentrations ranging from 14.6 to 234 mg/L.	Chloride and sulfate detected at concentrations less than the MCLs.	Iron and cadmium detected at concentrations greater than MCLs	Iron detected at concentrations greater than the EPA MCL in one sample

[a]Total arsenic, aluminum, mercury, and lead
[b]Arsenic, cadmium, mercury, and lead
[c]Arsenic, cadmium, lead, mercury, calcium, manganese, magnesium, potassium, sodium, and iron

Notes:
MCL - maximum contaminant level
NA - not analyzed
ND - not detected

5.0 INVESTIGATION RATIONALE AND APPROACH

5.1 CHEMICALS OF CONCERN

The purpose of this SI is to complete a comprehensive, consistent sample collection and analysis scope that can be used to fill any data gaps that remain after the previous investigations (Section 4). The contaminants of concern, based on the Contract Laboratory Program (CLP)-list compounds and elements, together with the four screening values that will be considered during the evaluation of the soil and groundwater data are listed in Appendix A of the Quality Assurance Project Plan (QAPP).

Except for samples collected from the transformer pad, the fuel oil tank vault, and the Umatilla Army Depot Borrow Site material, all samples will be analyzed for CLP-list VOCs, SVOCs, pesticide and PCBs, metals, strontium, uranium, and cyanide as described in Appendix A to the QAPP. These contaminants of concern are based on results from previous investigations and potential contaminants that could have originated from the former laboratory.

Soil samples collected at the transformer pad will be analyzed for PCBs only because no existing information indicates that past laboratory activities have adversely impacted the environment at this location. Soil samples collected in the fuel oil tank vault will not be analyzed for pesticides/PCBs since no existing information indicates that this class of compounds would be present. VOC, SVOC, diesel-range total petroleum hydrocarbons (TPH) data collected at this location will be used as PCB indicators. The samples collected from the buckets containing Umatilla Army Depot Borrow Site material will be analyzed for SVOCs, pesticide and PCBs, trace metals, explosives, and chemical agent breakdown products. These samples will not be analyzed for VOCs since these soils have been containerized and stored in a warehouse for at least three years.

5.2 DATA QUALITY OBJECTIVES AND OVERVIEW OF FIELD PROGRAM

DQOs are quantitative and qualitative statements specified to ensure that data of appropriate quality are collected during field activities. The DQO process ensures that sufficient data are collected to make required decisions within a reasonable certainty and that only the minimum necessary data are collected. The number and depth of sample collection locations and intervals have been estimated based on professional judgment using existing data (Section 4) and observations from a site visit conducted by USACE, EPA and the Oregon Department of Environmental Quality (ODEQ) on March 14, 2001.

The DQO processes for the data collection locations are presented in Tables 5-1 through 5-9. The primary focus of this investigation is to collect sufficient quantity of data of appropriate quality to reliably confirm that the previous soil removal activities were complete and no contaminated soil remains, and that no adverse impacts to the environment due to practices at the former NPD laboratory remain. The types of data to be collected include the following:

- Chemical contaminants in the soil
- Geologic/hydrogeologic characteristics of the subsurface
- Chemical contaminants in sediment at the base of the concrete sump
- Chemical contaminants in the groundwater

A variety of sampling collection methods will be used that range from Geoprobe® soil borings to temporary groundwater microwells. The following field activities described in this section will support or enable the collection of representative data:

- Site preparation for access to sampling locations, including debrushing and surface grading
- Geoprobe® soil sampling
- Manual soil sampling at locations not accessible by Geoprobe®
- Sampling of sediment from concrete sump
- Landfill trenching, sampling, and maintenance, including drum removal and sampling
- Temporary microwell installation, development, sampling, and abandonment
- Groundwater monitoring well sampling
- Collection of soil samples from Umatilla Army Depot Borrow Site material currently stored at the site
- Surveying of soil and temporary microwell sampling locations

Soil, sediment, concrete, and groundwater samples will be collected and analyzed as described in the Field Sampling Plan (FSP) and summarized in this section. The performance specification for each investigation method is based on the need to confirm that no contamination greater than the screening levels (listed in Appendix A of the QAPP) remains at the locations investigated at

the site. The analyses will meet the method quality objectives defined in the QAPP and required to satisfy the DQOs.

5.2.1 Soil Investigation

Sampling locations in the drainage ditch and the landfill area that are overgrown with blackberry thickets and other shrubs will be cleared of vegetation prior to sampling. Vegetation will be removed with a portable mower or mulcher or by hand when possible. To allow for access of the Geoprobe® rig, some sampling locations may require grading of surface soil, such as in the drainage ditch or landfill. Grading will be performed with a backhoe or other heavy equipment operated by URS personnel from Portland, Oregon. All boring locations are subject to clearance by an underground utility locate service. Sampling locations may need to be adjusted due to locations of underground utilities or overhead power lines. Proposed sampling locations are presented on Figure 3-1.

Soil samples will be collected to characterize soil conditions in the drainage ditch, dry well area, clean-out pipe, transformer pad, fuel oil tank vault, and landfill. A Geoprobe® direct-push sampling technique will be used to collect soil and to install temporary microwells for groundwater sampling (Section 5.2.4). Samples to be collected from locations that the Geoprobe® rig cannot access will be collected manually. Continuous soil samples will be collected for geologic description and to determine when native material is encountered. All geologic descriptions and boring logs shall be completed in accordance with American Society for Testing and Materials (ASTM) D2487 and D2488 (ASTM 2000a, 2000b). All darkly stained soils or odors encountered will be documented on the field forms. Soil investigation activities will be conducted as described in detail in the FSP. All samples will be analyzed by Sound Analytical Services, Inc., Fife, Washington, and Southwest Research Institute, San Antonio, Texas.

Drainage Ditch

Soil samples will be collected from a total of eight locations (SS-1 through SS-8) in the drainage ditch. At the locations listed below, soil samples will be collected in the interval between ground surface and 1 foot bgs, except for the sample collected in the ditch removal area, which will be collected in the native material beneath the excavation. Native material is anticipated to be within 5 feet bgs. The soil sample collected from the native material will be collected from the 1- to 2-foot horizon.

- Along the south property boundary near the utility vault and MW-1 as a background sample

- Immediately downstream (north) of the former drainage ditch soil removal area, upstream (south) of the former hazardous materials storage shed, and corresponding with the concrete sump effluent drain; a temporary microwell also will be installed at this location for groundwater sampling in addition to soil sampling (Section 5.2.4)

- North of Northwest Graham Road, immediately east of the landfill

- North of Northwest Graham Road, inside the landfill fenced area at the furthest upgradient portion of the west end of the drainage ditch, as a second background soil sample; this sample is not expected to be impacted by the landfill

Two soil samples will be collected between ground surface and 1 foot bgs and at 5 feet bgs at the locations listed below:

- Directly below the freeze/thaw drain pipe outfall

- Downstream (north) of the drain plug associated with the former hazardous materials storage building

- Downstream (north) of the former oil storage shed

- At the culvert immediately south of Northwest Graham Road

All soil samples collected from the drainage ditch will be analyzed for EPA CLP target compounds and analytes using EPA SW-846 methods (VOCs; SVOCs; pesticides/PCBs; metals, uranium, and strontium; and cyanide).

Dry Well

Soil samples will be collected from two depths at four locations (SS-9 through SS-12) around the periphery of the soil removal area and at one location (SS-13) in the center of the former excavation. One sampling depth will be the native material, which is anticipated to be no more than 6 feet bgs. The sample collected in the native material will be in the 1- to 2-foot horizon. The second sampling depth will be where evidence of contamination is encountered (based on screening), or immediately above the water table, whichever is shallower.

These samples shall be analyzed for EPA CLP target compounds and analytes using EPA SW-846 methods (VOCs; SVOCs; pesticide and PCBs; metals; uranium, and strontium, and cyanide).

Building Cleanout Pipe

Soil samples will be collected at three locations (SS-14 through SS-16) along the laboratory building cleanout pipe from the southeast building corner to the transformer pad. Each soil sample will be collected directly beneath the pipe and analyzed for EPA CLP target compounds and analytes using EPA SW-846 methods (VOCs; SVOCs; pesticide and PCBs; metals, uranium, and strontium; and cyanide).

Transformer Pad

Soil samples will be collected at four locations (SS-17 through SS-20) in the vicinity of the transformer pad between ground surface and one foot bgs. These samples will be analyzed for PCBs only using an EPA SW-846 method.

Fuel Oil Tank Vault

One soil sample (SS-21) will be collected at the approximate depth representative of the bottom of the toe wall of the former 10,000-gallon UST using Geoprobe® direct-push technology. The sample will be collected in the southern portion of the former excavation, near where the former fill port was located. This sample will be analyzed for EPA CLP target compounds (VOCs and SVOCs) using EPA SW-846 methods, and diesel-range TPH. The bottom of the toe wall is approximately 4 feet below grade. The sample will be collected in the 1- to 2-foot interval beneath the bottom of the toe wall.

5.2.2 Sediment Investigation

One sediment sample (SD-1) will be collected from the base of the concrete sump vault. Standing water in the sump will be removed prior to sampling the sediment. Sediment will be collected using a telescoping sample rod and a Teflon® sampling cup as described in the FSP. The sediment sample will be analyzed for EPA CLP target compounds and analytes using EPA SW-846 methods (VOCs; SVOCs; pesticide and PCBs; metals, uranium, and strontium; and cyanide).

5.2.3 Landfill Investigation

Sampling and maintenance work in the landfill will be conducted as described in detail in the FSP:

- Four surface soil samples (SS-22 through SS-25) will be collected between ground surface and 1 foot bgs along the north edge of the landfill.

- Four trenches (TR-1 through TR-4) will be excavated in the landfill to collect soil samples representative of the landfill material. The exact orientation and placement of the trenches will be determined by the excavation equipment operator and field personnel at the time of excavation work. Each trench will be the width of the excavator bucket, no more than 10 feet in length and excavated to a maximum depth of 6 feet. For each trench, a sample representative of the contents of the landfill will be collected from the center of the excavator bucket. The excavated soil shall be staged over a temporary impermeable barrier, such as heavy plastic sheeting, until the trenching is complete. Once sampling is completed, the soil will be returned to the excavation site. The excavator bucket will be decontaminated between trenches.

- After completion of each trench (and prior to backfilling), Geoprobe® soil samples (SS-26 through SS-29) will be collected from the native material beneath the landfill. Either the sides of each trench will be set back to allow the direct-push rig to safely access the sample collection area, or the Geoprobe® rig will be set up next to the trench.

- There are approximately five drums partially exposed at the northern toe of the landfill. Contents of these drums are expected to be hardened concrete. The drums are anticipated to be 35 gallons in size and have sensors arrayed around the outside. Each drum will be removed and staged in the fenced area near the landfill using the excavation equipment. If more of these types of drums are uncovered during exploratory trenching, they will be removed and staged in the same manner. If drums are found that do not match the above description, work will stop immediately and the USACE will be notified.

- A sample representative of the drum contents will be collected using a chisel and hammer. The results will be used to profile its contents for disposal.

- All soil and drum content (concrete) samples will be analyzed for EPA CLP target compounds and analytes using EPA SW-846 methods (VOCs; SVOCs; pesticide and PCBs; metals, uranium, and strontium; and cyanide).

5.2.4 Groundwater Investigation

Five temporary microwells (MC-1 through MC-5) will be installed at the site using a Geoprobe® direct-push technique:

- Three microwells will be installed on the west side (downgradient) of the former laboratory facility to determine any possible impact on groundwater from former

laboratory practices. The locations will be determined in the field based on actual groundwater flow directions.

- One microwell will be installed in the drainage ditch upstream (south) of the hazardous materials storage shed, concurrent with the Geoprobe® soil sample location in or near the former soil removal area.

- One microwell will be installed in the center of the former dry well excavation.

The total boring depth and screen interval will be consistent with the existing groundwater monitoring wells (Tetra Tech 1999). Temporary wells will be decommissioned within 72 hours of initial construction in accordance with State of Oregon well construction standards (Oregon Administrative Rules [OAR] Chapter 690 Divisions 220 and 240). The microwell locations and elevations will be surveyed prior to decommissioning. Groundwater investigation activities will be conducted as described in detail in the FSP.

To establish the local groundwater conditions and determine any possible impact on groundwater from the former NPD laboratory facility, groundwater samples and water level measurements will be collected from these five temporary microwells and the six existing monitoring wells. These groundwater samples will be analyzed for EPA CLP target compounds and analytes using EPA SW-846 methods (VOCs; SVOCs; pesticide and PCBs; total and dissolved metals, uranium and strontium; and cyanide).

5.2.5 Sampling of Umatilla Army Depot Borrow Site Material

Thirty-three 5-gallon buckets containing soil samples from the Umatilla Army Depot Borrow Site are currently stored at the former NPD laboratory site. Discrete soil samples from four of these containers (94-BH-2B, 94-BH-3A, 94-BH-4A, and 94-BH-4B) will be collected. These four containers were selected because the contents allegedly caused an allergic reaction in an employee. One primary and one duplicate sample will be collected from a composite of the remaining 29 containers. These samples will be analyzed for EPA CLP target compounds and analytes (SVOCs, pesticide and PCBs, and metals) and explosives by Sound Analytical Services, Inc. These soil samples also will be analyzed for agent breakdown products by Southwest Research Institute, San Antonio, Texas. If a breakdown product is detected, then the associated sample(s) also will be analyzed for the source chemical agent.

5.2.6 Surveying

Upon completion of field work, a licensed surveying subcontractor, Olson Engineering, Inc., Vancouver, Washington, will survey all soil data collection locations and five temporary microwell locations created during this investigation. Horizontal and ground surface elevation

coordinates will be provided for all data collection locations and reported in North American Datum of 1983 (NAD83) (horizontal) and National Geodetic Vertical Datum of 1929 (NGVD29) (vertical).

Table 5-1
Drainage Ditch Investigation
Data Quality Objectives Process

Problem Statement:
Existing data are not sufficient to determine that the contaminated soil removal was complete.

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
Soil Sample Collection			
Confirm that all impacts from the contaminated soil in the drainage ditch area have been removed.	Chemical and geotechnical information in the surface and vertical extent of the drainage.	Soil samples will be collected from eight locations between ground surface and 1 foot and/or at 5 feet bgs. Soil samples will be analyzed for VOCs, SVOCs, metals plus uranium and strontium, pesticide and PCBs, and cyanide.	Soil sampling locations were pre-selected during the March 14, 2001, site walk by Mamie Brouwer, Mike Gross, Mark Ader, and Rod Struck, based on infrastructure and historical activities.
Microwell Installation and Groundwater Sample Collection (Section 5.2.4)			
Confirm that groundwater in the drainage ditch area has not been adversely impacted as a result of past laboratory activities.	Groundwater depth and flow direction and chemical composition.	Collect one groundwater sample and analyze for VOCs, SVOCs, metals plus uranium and strontium, pesticides/PCBs, and cyanide.	Microwell location will be placed in one of the downgradient push locations as pre-selected during the March 14, 2001, site walk by Mamie Brouwer, Mike Gross, Mark Ader, and Rod Struck, based on infrastructure and historical activities.

Table 5-2
Dry Well Investigation
Data Quality Objectives Process

Problem Statement:
Existing data are not sufficient to determine that the contaminated soil removal was complete.

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
Soil Sample Collection			
Confirm that all impacts from the contaminated soil in the dry well area have been removed.	Chemical and geotechnical information in the surface and vertical extent of dry well soil removal area.	Four soil sample collection penetrations. Locations will be placed around the periphery of the soil removal area. Samples will be collected in one interval between the ground surface and 1 foot below ground surface (bgs). One sample will be collected in the center of the former excavation in the native material (approximately 6 feet bgs). Five soil samples will be analyzed for VOCs, SVOCs, metals plus uranium and strontium, pesticide and PCBs, and cyanide.	Soil sampling locations were pre-selected during the March 14, 2001, site walk by Mamie Brouwer, Mike Gross, Mark Ader, and Rod Struck, based on infrastructure and historical activities.
Microwell Installation and Groundwater Sample Collection (Section 5.2.4)			
Confirm that groundwater in the vicinity of the former dry well has not been adversely impacted as a result of past laboratory activities.	Groundwater depth and flow direction and chemical composition.	Collect one groundwater sample and analyze for VOCs, SVOCs, metals plus uranium and strontium, pesticides/PCBs, and cyanide.	Microwell location will be placed in the center of the former excavation as pre-selected during the March 14, 2001, site walk by Mamie Brouwer, Mike Gross, Mark Ader, and Rod Struck, based on infrastructure and historical activities.

Table 5-3
Laboratory Building Cleanout Pipe Investigation
Data Quality Objectives Process

Problem Statement:
Insufficient data are available to evaluate any adverse impacts to the environment from past laboratory activities.

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
Soil Sample Collection			
Determine presence of contamination along the building cleanout pipe to determine if the building drain system leaked.	Confirm presence of contamination, if any.	Three soil sample collection locations along the eastern side of the laboratory from the southeast corner to the transformer pad.	These soil sampling locations were pre-selected during the May 17, 2001, site walk by Mike Gross, Mamie Brouwer, Janette Rau, and Andrew Zabel, based on infrastructure and historical activities.

Table 5-4
Transformer Pad Investigation
Site Investigation Data Quality Objectives Process

Problem Statement:
Insufficient data are available to determine if the pole-mounted transformers have adversely impacted the soil around the existing transformer pad.

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
Soil Sample Collection			
Determine presence of PCBs in the surficial soils around the Transformer Pad.	Surficial extent of PCBs, if any	Collect four soil samples around the periphery of the existing transformer pad at intervals between the ground surface and one foot bgs. Analyze four soil samples for PCBs.	Soil sampling locations were selected during the May 17, 2001, site walk by Mamie Brouwer, Mike Gross, Janette Rau and Andrew Zabel, based on infrastructure and historical activities.

Table 5-5
Fuel Oil Tank Vault Investigation
Data Quality Objectives Process

Problem Statement:
Existing data are not sufficient to determine that the contaminated soil removal was complete.

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
Soil Sample Collection			
Determine concentration of any remaining soil contamination after the vault excavation.	Confirm presence of contamination, if any.	One soil sample collection location in the residual native soils located around the excavated vault. The soil sample will be analyzed for VOCs, SVOCs, and diesel-range total petroleum hydrocarbons.	This soil sampling location was pre-selected during the March 14, 2001, site walk by Mamie Brouwer, Mike Gross, Mark Ader, and Rod Struck, based on infrastructure and historical activities.

Table 5-6
Concrete Sump Investigation
Data Quality Objectives Process

Problem Statement:
Insufficient data are available to evaluate any adverse impacts to the environment from past laboratory activities.

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
Soil Sample Collection			
Determine presence of contamination in the residual sump sediments.	Confirm presence of contamination, if any.	One soil sample collection location in the residual sediments located in the sump. Sample will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, uranium, strontium, and cyanide.	This soil sampling location was pre-selected during the March 14, 2001, site walk by Mamie Brouwer, Mike Gross, Mark Ader, and Rod Struck, based on infrastructure and historical activities.

Table 5-7
Landfill Investigation
Data Quality Objectives Process

Problem Statement:
Insufficient data are available to evaluate any adverse impacts to the environment from past laboratory activities.

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
Soil Sample Collection			
Determine concentration of any contamination in the landfill.	Confirm presence of contamination, if any.	Complete four trenches in the landfill and collect one soil sample representative of the fill material and one representative of the native material. Collect four samples around the north toe of the landfill. All samples will be analyzed for VOCs, SVOCs, pesticide and PCBs, metals plus uranium and strontium, and cyanide.	These soil sampling locations were pre-selected during the March 14, 2001, site walk by Mamie Brouwer, Mike Gross, Mark Ader, and Rod Struck, based on infrastructure and historical activities.
Drum Content Sample Collection			
Confirm that drums disposed of in the landfill were filled with concrete and are not contaminated.	Confirm presence of contamination, if any.	One sample representative of drum contents will be collected and analyzed for VOCs, SVOCs, pesticide and PCBs, metals plus uranium and strontium, and cyanide.	All drums will be inspected for sensors and straps. Mike Gross and Mamie Brouwer will be immediately notified if drums without testing equipment are encountered. After the analytical results are validated and reviewed, the drums will be removed from the site.

Table 5-8
Groundwater Investigation
Data Quality Objectives Process

Problem Statement:
Insufficient data are available to evaluate any adverse impacts to the environment from past laboratory activities.

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
Temporary Microwell Groundwater Sample Collection			
Determine concentration of any contamination in the groundwater that can be attributed to laboratory activities.	Confirm presence of contamination, if any.	Install three microwells downgradient of the laboratory building and collect three samples. Analyze all groundwater samples for VOCs, SVOCs, pesticide and PCBs, metals plus uranium and strontium, and cyanide.	Potential microwell locations were pre-selected during the March 14, 2001, site walk by Mamie Brouwer, Mike Gross, Mark Ader, and Rod Struck, based on infrastructure and historical activities.
Monitoring Well Groundwater Sample Collection			
Determine concentration of any contamination in the groundwater that can be attributed to laboratory activities.	Confirm presence of contamination, if any.	Collect groundwater samples from six existing groundwater monitoring wells (i.e., MW-1, -2, -3, -4, -5, and -6). Analyze all groundwater samples for VOCs, SVOCs, pesticide and PCBs, total and dissolved metals plus uranium and strontium, and cyanide.	Groundwater sampling locations were pre-selected during the March 14, 2001, site walk by Mamie Brouwer, Mike Gross, Mark Ader, and Rod Struck, based on infrastructure and historical activities.

Note: Additional temporary microwells will be installed and sampled as presented in Tables 5-1 and 5-2, and discussed in Section 2.5.4.

Table 5-9
Umatilla Borrow Site Materials Investigation
Data Quality Objectives Process

Problem Statement:
Insufficient data are available to fully characterize any chemical contaminants in the borrow site soils.

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
Soil Sample Collection			
Determine concentration of any contamination in the Umatilla borrow site materials	Confirm presence of contamination, if any.	Collect one soil sample from each of four buckets (94-BH-2B, 94-BH-3A, 94-BH-4A, and 94-BH-4B) and one composite and one duplicate sample from the remaining buckets from soils in the 33 five-gallon buckets. These samples will be analyzed for SVOCs, pesticide and PCBs, total and dissolved metals, uranium and strontium, and explosives. These samples also will be analyzed for chemical agent breakdown products from mustard, VX, and GB using Army-approved methods.	The buckets containing the borrow site material were inspected in the laboratory warehouse and moved to the former oil storage building. After the analytical results are validated and reviewed, the buckets and soil will be containerized and removed from the site.

6.0 DATA REVIEW, PRESENTATION, AND INTERPRETATION

6.1 QUALITY ASSURANCE REVIEW

The field method review process for this project will include Field Investigation Manager supervision and review of the procedures being implemented in the field for consistency with the established protocols. Field forms will be reviewed on a daily basis by the USACE Project Manager.

The chemical data review process for this project will include data generation, reduction, and two levels of QA review. The first level of review will be conducted by the analytical laboratory data reviewer. After receipt of data packages, the Project QAM, or a designee, will conduct an independent data quality review and generate a quality control summary report that will evaluate attainment of data quality objectives and method quality objectives of the overall project.

6.1.1 Field Measurement Quality Assurance

The Field Investigation Manager is responsible for field quality assurance. She will review the procedures being implemented in the field for consistency with the established protocols. The Field Investigation Manager is responsible for supervising and checking that samples are collected and handled in accordance with this Management Plan and that documentation of work is adequate and complete. Sample collection, preservation, labeling, etc., will be checked for completeness. Where procedures are not strictly in compliance with established protocol, the deviations will be field documented and reported to the Project QAM. Corrective actions will be defined and implemented by the Field Investigation Manager and documented as appropriate.

6.1.2 Fixed Laboratory Quality Assurance

One hundred percent of the fixed laboratories' data will be reviewed against laboratory performance criteria and sample-specific criteria. The quality review on the data will include evaluation of precision, accuracy, representativeness, comparability, and completeness, sampling documentation, holding times, instrument calibration, and tuning.

6.2 DATA PRESENTATION

Site investigation results will be presented in text, tables, and graphics. Text will be in Microsoft Word 97 format. Tabular data will be presented in Microsoft Excel 97 or Microsoft Word 97 formats. Microsoft Access data will be exported to Excel for preparation of reports and other documents. Schematic graphical data will be presented using Macromedia Freehand 5.0, CorelDraw 8.0, or similar software. Computer-aided drafting of site plans and other

scale-intensive graphics will be performed using Intergraph Microstation. Where appropriate, geographic presentation of analytical data will be presented using GMS software.

6.3 DATA INTERPRETATION

The objectives of this SI are to confirm that no contaminated soil remains at locations where soil removal activities were conducted previously, and to verify that previous laboratory activities have not adversely impacted soil and groundwater quality beneath the site. The primary focus of the field activities are to support these objectives and to collect sufficient data to confirm a finding of no significant impact. Data to be collected include the following.

- Site geology and stratigraphy, and groundwater elevation data from temporary microwells and existing monitoring wells

- Analytical results of soil, sediment, and groundwater samples collected from Geoprobe® borings, surface soil sample locations, temporary microwells, and existing monitoring wells

Soil and groundwater results will be compared to screening values presented in Appendix A of the QAPP.

7.0 DATA MANAGEMENT AND REPORTING

This section of the Work Plan describes the flow and management of data that has been collected. The method of reporting project results is also described.

Two primary categories of data will be generated for this project: field data and fixed laboratory data. The procedures to be used for each type of data are described below.

7.1 FIELD DATA

Field measurements/observations will be recorded by field team members in logbooks, on the appropriate field forms, and in photographs. All field data will be transferred to the Field Investigation Manager. A temporary file will be established and maintained to ensure proper hard copy storage during field operations. These files will be added to and used by the field team as data are generated. Daily chemical quality control reports (DCQCRs) will be generated and faxed to the Technical Lead at the USACE Seattle District office. The DCQCR will include all field data generated on a daily basis, including chain of custody forms and field sampling forms. Incoming project-related material, including correspondence, authorizations, chain of custody forms, or other information, will be marked with the date received and the project name.

Upon completion of the field program, the temporary file will be incorporated into the URS permanent project file. The Project Manager will oversee the input of project records. Copies of all field documents may be made and retained by the originator for use in report preparation and later reference. The originals will be filed in the office project file.

On-site field measurements will be input into an electronic database. The data will then be printed out and compared to the original field records to ensure input accuracy. All review documentation will be initialed and dated by the reviewer, then filed with the quality review documentation.

7.2 FIXED LABORATORY DATA

Fixed laboratory data will be transferred from the project laboratories to the Project Manager or Project Chemist in hard copy and electronic formats. Data will be loaded into the electronic database. Hard copies of the laboratory deliverables will be used to verify the accuracy of electronic data. The original hard copies of laboratory deliverables will then be stored in the permanent project file.

The laboratories will maintain and follow their own detailed procedures for laboratory recordkeeping in order to support the validity of all analytical work. Each data package submitted to the Project Manager will contain the laboratory's written certification that the requested analytical method was run and that all QA/QC checks were within established control limits on all samples, with exceptions noted.

7.3 REPORTING

Field activities will be documented in draft and final versions of a report. The report will include a discussion of field activities and observations, including stratigraphy and hydrogeology; results of sampling and analysis; and the nature, extent, and character of site contamination, if encountered. Field notes, calculations, field forms, analytical results and resultant interpretations will be included as appropriate. This report also will include an analysis of the results in relation to the purpose and objectives of the SI. Formal, written responses to the USACE project team review comments will be prepared and incorporated into the final reports as necessary.

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FINAL

SAMPLING AND ANALYSIS PLAN

SITE INVESTIGATION
Former North Pacific Division Laboratory Troutdale, Oregon

Prepared for

U.S. Army Corps of Engineers
Seattle District
4735 East Marginal Way South
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Part I

FIELD SAMPLING PLAN

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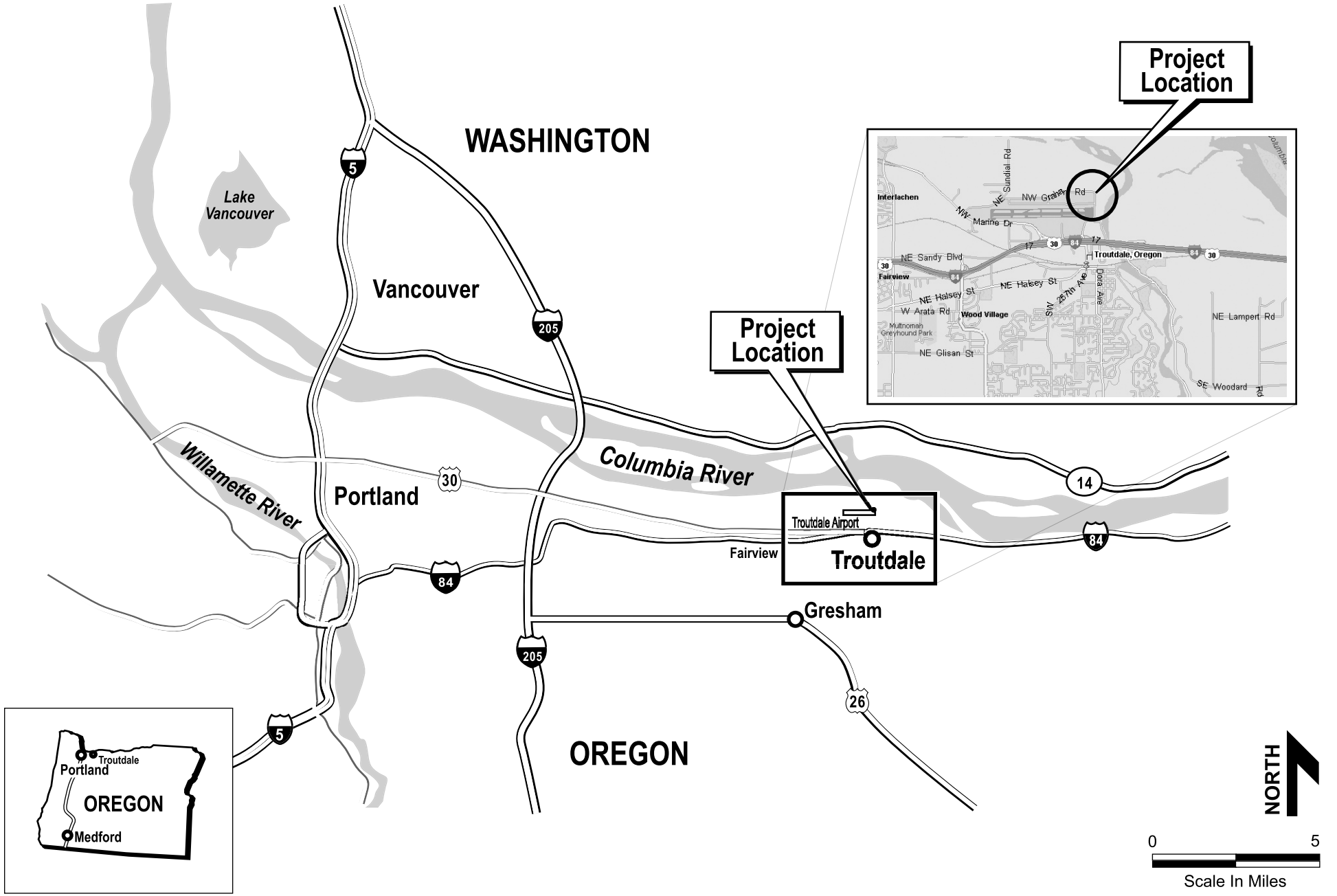
ABBREVIATIONS AND ACRONYMS

ASTM	American Society for Testing and Materials
bgs	below ground surface
CLP	Contract Laboratory Program
DCQCR	daily chemical quality control report
DO	dissolved oxygen
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FSP	field sampling plan
HSP	health and safety plan
IDW	investigation-derived waste
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt
NAD	North American Datum
NGVD	National Geodetic Vertical Datum
NPD	North Pacific Division
NTU	nephelometric turbidity unit
OAR	Oregon Administrative Rules
ORP	oxidation-reduction potential
PCB	polychlorinated biphenyl
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAM	quality assurance manager
QAPP	quality assurance project plan
RPD	relative percent difference
SAP	sampling and analysis plan
SDG	sample delivery group
SOP	standard operating procedure
SVOC	semivolatile organic compound
TPH-Dx	total petroleum hydrocarbon—diesel extended
URS	URS Corporation and subsidiaries
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

1.0 INTRODUCTION

The Sampling and Analysis Plan (SAP) is an integral part of the Management Plan for a site investigation at the former North Pacific Division (NPD) laboratory, located in Troutdale, Oregon (Figure 1-1). The purpose of the SAP is to ensure production of high quality data that meet project objectives and requirements and accurately characterize measurement parameters. It provides the protocol for collecting samples, measuring and controlling data, and documenting field and laboratory data so that the data are technically and legally defensible.

The SAP has two major components: Part I - this Field Sampling Plan (FSP) and Part II - the Quality Assurance Project Plan (QAPP). The FSP presents the detailed scope of work associated with field activities (e.g., sample types and sampling locations) and specifies the procedures to be used for sampling and other field operations. The QAPP describes the analytical data quality objectives (DQOs), laboratory analytical procedures, quality assurance/quality control (QA/QC) procedures, and data quality evaluation criteria.



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MANAGEMENT PLAN FOR
SITE INVESTIGATION
Former NPD Laboratory
Troutdale, Oregon

Figure 1-1
Site Location

2.0 FIELD ACTIVITIES

Field activities will be conducted to characterize subsurface conditions at the former NPD laboratory site. Each activity described in this section will support or enable the collection of representative data. Field personnel will be required to act in accordance with the site-specific Health and Safety Plan (HSP) for this site investigation. The following activities will be conducted, and are summarized on Table 2-1. The analytical program is summarized on Table 2-2.

- Site preparation for access to sampling locations, including debrushing and surface grading
- Geoprobe® soil sampling
- Manual soil sampling at locations not accessible by Geoprobe®
- Sampling of sediment from base of concrete sump
- Landfill trenching and sampling, and drum removal and sampling
- Temporary microwell installation, development, sampling, and abandonment
- Groundwater monitoring well sampling
- Collection of soil samples from Umatilla Army Depot Borrow Site material currently stored at the site
- Surveying of soil and temporary microwell sampling locations
- Dispose of investigation-derived waste (IDW)

2.1 SITE PREPARATION

In order to access specific sampling locations, it may be necessary to clear vegetation and grade the ground surface at these areas. The sampling locations in the drainage ditch and the landfill that are overgrown with blackberry thickets and other shrubs will be cleared of vegetation prior to sampling. Vegetation will be removed with a portable mower or mulcher or by hand when possible. Vegetation will be disposed of on site as mulch at the location of origin. To allow for access of the Geoprobe® rig, some sampling locations may require grading of surface soil, such

as in the drainage ditch and landfill trenches. Grading will be performed with a backhoe or other heavy equipment operated by URS personnel from Portland, Oregon. Site grading will be performed as needed at the discretion of the Geoprobe® operator and the on-site field personnel. At the end of the investigation, the site will be returned to its original condition.

2.2 SOIL INVESTIGATION

A Geoprobe® direct-push sampling rig will be used to collect soil samples as described in this section, or to install temporary microwells for groundwater sampling (Section 2.5). Surface soil samples to be collected from locations that the Geoprobe® rig cannot access will be collected manually. Geoprobe® and soil sampling procedures are described in Sections 2.2.2 and 2.2.3.

2.2.1 Sampling Locations

This section describes locations and depths of soil samples that will be collected to characterize subsurface conditions in each area. All boring locations are subject to clearance by an underground utility locate service. Sampling locations may need to be adjusted due to locations of underground utilities or overhead power lines. Table 2-3 summarizes the number of samples per location and depth to be collected during the soil investigation. Proposed sampling locations are presented on Figure 2-1.

Drainage Ditch

Soil samples will be collected from eight locations in the drainage ditch. Each sample will be collected using the Geoprobe® direct-push method described in Section 2.2.2. Samples will be collected from the following locations.

- **SS-1:** A soil sample will be collected along the south property boundary near the utility vault and MW-1, from the interval of ground surface to 1 foot below ground surface (bgs) as a background sample. Low overhead power lines require that this sample location be west of the utility vault.

- **SS-2:** A second background soil sample will be collected inside the landfill fenced area at the west end of the drainage ditch. This sample will be collected from the interval of ground surface to 1 foot bgs.

- **SS-3:** Soil samples will be collected from a location in the drainage ditch downstream (north) of the former hazardous materials storage building. These samples will be collected approximately 2 feet north (downstream) of the drain plug from this building. This sampling location also satisfies the requirement of

sampling downstream of the ditch removal area. Samples will be collected from depths of 0 to 1 foot bgs and 5 feet bgs.

- **SS-4:** Soil samples will be collected from a location in the drainage ditch removal area just south of the former hazardous materials storage shed. This location corresponds with the concrete sump effluent drain. Samples will be collected from a depth of approximately 6 to 7 feet bgs (i.e., native material). A temporary microwell (MC-1) also will be installed at this location for groundwater sampling in addition to soil sampling. Microwell installation and groundwater sampling is described in Section 2.5.

- **SS-5:** One soil sample will be collected north of Northwest Graham Road, immediately east of the landfill, from a depth of 0 to 1 foot bgs.

- **SS-6:** Soil samples will be collected from a location in the drainage ditch directly below the freeze/thaw drain pipe outfall, upstream (south) of the former ditch removal area. Samples will be collected from depths of 0 to 1 foot bgs and 5 feet bgs.

- **SS-7:** Soil samples will be collected from a location in the drainage ditch immediately north of the former oil storage building, downstream of the culvert. The samples will be collected from depths of 0 to 1 foot bgs and 5 feet bgs.

- **SS-8:** Soil samples will be collected in the drainage ditch at the culvert immediately south of Northwest Graham Road. These samples will be collected from depths of 0 to 1 foot bgs and 5 feet bgs.

Dry Well

Soil samples will be collected from four locations around the perimeter of the former dry well excavation (SS-9 through SS-12) and at one location in the center of the former excavation (SS-13). The locations will be based on the dimensions of the former excavation. Samples will be collected from two depths: (1) native material (approximately 6 feet bgs), and (2) where evidence of contamination is observed or above the water table, whichever is shallower. The sampling locations may need to be adjusted due to the overhead power lines.

A microwell (MC-2) will be installed in the center of the former excavation for groundwater sampling (Section 2.5).

Building Cleanout Pipe

Soil samples will be collected from three locations (SS-14 through SS-16) along the length of the concrete cleanout pipe associated with the laboratory portion of the main building. The samples will be collected at a depth below the pipe. The depth of the pipe will be estimated visually by observing the beginning depth at the header and the ending depth at the concrete sump.

Transformer Pad

Soil samples will be collected from four locations (SS-17 through SS-20) from a depth of 0 to 1 foot bgs in the vicinity of the transformer pad. Because of access restrictions to the transformer pad (i.e., the fence), these samples will be collected manually instead of using the Geoprobe® rig. Three samples will be collected outside of the fence at the south end of the enclosure. The fourth sample in this area will be collected from within the enclosure, north of the pad. It is not necessary to collect samples beneath the asphalt in this area.

Fuel Oil Tank Vault

One soil sample (SS-21) will be collected from a depth that is representative of the base of the toe wall associated with the former 10,000-gallon underground storage tank. The sample will be collected at a depth of approximately 5 to 6 feet bgs. The sample will be collected in the southern portion of the footprint of the former excavation near where the former fill port was located.

Landfill

Soil samples will be collected from four locations (SS-22 through SS-25) along the north edge of the landfill from a depth of 0 to 1 foot bgs. It is likely that the Geoprobe® rig will be unable to access this area, so samples will be collected manually.

As discussed in Section 2.4, four exploratory trenches (TR-1 through TR-4) will be completed in the landfill and samples will be collected from each trench. After completion of each trench, Geoprobe® soil samples will be collected from the native material in each trench (SS-26 through SS-29). The depth of the native material is unknown.

2.2.2 Geoprobe® Methodology and Procedures

All borings will be advanced using a truck-mounted, direct-push, Geoprobe® rig. A Geoprobe® is a hydraulically-powered, percussion probing machine. Probing tools are pushed into the ground using the weight of the rig combined with percussion to advance the tool string. The on-site geologist will direct the drill crew to set up on each boring location only after each has been cleared by a utility locator and surveyed for overhead conflicts. The Geoprobe® rig will then be

positioned over the sampling location and the tower will be erected. The driller will level the rig and ensure the vertical orientation of the sampler.

The push probes are constructed of 36-inch by 2-inch steel, and equipped with a hardened steel, drop-off, expendable tip. The probes will be lined with polyethylene tubing to contain the soil in a disposable, laboratory-approved receptacle and to prevent cross-contamination. When the desired depth is achieved, the probe string is removed to the surface to retrieve the sample. All work shall be conducted so as to eliminate the potential for contamination entering the boring. No petroleum-based lubricants shall be used on the probes.

If refusal is met during drilling, and after concluding each boring, the boring will be abandoned in accordance with the Oregon State Department of Water Resources monitoring well standards (Oregon Administrative Rules [OAR] Chapter 690 Division 220). Depending upon site conditions, the grouting material may consist of hydrated bentonite pellets or a grout mixture of Portland cement and bentonite powder. The grouting material will be manually placed into the hole as the push probe rods are removed. A tape measure will be used during addition of grout or pellets to ensure that bridging is not occurring. Following push probe retraction, additional pellets or grout will be added to bring the grout level to ground surface.

If refusal is met during drilling, a new boring will be started a minimum of 3 feet from the original boring to minimize the impact of the grout material. All adjustments and rationales will be noted in the field logbook or boring logs. If refusal is encountered after several additional attempts, then the U.S. Army Corps of Engineers (USACE) and URS project managers will confer about the boring locations and reevaluate the situation.

Down-hole and sampling equipment (e.g., push probe rods, soil samplers) in direct contact with the sampled materials, soil cuttings, and fluids will be decontaminated between borings and other sampling locations. Decontamination procedures are discussed in Section 2.8.

All waste generated from drilling activities will be transferred to approved 55-gallon drums for disposal IDW. IDW handling procedures are discussed in the IDW Plan.

Records of Geoprobe® and manual soil sampling operations and related activities will be documented by the overseeing geologist and by the drilling contractor. These records will consist of the soil boring log (Appendix A) and information recorded in the project field notebook. The soil boring log will include descriptions of soil encountered, percent recovery of each sample, total depth of the boring, diameter of the hole, formation contacts, occurrence of first water, sampling depths, water level measurements, amount of sealing material used for abandonment, and any other information deemed appropriate by field personnel. Copies of these records will be maintained at the site while the investigation is in progress, and subsequently will remain in the permanent project file.

A field drilling report will be prepared and maintained by the drilling contractor on a daily basis. The report will specify the number of hours worked, materials used, unusual problems, and other special comments and observations.

2.2.3 Sample Collection and Analysis

Soil samples will be collected continuously to the final depth in each Geoprobe® soil boring. Soil will be logged by or under supervision of an Oregon licensed geologist according to American Society for Testing and Materials D2488 (ASTM 2000). Information will be recorded on a boring log (Appendix A). In addition to standard geologic classification, any staining, odors, or unusual features will be noted on the form.

After logging has been completed, soil samples for chemical analysis will be collected. To minimize volatilization, soil for analysis of volatile organic compounds (VOCs) will be collected and preserved in the field using U.S. Environmental Protection Agency (EPA) SW-846 Method 5035. The procedures for collecting and preserving samples for low-level and high-level VOC analysis using this method are presented below.

- Using a disposable plastic syringe with the tip cut off and the rubber cap removed from the plunger, collect approximately 5 grams (approximately 3 cubic centimeters) of soil. When sampling material that contains gravel or is too hard for the syringe to penetrate, a clean chisel and spatula will be used to break up the material and quickly transfer it to jars containing preservative, as described below. Ensure that the spatula does not contact the liquid contents.

- The material collected for low-level analysis must be tested for the presence of carbonates prior to adding the sample to the acidic preservative. Place a drop of hydrochloric acid on a separate aliquot of the material. If it effervesces, then the low-level preservation is inappropriate and only the high-level sample can be collected.

- Each laboratory-supplied jar used for this method has been pre-weighed and pre-labeled by the analytical laboratory. Do not add additional labels to the pre-weighed containers; use only permanent ink to mark the container and lid directly. Place a 5-gram aliquots of soil into each of two jars containing aqueous sodium bisulfate for low-level analysis. Hold the jar at an angle to minimize splashing. Place a 25-gram aliquot of soil into one empty jar for high-level analysis. Add the contents of one container of methanol (25 mL) to this jar of soil.

- After the soil and preservative have been combined, wipe the lid and jar threads, if necessary, to ensure that the lid fits securely on the jar. Any material on the threads may allow preservative to leak out, thus compromising the sample integrity. Note on the sample custody form if any preservative spillage occurred. Gently tap the sampling container to while holding it in an upright position to ensure that the preservative completely contacts the soil surfaces and disaggregate any large clumps.

- Fill one 2-ounce jar without preservative with the soil to provide additional sample material for percent moisture determination if no other testing by the laboratory is required.

- Shipment of samples containing methanol collected according to the instructions above is in accordance with 49 CFR 173.150 under the limited quantity exception. If the total volume in each container is less than 1 liter, and the shipment is packaged in strong outer packaging, then shippers are not subject to hazardous materials regulations or training.

After VOC samples have been collected, soil will be transferred to a decontaminated, large, stainless steel bowl. Large grains of gravel and pieces of debris will be removed from the soil. Any unusual pieces removed will be noted in the logbook or boring log form. The sample material will then be thoroughly homogenized by stirring with a decontaminated stainless steel spoon. Soil will be placed into laboratory-supplied glass jars; containers will be completely filled. The type and number of sample containers required for each analytical method are discussed in Section 3.

Except for samples collected from the transformer pad and the fuel oil tank vault, all Geoprobe® soil samples will be analyzed for EPA Contract Laboratory Program (CLP) target compounds and analytes: VOCs, semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), metals, strontium and uranium, and cyanide using EPA SW-846 methods (Table 2-2). Soil samples collected at the transformer pad will be analyzed for PCBs only. Soil samples collected in the fuel oil tank vault will be analyzed for VOCs, SVOCs, and total petroleum hydrocarbons—diesel extended (TPH-Dx). The soil samples will be analyzed by Sound Analytical Services, Inc., according to the methods presented in Table 2-4.

2.3 SEDIMENT SAMPLING AND ANALYSIS

One sediment sample will be collected from a location (SD-1) at the base of the concrete sump vault (Figure 2-1). This vault is approximately 8 feet deep by 10 feet long by 8 feet wide. Initial observations indicate that approximately 4 feet of standing water will require removal prior to

sampling. This water will be removed using a sump pump. All water will be pumped into 55-gallon drums and properly labeled; it will be handled according to the IDW Plan.

Sediment will be collected using a decontaminated, telescoping sampling rod and a Teflon® sampling cup. The sampling cup will be lowered into the vault and moved along the bottom on its side to collect sediment. The sampling cup will be raised and emptied into a decontaminated, stainless steel bowl. This method will be repeated until the desired quantity of sediment has been obtained. The sediment will be preserved or composited as described in Section 2.2.3.

Sediment samples will be analyzed for EPA CLP target compounds and analytes: VOCs, SVOCs, pesticides/PCBs, metals, strontium and uranium, and cyanide using EPA SW-846 methods (Table 2-2). The sediment samples will be analyzed by Sound Analytical Services, Inc., according to the methods presented in Table 2-4.

Sampling equipment in direct contact with the sampled materials will be decontaminated prior to use. Decontamination procedures are discussed in Section 2.8.

2.4 LANDFILL SAMPLING AND DRUM REMOVAL

In addition to the Geoprobe® and manual soil sampling discussed in Section 2.2.1, landfill soil samples will be collected from four exploratory trenches (TR-1 through TR-4) (Figure 2-1). Additional landfill work involves moving drums of hardened concrete visible at the toe of the landfill, or any that are uncovered during trenching. Excavation of exploratory trenches and drum removal will be completed using an excavator operated by URS personnel from Portland, Oregon.

If necessary, the equipment operator will grade sample locations in the landfill and throughout the site for Geoprobe® rig access. Grading work will be completed as necessary in the field at the time of sampling, at the discretion of the Geoprobe® rig operator and field personnel. This grading will allow for safer, controlled rig access to several sampling areas that may be prohibitively steep.

2.4.1 Trenching

Four trenches will be excavated in the landfill to collect soil samples representative of the landfill material. Trenching will be supervised by the on-site geologist to determine depth to native material (if encountered) and to log the trenches. Observations and profiles of the trenches will be recorded in the field logbook. Each trench will be photographed. The exact orientation and placement of the trenches will be determined by the excavation equipment operator and field personnel at the time of excavation work. Trenching may be difficult due to

the presence of "concrete pours" in the landfill. These solid areas of concrete may impose restrictions on the trench size and location.

The size of each trench will be approximately the width of an excavator bucket (3 feet), a maximum of 10 feet in length, and 6 feet in depth. A sample representative of the contents of the landfill will be collected using a slide hammer. If conditions prevent collection of a representative sample using a slide hammer then samples will be collected from the center of the excavator bucket. The sampling procedures described in Section 2.2.3 will be used to sample soil from the excavator bucket.

Following completion of each trench, the excavation equipment operator will grade the sides of the trench to allow the Geoprobe® rig access to the base of the trench. Alternatively, the Geoprobe® rig could set up adjacent to the trench to collect a sample. One sample will be collected from each trench in the native material using the Geoprobe® rig. The depth to the native material is unknown.

Trench soil samples will be analyzed for EPA CLP target compounds and analytes: VOCs, SVOCs, pesticides/PCBs, metals, strontium and uranium, and cyanide (Table 2-2) using EPA SW-846 methods. The soil samples will be analyzed by Sound Analytical Services, Inc., according to the methods presented in Table 2-4.

The excavator bucket and sampling equipment in direct contact with the sampled materials will be decontaminated prior to use. Decontamination procedures are discussed in Section 2.8.

2.4.2 Drum Removal

There are approximately five drums partially exposed at the northern toe of the landfill. Contents of these drums are expected to be hardened concrete. These drums are all expected to contain the same material. The drums are anticipated to be 35 gallons in size and have sensors arrayed around the outside. If drums are found that do not match this description, work will stop immediately and the USACE will be notified. Each drum will be removed and staged in the fenced area near the landfill. The excavation equipment will be used to excavate and move the drums to the staging area. It is anticipated that up to five more drums may be uncovered during exploratory trenching. If so, these drums will be removed and staged in the same manner.

A sample will be collected from a representative drum to identify its contents for disposal. Sampling of the drum contents will be accomplished using a decontaminated chisel and hammer. Care will be taken to minimize impact to the concrete sample in order to limit volatilization of potential contaminants. The chip sample will be transferred to laboratory-provided glassware. The concrete sample will be sent to the laboratory as collected in chips, and the laboratory will

analyze the sample in chip form. To prevent volatilization of any VOCs that may be present in the chip sample, the laboratory will be requested to not pulverize, grind, or sift the sample.

Each drum, once removed, will be inspected and labeled, and the drum contents and condition will be noted in the field logbook. The drums will be disposed of as described in the IDW Plan by an independent waste removal contractor.

Concrete samples collected from the landfill drums will be analyzed for EPA CLP target compounds and analytes (Table 2-2) (VOCs, SVOCs, pesticides/PCBs, metals, strontium and uranium, and cyanide) using EPA SW-846 methods by Sound Analytical Services, Inc., according to the methods presented in Table 2-5. The type and number of sample containers required are discussed in Section 3.

2.5 GROUNDWATER INVESTIGATION

To establish the local groundwater conditions and determine any possible impact on groundwater from the former NPD laboratory facility, groundwater samples and water level measurements will be collected from five temporary microwells and six existing monitoring wells.

2.5.1 Sampling Locations

Five temporary microwells will be installed at the site. Three microwells (MC-3 through MC-5) will be installed on the west (downgradient) side of the former laboratory facility to assess the impact to groundwater of potentially leaky laboratory plumbing. One microwell (MC-1) will be installed in the drainage ditch to the south of the hazardous materials storage shed, concurrent with a Geoprobe® soil sampling location. The fifth microwell (MC-2) will be installed in the center of the former dry well excavation. Six monitoring wells currently exist at the site. Proposed microwell and existing monitoring well locations are presented in Figure 2-1.

Each microwell will be installed to an approximate depth of 20 feet bgs. The boring depths and screen intervals will be consistent with the existing groundwater monitoring wells (Table 2-6). Prior to selection of the locations for the three temporary microwells west of the main building, water levels in the six existing monitoring wells will be measured. The water levels will be used to determine the local groundwater flow direction. These three microwell locations will be based on the direction of groundwater flow from the laboratory portion of the main building.

2.5.2 Temporary Microwell Installation, Development, and Abandonment

Installation

For installation of a temporary microwell, a Geoprobe® boring will be advanced as described in Section 2.2.2. When the desired depth is reached, the prepacked polyvinyl chloride (PVC) well screen and riser will be inserted down the center of the push rods. Sections of PVC riser will be attached until the well screen is at the desired depth. Installation will be monitored by field personnel. All details of the microwell installation will be noted in the field logbook.

The screen will be constructed of ¾-inch inside diameter, schedule 40 PVC with 0.010-inch slots (10 slot). The sand pack in the prepacked screens will consist of 10-20 silica sand. The screen length will be 10 to 15 feet, and will be decided in the field based upon water level.

Development

The temporary microwells will be allowed to stabilize for 24 hours after installation and prior to development. Due to the small diameter of the microwells, development will consist of low-flow pumping until water quality parameters stabilize.

During development, groundwater quality parameters (pH, temperature, specific conductance, oxidation-reduction potential [ORP], dissolved oxygen [DO], and turbidity) will be monitored. Measurements will be collected at intervals of approximately 10 to 20 minutes. When readings stabilize, purging will cease. The stabilization guidelines are three successive readings within +/− 0.1 for pH; +/− 3 percent for conductance; +/− 10 percent for temperature, turbidity, and DO; and +/− 10 millivolts (mV) for ORP. A turbidity reading of 10 nephelometric turbidity units (NTUs) or less is desirable. The information will be documented on a monitoring well development data sheet (Appendix A). If the indicator parameters do not stabilize, purging will cease at the discretion of the USACE. The development water will be pumped into 55-gallon drums and handled according to the IDW Plan.

Abandonment

The temporary microwells are to be decommissioned within 72 hours in compliance with Oregon State Department of Water Resources monitoring well standards (OAR Chapter 690 Divisions 200 through 240). Abandonment will be monitored by field personnel. All details of the microwell abandonment will be noted in the field logbook.

The prepacked well screen and riser will be removed in sections and the excess piping containerized. This material will be disposed of as non-hazardous waste according to the IDW Plan. The microwell location will be grouted to ensure that vertical cross-contamination does

not occur. Depending upon site conditions, the grouting material may consist of hydrated bentonite pellets or a grout mixture of silica flour, Portland cement, and/or bentonite powder. The grouting material will be manually placed into the hole as the microwell and push probe rods are removed. Following push probe retraction, additional grout will be added to bring the grout level to ground surface.

2.5.3 Monitoring Well and Temporary Microwell Groundwater Sampling

Prior to beginning the sampling effort, static water levels will be measured in all monitoring wells and microwells within a period of 4 hours. Water levels will be measured in each well again before low-flow purging. Measurements will be collected after the microwell or monitoring well cap has been removed and the well has stabilized for a minimum of 5 minutes. Water levels and total depths of monitoring wells and microwells will be measured using an electronic water-level indicator with a precision of 0.01 foot. Water levels will be recorded in the logbook and on each groundwater sampling data sheet (Appendix A).

Microwells will be allowed to stabilize for 24 hours after development before groundwater sampling is conducted. A low-flow, minimal drawdown technique using a ¾-inch QED Environmental Systems, Inc. bladder pump will be used for groundwater purging and sampling according to the USACE standard operating procedure in Appendix B, *Low-Flow Ground Water Purging and Sampling Using Dedicated Bladder Pump System.* The bladder pump will be fitted with disposable, Teflon®-lined tubing. The bladder pump intake will be positioned at a level that is adjacent to or slightly above the midpoint of the screened interval. Purging shall proceed at a rate of approximately 0.1 to 0.5 liter per minute. During purging, the water level in the monitoring wells will be monitored at least every 2 to 5 minutes to ensure the water level is not dropping. Because of the small diameter, the water levels in the temporary microwells cannot be measured during purging.

Conductance, temperature, pH, DO, turbidity, and ORP will be measured during purging using a water quality meter with a flow-through cell. Measurements will be collected at intervals of approximately 2 to 5 minutes. When readings stabilize, purging will cease and samples will be collected. The stabilization guidelines are three successive readings within +/− 0.1 for pH; +/− 3 percent for conductance; +/− 10 percent for temperature, turbidity, and DO; and +/− 10 mV for ORP. A turbidity reading of 10 NTUs or less is desirable. The information will be documented on a groundwater sampling data sheet (Appendix A). If the indicator parameters do not stabilize, purging will cease after 60 minutes have elapsed and samples will be collected.

Groundwater samples from the bladder pumps will be collected into laboratory-supplied sample containers directly from the end of the pump discharge tubing. Dissolved metals samples will be filtered by attaching a 0.45-µm filter to the end of the tubing.

A minimal amount of purge water will be generated during low-flow purging and sampling. The purge water that is generated will be contained temporarily, then handled according to the IDW Plan.

Standard USACE Seattle District padlocks (provided by the USACE) will be placed on each monitoring well after sampling is complete. The existing padlocks will be discarded.

2.5.4 Groundwater Analytical Program

The groundwater samples will be analyzed for EPA CLP target compounds and analytes (Table 2-2) (VOCs, SVOCs, pesticides/PCBs, total and dissolved metals, strontium and uranium, and cyanide) using EPA SW-846 methods by Sound Analytical Services, Inc., according to the methods presented in Table 2-7.

2.6 SAMPLING OF UMATILLA ARMY DEPOT BORROW SITE MATERIAL

Thirty-three 5-gallon buckets containing soil samples from the Umatilla Army Depot Borrow Site are currently stored at the former NPD laboratory site. Discrete soil samples from four of these containers (94-BH-2B, 94-BH-3A, 94-BH-4A, and 94-BH-4B) will be collected, and one primary and one duplicate sample will be collected from a composite of the remaining 29 containers. Samples will be composited as described in Section 2.2.3.

These samples will be analyzed for EPA CLP target compounds and analytes (SVOCs, pesticide and PCBs, metals, and cyanide) and explosives (Table 2-2) by Sound Analytical Services, Inc., using EPA SW-846 methods. Analytical methods are presented on Table 2-4. These soil samples also will be analyzed for chemical agent breakdown products by Southwest Research Institute. If a breakdown product is detected, then the associated sample(s) also will be analyzed for the source chemical agent.

These containers and contents will be disposed of with IDW by the independent disposal contractor at the end of the investigation.

2.7 SURVEYING

Upon completion of field work, the licensed surveying subcontractor, Olson Engineering, Inc., of Vancouver, Washington, will survey all push probe, manual, and exploratory trench soil data collection locations and five temporary microwell locations created during this investigation. The microwells will be surveyed prior to decommissioning. Monitoring wells MW-6 (landfill), MW-3 (west side of the building) and MW-1 (southeast side of the building), and/or an existing on-site survey marker will be used for vertical on horizontal control.

Horizontal and ground surface elevation coordinates will be provided for all data collection locations and reported in North American Datum (NAD) 83 (horizontal) and National Geodetic Vertical Datum (NGVD) 29 (vertical). For all wells, the elevation of the top of the well riser (PVC) and the top of the steel protective casing shall also be measured. All vertical survey measurements shall be made to the nearest 0.01 foot, and horizontal survey measurements shall be made to the nearest 0.1 foot.

2.8 DECONTAMINATION OF DRILLING AND SAMPLING EQUIPMENT

Equipment used during the field investigation and sampling activities will be decontaminated before use at the site and between sampling locations to prevent cross-contamination. The field activities in which decontamination procedures will be followed include completing Geoprobe® borings; installing temporary microwells; sampling sediment, soil, and groundwater; completing trenches; and all associated sampling activities. The specific procedures for decontamination are outlined in this section.

Down-hole equipment (e.g., push probe rods, soil samplers and liners) and other equipment in direct contact with the sampled materials, soil cuttings, and fluids will be cleaned between borings and other sampling locations. This equipment will be decontaminated using a hot-water pressure washer.

Sampling equipment includes all nondisposable sampling devices, which are used to collect or contain a sample prior to placement into a laboratory-provided sample container. Such equipment may include split spoons, stainless steel spoons and bowls, stainless steel cable and the submersible pump. Disposable equipment may include tubing. Before initial use, all sampling equipment that may contribute to the contamination of a sample must be thoroughly decontaminated, unless specific documentation exists to show that the sampling equipment has already been decontaminated. Pre-cleaned equipment in factory-sealed containers does not require decontamination.

The sampling equipment will be decontaminated between sample locations according to the following procedure:

1. Thoroughly scrub equipment with phosphate-free detergent and potable water; a brush will be used to remove any particulate matter or surface film.

2. Thoroughly rinse the outside of and flush the inside of equipment with clean potable water.

3. Rinse and flush equipment with clean, laboratory-supplied water free of analytes of concern.

4. Rinse equipment with reagent-grade methanol.

5. Rinse equipment with reagent-grade cyclohexane or hexane.

6. Allow equipment to air dry, then wrap it in foil if not to be used immediately.

Geoprobe® equipment will be decontaminated on a trailer equipped with a water collection basin. Excavating equipment will be decontaminated within the landfill fenced area, and wash water will be allowed to infiltrate into the ground surface. The containment and disposal of decontamination wash water and other waste material is described in the IDW Plan.

2.9 FIELD QUALITY CONTROL SAMPLES

Field quality control (QC) samples will be employed to evaluate data quality. QC samples are controlled samples introduced into the analysis stream whose results are used to review data quality and to calculate the accuracy and precision of the chemical analysis program. The purpose of each type of field QC sample, collection and analysis frequency, evaluation criteria, and methods of collection are summarized in this section and described in more detail in the QAPP.

Field QC checks are accomplished through the analysis of controlled samples that are introduced to the laboratory from the field. Rinsate blanks, trip blanks, field duplicates, and matrix spike/matrix spike duplicates (MS/MSDs) will be collected and submitted to the laboratory to provide a means of assessing the quality of data resulting from the field sampling program. QC sample requirements are presented on Tables 2-4, 2-5, and 2-7.

2.9.1 Rinsate Blanks

Rinsate blanks are collected to determine the potential for cross-contamination of samples during collection by assessing the decontamination process. Rinsate blanks will be collected and analyzed at the rate of 5 percent if nondedicated sampling equipment is used. Rinsate blanks will consist of laboratory-supplied, deionized water collected from the final rinse of sampling equipment after the decontamination procedures described in Section 2.8 are complete.

The rinsate groundwater blank will be collected by filling a rinsed PVC tube (used in decontamination) with 2 gallons of laboratory-supplied, deionized water. A 4-foot-long piece of unused Teflon®-lined tubing will be attached to the freshly decontaminated pump. The pump will be placed into the PVC tube containing the deionized water. The pump will be started and

flow established at approximately 300 milliliters (mL) per minute. Pre-labeled sample containers will be filled from the discharge end of the tubing.

The rinsate soil blank will be collected from the stainless steel bowls that will be used to collect soil samples prior to placing them in sample containers. The rinsate blank will be collected by filling the bowl with approximately 2 gallons of laboratory-supplied, deionized water, then filling pre-labeled, laboratory-supplied sample containers.

All rinsate blanks will be submitted blind to the laboratory, with sample numbers that are indistinguishable from primary samples. QC criteria and corrective actions are the same as for method blanks (as described in the QAPP). Blank samples will be analyzed for the same parameters as the associated field samples.

2.9.2 Trip Blanks

Trip blanks are analyzed only for VOCs and are used to determine if contamination has occurred during sampling, handling, shipping, or storage of samples or sample bottles. One trip blank (40-mL vial with preserved contaminant-free water) will be submitted to the project laboratory for each cooler containing aqueous samples for VOC analysis. Two trip blanks (one 4-ounce glass jar or 40-mL vial containing methanol and one 40-mL vial containing aqueous sodium bisulfate) will be submitted to the project laboratory for each cooler containing soil, sediment, or concrete samples for VOC analysis.

Trip blanks will be provided by the laboratory. At no time after their preparation are the trip blank sample containers to be opened until they return to the laboratory. Each trip blank will be inspected for bubbles and overall condition, which will be noted in the field logbook. Each trip blank will be assigned a number which will be recorded in the field logbook and on the chain of custody form. Trip blanks will be analyzed at a rate of one per cooler containing samples for VOC analysis. Quality control criteria for trip blanks require that no contaminants be detected in the blanks.

2.9.3 Field Duplicates

Field duplicate samples will be used to check for sampling reproducibility. Field duplicates will be collected from sampling locations with potentially high concentrations of target analytes. Field duplicates will be submitted to the laboratory at a frequency of 10 percent of the field samples for every analytical method. Field duplicate samples will be collected in conjunction with and analyzed by the same methods as the primary sample. Control limits for field duplicate precision are 30 percent relative percent difference (RPD) for water samples and 50 percent RPD for soil, sediment, and concrete samples.

Field duplicates will be submitted blind to the laboratories, with sample numbers that are indistinguishable from primary samples. QC criteria for field duplicates and calculation and reporting of the RPD are described in Section 7.1 of the QAPP.

2.9.4 Matrix Spike/Matrix Spike Duplicates

MS/MSDs are used to assess sample matrix interferences and analytical errors, as well as to measure the accuracy and precision of the analysis. The MS/MSDs will be collected and analyzed at a rate of 5 percent of the field samples for each analytical method or at least one for each analytical batch, whichever frequency is greater. Known concentrations of analytes are added to environmental samples; the MS or MSD is then processed through the entire analytical procedure and the recovery of the analytes calculated. Results are expressed as percent recovery of the known spiked amount (and RPD for MS/MSD pairs).

Field duplicate and MS/MSD samples will be collected from different locations. Additionally, MS/MSD samples should not be collected from locations with potentially high concentrations of target analytes that may mask the added MS/MSD compounds.

2.9.5 Temperature Blanks

One temperature blank will be prepared and submitted to the laboratory with each cooler. The temperature blank will consist of a sample jar containing water, which will be packed in the cooler on ice in the same manner as the rest of the samples. The temperature blank is to be used to measure the cooler temperature upon receipt of the cooler at the laboratory.

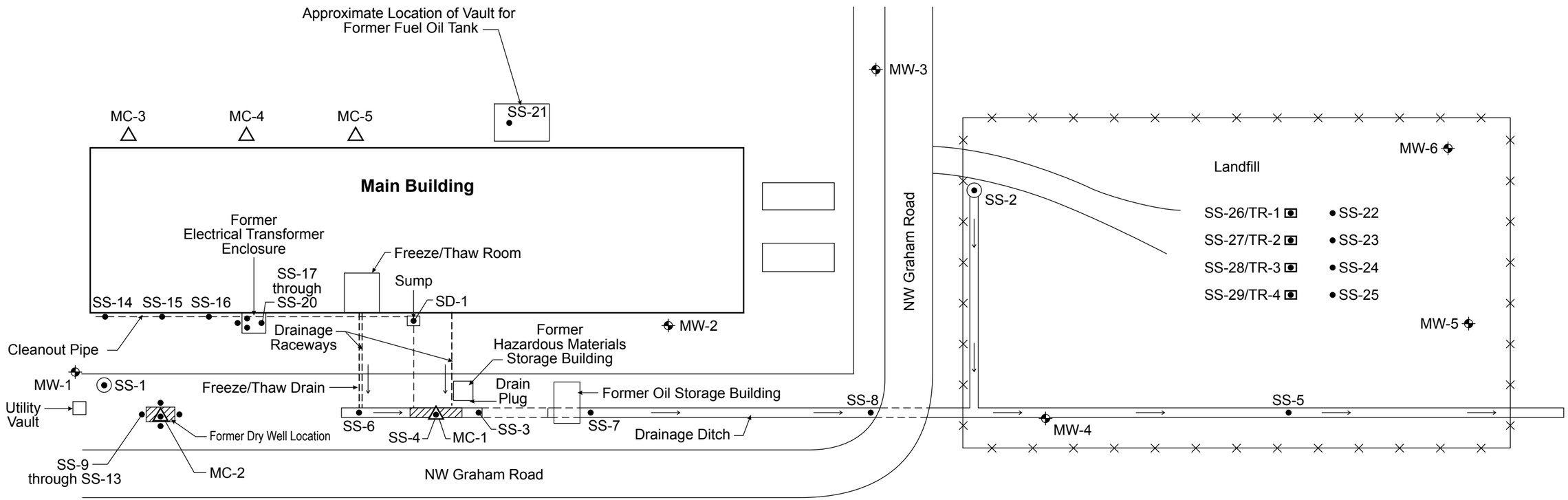
2.10 CALIBRATION OF FIELD INSTRUMENTS

All calibration procedures and measurements will be made in accordance with the manufacturer's specifications and the USACE SOP for low-flow purging and sampling (Appendix B). Field instruments will be checked and calibrated before their use on site, and batteries will be charged and checked daily. A three-point initial calibration will be conducted if applicable to the instrument being used. One-point calibrations may be used thereafter.

Instrument calibration will be conducted at the beginning of each workday and if necessary through the course of the day. A final calibration will be conducted at the end of the day after the last field sample has been analyzed. Special attention will be given to instruments that may drift with change in ambient temperature or humidity. Equipment that fails calibration and/or becomes otherwise inoperable during the field investigation will be removed from service and segregated to prevent inadvertent use. Such equipment will be properly tagged to indicate that it

should not be used until repaired. Equipment that cannot be repaired or recalibrated will be replaced.

All documentation pertinent to the calibration and/or maintenance of field equipment will be maintained in an active field logbook.



LEGEND

	Fence	MW-1	Existing groundwater monitoring well
	Subsurface feature	SS-3	Proposed soil or sediment sampling location
	Former soil removal area	MC-1	Proposed groundwater microwell location
	Direction of flow	TR-1	Proposed exploratory trench location
		SS-1	Proposed background soil sampling location

NOTE

Proposed sampling and trench locations may be adjusted in the field depending on site conditions.

0 80 160

Scale in Feet

SOURCE: Tetra Tech: Final Cleanup Report – Soil Removal and Groundwater Sampling NPD Laboratory, Troutdale, Oregon, 1999.

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MANAGEMENT PLAN FOR SITE INVESTIGATION
Former NPD Laboratory
Troutdale, Oregon

Figure 2-1
Site Layout and Proposed Sampling Locations

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Table 2-1
Summary of Field Activities

Area	Debrushing or Grading	Geoprobe® Soil Sampling	Manual Soil Sampling	Sediment Sampling	Trenching and Drum Removal and Sampling	Microwell Installation	Groundwater Sampling
Drainage ditch	X	X	X			X	X
Dry well		X				X	X
Building cleanout pipe		X					
Transformer pad			X				
Fuel oil tank vault		X					
Landfill	X	X	X		X		
Concrete sump vault				X			
West of laboratory building						X	X
Existing monitoring wells							X

Note: Soil samples also will be collected from buckets containing Umatilla Army Depot Borrow Site material, currently stored at the site.

Table 2-2
Summary of Analytical Program

Parameter	Drainage Ditch (Soil)	Dry Well (Soil)	Building Cleanout Pipe (Soil)	Transformer Pad (Soil)	Fuel Oil Tank Vault (Soil)	Landfill (Soil)	Concrete Sump (Sediment)	Landfill Drums (Concrete)	Microwells and Monitoring Wells (Groundwater)	Umatilla Army Depot Borrow Site Material (Soil)
Volatile organic compounds	X	X	X		X	X	X	X	X	
Semivolatile organic compounds	X	X	X		X	X	X	X	X	X
Organochlorine pesticides/PCBs	X	X	X			X	X	X	X	X
Organochlorine PCBs				X						
Total metals	X	X	X			X	X	X	X	X
Dissolved metals									X	
Strontium and uranium	X	X	X			X	X	X	X	
Total cyanide	X	X	X			X	X	X	X	
TPH diesel-range					X					
Explosives residues										X
Chemical agent breakdown products										X

Table 2-3
Number of Primary Soil Samples at Each Location and Depth

Area	Geoprobe® (0-1 foot bgs)	Geoprobe® (Native Material)	Manual Sampling (0-1 foot bgs)	Trenching
Drainage ditch	6	5	1	
Dry well		10[a]		
Building cleanout pipe		3[b]		
Transformer pad			4	
Fuel oil tank vault		1		
Landfill		4	4	4

[a]First depth in native material; second depth at contamination or immediately above water table, whichever is shallower
[b]At depth immediately below cleanout pipe

Note: Additional soil samples (not presented on this table) will be collected from buckets containing Umatilla Army Depot Borrow Site materials currently stored at the site.

Table 2-4
Soil and Sediment Analytical Methods and Quality Control Samples

Parameter	Method	Number of Soil and Sediment Samples						
		Primary	Field Duplicate (10%)	Trip Blank[a] (per cooler)	Rinsate Blank (5%)	MS (5%)	Lab Duplicate or MSD (5%)	Total
Volatile organic compounds	EPA SW-846 Method 5035/8260B	36	4	4	2	2	2	50
Semivolatile organic compounds	EPA SW-846 Method 3550B/8270C	36	4		2	2	2	46
Organochlorine pesticides and PCBs	EPA SW-846 Method 3550B/8081A/8082	35	4		2	2	2	45
Organochlorine PCBs	EPA SW-846 Method 3550B/8082	4						4
Total metals	EPA SW-846 3051/6010B/6020/7471A	35	4		2	2	2	45
Total cyanide	EPA SW-846 Method 9013/9012A	35	4		2	2	2	45
TPH diesel-range	NWTPH-Dx	1				1	1	3
Explosives residues	EPA SW-846 Method SPE/8330	1	1		1	1	1	5
Chemical agent breakdown products	Southwest Research Institute SOPs	5	1		1	1	1	9

Notes:
MS - matrix spike
MSD - matrix spike duplicate
NWTPH-Dx - northwest total petroleum hydrocarbons—diesel extended
SDG - sample delivery group
[a]Estimated

Table 2-5
Concrete Analytical Methods and Quality Control Samples

Parameter	Method	Number of Concrete Samples						
		Primary	Field Duplicate (10%)	MS (5%)	Lab Duplicate or MSD (5%)	Trip Blank[a] (per cooler)	Rinsate Blank (5%)	Total
Volatile organic compounds	EPA SW-846 Method 5035/8260B	1	1	1	1	1	1	6
Semivolatile organic compounds	EPA SW-846 Method 3550B/8270C	1	1	1	1		1	5
Organochlorine pesticides and PCBs	EPA SW-846 Method 3550B/8081A/8082	1	1	1	1		1	5
Total metals	EPA SW-846 3051/6010B/6020/7471A	1	1	1	1		1	5
Total cyanide	EPA SW-846 Method 9013/9012A	1	1	1	1		1	5

Notes:
MS - matrix spike
MSD - matrix spike duplicate
SDG - sample delivery group
[a]Estimated

Table 2-6
Existing Monitoring Well Construction and Elevation Information

Well No.	WRD Well ID No.	Total Depth (feet bgs)	Screen Interval (feet bgs)	Surface Elevation (feet msl)	Top of Casing Elevation (feet msl)
MW-1	L18074	20	4.5 - 19.5	36.3	38.62
MW-2	L18075	20.5	5.0 - 20.0	34.4	36.66
MW-3	L18076	19	2.85 - 17.85	33.87	33.51
MW-4	L18077	19	3.5 - 18.5	35.03	34.76
MW-5	L18078	19	3.35 - 18.35	32.35	31.91
MW-6	L18079	19	3.2 - 18.2	32.52	32.09

Notes:
msl - mean sea level
WRD - Oregon State Water Resources Department

Table 2-7
Groundwater Analytical Methods and Quality Control Samples

Parameter	Method	Number of Groundwater Samples						
		Primary	Field Duplicate (10%)	MS (5%)	Lab Duplicate or MSD (5%)	Trip Blank[a] (per cooler)	Rinsate Blank (5%)	Total
Volatile organic compounds	EPA SW-846 Method 5030B/8260B	11	2	1	1	2	1	18
Semivolatile organic compounds	EPA SW-846 Method 3510C/8270C	11	2	1	1		1	16
Organochlorine pesticides and PCBs	EPA SW-846 Method 3510C/8081A/8082	11	2	1	1		1	16
Total metals	EPA SW-846 3010A/6010B/6020/7470A	11	2	1	1		1	16
Dissolved metals (field filtered)	EPA SW-846 3010A/6010B/6020/7470A	11	2	1	1			15
Total cyanide	EPA SW-846 9012A	11	2	1	1		1	16

Notes:
MS - matrix spike
MSD - matrix spike duplicate
SDG - sample delivery group
[a]Estimated

3.0 SAMPLE HANDLING AND DOCUMENTATION

This section describes sample handling and documentation procedures. The procedures described are designed to provide a thorough record of events surrounding the collection of each sample, and to ensure, as far as can be accomplished in the field, that data collected are useable.

3.1 FIELD LOGBOOKS

Permanently bound field books with waterproof paper will be used as field logbooks because of their compact size, durability, and secure page binding. The pages of the logbook should be numbered consecutively and should not be removed for any reason. Entries will be made in black waterproof indelible ink.

Logbooks will document the procedures performed by field personnel. Each entry should be dated, legible, and contain accurate and complete documentation of the individual's activities. Documentation in the field logbook will be at a level of detail sufficient to explain and reconstruct field activities without relying on recollection by the field team members. Because the logbook is a complete documentation of field procedures, it should contain only facts and observations. Language should be objective, clear, concise, and free of personal interpretation or terminology that might be misconstrued.

No erasures will be allowed. If an incorrect entry is made, the information will be crossed out with a single strike mark and the change initialed and dated by the team member making the change.

Field logbooks will be identified by the project name and a project-specific number (e.g., "Logbook #1 for Former North Pacific Division Laboratory Site Investigation"), and stored in the field project files when not in use. Field logbooks will be photocopied after the field investigation, and photocopies will be stored in the permanent project files. After field activities are completed, logbooks will be stored in the permanent project file.

3.2 SAMPLE IDENTIFICATION AND LABELING

To provide a sample tracking mechanism, each sample collected will be given a sample identification number using the numbering system shown in Table 3-1. The sample identification number will include the sample type, station number, and an identification of the type of sample (primary, field split, etc.). The site name and sampling date will not be included in the sample identification number because this information will be recorded on the sample

label and chain of custody form. Sample type, station number, and depth designations are shown below.

MS/MSD samples will not be designated in the primary sample number. The sample to be used for MS/MSD will be specified in the comment section of the chain of custody. Trip blanks will be numbered with the prefix "TB-" followed by a sequential number starting with 001. The QC field duplicate and field/rinsate blank samples will be identified with a fictitious station number of the primary sample. The fictitious station numbers used to identify QC field duplicates and field/rinsate blanks will consist of a constant integer added to the number of the primary sample location that has been chosen as the QA station. A field duplicate sample will be designated by adding the integer 300 to the station number from which it was collected. A rinsate blank sample will be designated by adding the integer 600 to the station number from which the blank is collected. No indication that a sample is a duplicate will be provided on the sample label or chain of custody form. Cross-references for duplicate and blank sample numbers will be clearly recorded in the field book and field logs.

Example 1: A primary soil sample collected from a depth of 5 feet bgs at SS-1 would be labeled SS-001-05.

Example 2: A duplicate of primary sample SS-001-05 would be labeled SS-301-05.

Example 3: A rinsate blank of primary sample SS-001-05 would be labeled SS-601-05.

Example 4: A groundwater sample collected from microwell MC-1 would be labeled MC-001.

Example 5: An exploratory trench sample from the trench TR-3 at a depth of 5 feet bgs would be labeled TR-003-05.

Example 6: The fourth trip blank submitted for this investigation would be designated TB-004.

Sample labels, whether blank or pre-printed, will contain an abbreviated summary of the logbook entry for the sample. The following information should be included on sample container labels:

- Project number and name
- Site location
- Sample identification number
- Date and time of sampling
- Initials of sampling personnel
- Type of sample preservatives added

3.3 SAMPLE DELIVERY GROUP

Soil and groundwater samples will be sent to the analytical laboratories in sample delivery groups (SDGs). Each SDG will consist of primary samples, blind field duplicates, associated MS/MSD samples, and/or rinsate blanks.

3.4 SAMPLE PRESERVATION AND HANDLING

This section describes the techniques used to handle and preserve samples once they are collected, including descriptions of sample containers, preservation techniques, and storage requirements.

3.4.1 Sample Containers

Soil and groundwater samples (primary as well as QC) will be collected in glass or plastic containers supplied by the analytical laboratory. The containers will have screw-type lids to ensure the bottles are adequately sealed. Teflon® inserts inside the lids of the containers will prevent sample reaction with the lid and improve the quality of the seal. The specific container types, volumes, number of containers, and holding times for each analysis for soil, sediment, and concrete are listed in Table 3-2, and the same information for groundwater is listed in Table 3-3.

The containers will be precleaned and certified under chain of custody. Commercially available precleaned jars are acceptable. The field team will record batch numbers for the bottles in the logbook. With this documentation, bottles can be traced and bottle wash analyses can be reviewed.

3.4.2 Sample Preservation

Required preservatives for groundwater and rinsate blanks will be added to the sample containers by the laboratory. They will affix waterproof labels to the bottles, on which the type and amount of preservative will be written.

Sample preservation procedures are used to maintain the original character of analytes during storage and shipment. Regardless of the nature of the sample, absolute stability for all constituents cannot be achieved. Preservation techniques, such as pH control and refrigeration, may retard physicochemical and biochemical changes. As a general rule, analyzing the sample as soon as possible is the best way to minimize physicochemical and biochemical changes.

All samples will be placed in the appropriate sample container and refrigerated (on ice or ice-substitute in a cooler) immediately upon sample collection. Samples will be shipped to the laboratory on a daily basis. The analytical laboratories will meet all specified holding times (35 days) and should make every effort to prepare and analyze the samples immediately after they are received. Chemical preservation, sample container types, and temperature requirements for the analyses performed in this investigation are shown in Tables 3-2 and 3-3.

3.4.3 Storage Requirements

Samples will be placed in secure, on-site storage, or remain in the possession of the sampling personnel until they are shipped or delivered to the laboratory. Immediately after collection, and during shipment to the analytical laboratory, samples will be stored in coolers on ice or an ice-substitute at approximately 4°C. Ice packaged in plastic storage bags will be used to maintain the temperature in the shipping containers at approximately 4°C. Ice will be replenished as needed to ensure adequate cooling of samples during storage and shipping.

3.5 SAMPLE DOCUMENTATION

Entries into the logbook or other relevant sampling forms for sampling events will include, but not necessarily be limited to, the following:

- Project name, location, and number
- Rationale for collecting the sample
- Date and time of sampling
- Sample numbers
- Cross-reference of numbers for split and blank samples
- Media sampled
- Geographical location of the sampling point in reference to site facilities
- Physical location of the sampling point, such as depth below surface
- Method of sampling, including procedures, equipment, and any departure from the procedures specified in the Work Plan or the SAP

- Rationale for any deviations from Management Plan procedures and documentation
- Results of field measurements
- Sample preservation
- Type and quantity of container used for each sample
- Weather conditions at the time of sampling and previous events that may influence the representative nature of a sample—at a minimum, include temperature, approximate wind speed and direction, and sky cover
- Photographic information—briefly describe what was photographed and why, the date and time, the compass direction of the picture, number of the frame on the roll, and roll number
- Sketches, when appropriate, with reference points tied to existing structures in the area (e.g., trees, existing monitoring wells)
- Analyses requested
- Disposition of the sample (i.e., where it is being shipped)
- Airbill number of sample shipment, when applicable
- Other pertinent observations, such as the presence of other persons on the site (those associated with the job or members of the press, special interest groups, or passersby), and actions by others that may affect performance of site tasks
- Type of health and safety clothing/equipment used
- Name(s) of sampling personnel

3.6 CHAIN OF CUSTODY PROCEDURES

Verifiable sample custody is an integral part of all field and laboratory operations associated with this field investigation. The primary purpose of the chain of custody procedures is to document

the possession of the samples from collection through storage and analysis to reporting. Chain of custody forms will become the permanent records of sample handling and shipment. The Field Investigation Manager or designee will be responsible for monitoring compliance with chain of custody procedures.

Field sampling personnel are responsible for the care and security of samples from the time the samples are collected until they have been turned over to the shipping agent or laboratory. A sample is considered to be in one's custody if it is in plain view at all times, in the physical possession of the sampler, or stored in a locked place where tampering is prevented.

Empty coolers containing ice or ice substitute will be available at the study area for use each day in the field. Samples collected during the day will be stored in these coolers beginning at the time of collection. The coolers will be locked inside the field vehicle or other secure location when sampling personnel are not present.

A chain of custody form will be filled out for samples in each cooler, starting when the first sample of each batch is collected. An example of chain of custody record is shown in Appendix A. Each chain of custody form will contain the following information:

- Sample identification numbers
- Date and time of sampling
- Type of sample and number of sample containers associated with each sampling point
- Total number of sample containers in cooler
- Unique cooler identification number
- List of analyses requested
- Name and signature of sampling personnel
- Shipping air bill number, when applicable
- Comments regarding MS/MSD samples, or any other information that is necessary for the laboratory
- Spaces for transfer of custody acknowledgment

When the chain of custody forms are complete, field team members will cross-check the form for possible errors. If samples are repackaged for shipping or delivery, one team member will cross-check the chain of custody with the samples that are packed while another team member packages the samples. Corrections will be made to each record with a single strike mark that is dated and initialed. The person who initials corrections will be the same person that relinquishes custody of the samples. The chain of custody forms will be signed and dated, placed in resealable plastic bags, and taped to the inside lid of the respective coolers.

3.6.1 Transfer to Project Laboratories

After a cooler of samples is packaged and the chain of custody form has been completed, sampling personnel will close the cooler, seal it with packing tape, and affix two signed and dated custody seals so that if the cooler is opened the seals will be broken. Custody seals will contain the following information:

- Sample team member's signature (signature must match signature on chain of custody forms)
- Date

Coolers with completed chain of custody documentation will be hand-delivered, sent by courier, or shipped by overnight courier to the laboratory by the sampling team. The shipping agent will not enter into the formal chain of custody procedures, and therefore will not sign the chain of custody form. Copies of bills of lading provided by the shipping agent will be kept with chain of custody forms in order to document shipping procedures.

3.6.2 Laboratory Custody Procedures

A cooler receipt form will be filled out by the laboratory (Appendix A). Upon receipt by the laboratory, custody seals will be inspected and the chain of custody forms signed and dated by laboratory personnel. Laboratory personnel will verify sample numbers and the conditions of each cooler. The laboratory will fax each chain of custody and cooler receipt form to the URS PM within 8 hours. URS will be notified of any discrepancies immediately. Shipping manifests and chain of custody forms signed and dated by laboratory personnel will be considered sufficient documentation of sample custody transfer from the sampler, through the shipping agent, to the analyst in the contracted analytical laboratory.

A copy (pink) of each chain of custody form will be retained by the sampling team for the project file and the original (yellow and white) will be sent with the samples. Bills of lading will also be retained as part of the documentation for the chain of custody records. In conjunction

with data reporting, the analytical laboratory will return the original chain of custody forms to the project manager for inclusion into the central project file.

3.7 DAILY CHEMICAL QUALITY CONTROL REPORTS

Field activities will be documented via the daily chemical quality control report (DCQCR) form. An example DCQCR form is included in Appendix A. The reports will be prepared and submitted daily, and will summarize field and laboratory activities and results. All field measurement data and field sampling decisions will be made available to the USACE within 24 hours of sample collection. The DCQCR will contain the following information:

- Project information
- Work performed and samples collected including associated QA/QC samples, and personnel involved
- Weather
- Available analytical results, physical parameter measurements, calculation results, and required QC data
- Field audits performed and results
- Sampling, sample handling, chemical parameter measurement problems, deviations from the approved plan, and corrective actions taken
- Signatures of field personnel completing the DCQCR and initials of personnel making changes
- Summary of verbal or written instructions for retesting or changes of work

The DCQCR will be completed at the end of each day. Copies of field forms and pages of the field logbook completed for that day's work will be referenced on the form and attached to minimize transcription errors.

Table 3-1
Sample Identification Numbering System

Sample Type	Sample Type Prefix[a]	Sample Location or Drum No.[b]	Depth
Geoprobe® Boring and Surface Sample–Soil	SS	001, 002…	feet bgs
Monitoring Well–Groundwater	MW	001-006	NA
Microwell–Groundwater	MC	001-005	NA
Concrete Sump–Sediment	SD	001	NA
Exploratory Trench–Soil	TR	001-004	feet bgs
Drum–Concrete	DC	001, 002…	NA
Umatilla Samples–Soil	US	001-005	NA
Trip Blank	TB	001, 002…	NA

[a]Specify MS or MSD in comment section of the chain of custody form, but not in sample name.
[b]For duplicate, add integer of 300 to sample number; for rinsate blank, add integer of 600 to sample number.

Table 3-2
Container, Preservation, and Holding Time Requirements–Soil, Sediment, Concrete

Parameter	Method	Container Description[ab]	Number Required	Preservation Requirements	Holding Time
Volatile organic compounds	EPA SW-846 Method 5035/8260B	4 oz. Glass with Teflon®-lined lid	1	4°C, methanol	14 days
Semivolatile organic compounds	EPA SW-846 Method 3550B/8270C	4 oz. glass	1	4°C	14 days extract/40 days analysis
Organochlorine pesticides and PCBs	EPA SW-846 Method 3550B/8081A/8082	4 oz. glass	1	4°C	14 days extract/40 days analysis
Organochlorine PCBs	EPA SW-846 Method 3550B/8082	4 oz. glass	1	4°C	14 days extract/40 days analysis
Total metals	EPA SW-846 3051/6010B/6020/7471A	4 oz. glass	1	4°C	6 months (28 days for mercury)
Total cyanide	EPA SW-846 Method 9013/9012A	4 oz. glass	1	4°C	14 days
TPH diesel-range	NWTPH-Dx	4 oz. glass	1	4°C	14 days extract/40 days analysis
Explosives residues	EPA SW-846 Method SPE/8330	4 oz. amber glass	1	4°C, dark	14 days extract/40 days analysis
Chemical agent breakdown products	Southwest Research Institute SOPs	8 oz. amber glass	2	4°C, dark	14 days extract/40 days analysis

[a]Concrete samples may require 8-oz or 16-oz glass containers
[b]All glass sample containers will have Teflon®-lined lids

Notes:
HDPE - high density polyethylene
NWTPH-Dx - northwest total petroleum hydrocarbons—diesel extended
TPH - total petroleum hydrocarbons

Table 3-3
Container, Preservation, and Holding Time Requirements–Groundwater

Parameter	Method	Container Description	Number Required	Preservation Requirements	Holding Time
Volatile organic compounds	EPA SW-846 Method 5030B/8260B	40 ml VOA vial[a]	3	4°C, HCI to pH < 2	14 days
Semivolatile organic compounds	EPA SW-846 Method 3510C/8270C	1 L glass amber[a]	2	4°C	7 days extract/40 days analysis
Organochlorine pesticides and PCBs	EPA SW-846 Method 3510C/8081A/ 8082	1 L glass amber[a]	2	4°C	7 days extract/40 days analysis
Total metals	EPA SW-846 3010A/6010B/6020/ 7470A	500 mL HDPE	1	4°C, HNO_3 to pH < 2	6 months (28 days for mercury)
Dissolved metals (field filtered)[b]	EPA SW-846 3010A/6010B/6020/ 7470A	500 mL HDPE	1	4°C, HNO_3 to pH < 2	6 months (28 days for mercury)
Total cyanide	EPA SW-846 9012A	1 L HDPE	1	4°C, NAOH to pH > 12	14 days

[a]All glass sample containers will have Teflon®-lined lids.
[b]Sample will be filtered using a 0.45 µm filter prior to preservation.
Note:
HDPE - high density polyethylene

4.0 SAMPLE PACKAGING AND SHIPPING

4.1 PACKAGING

The procedures and materials used for sample packaging must adequately protect the sample container from accidental breakage during shipping. Sample packaging and labeling will conform to the requirements of Appendix F of Engineering Manual EM-200-1-3 (USACE 2001). Glass sample containers will be placed into plastic bags, and will be wrapped and cushioned in inert packing material such as Styrofoam, closed-cell foam packing material, or plastic bubble wrap. Plastic sample containers do not require individual cushioning material, but should be packed well to prevent movement during transport. Caps will be screwed on tightly. The plastic sample containers will be placed into individual, resealable plastic bags, which will then be sealed. Ice or ice-substitute will be placed in the container in a manner to ensure adequate and equal cooling for all samples.

4.2 SHIPPING

All sample containers will be placed inside a strong shipping container, such as a metal or plastic picnic cooler with a hard plastic liner. The shipping container should be sufficient to prevent leaks or spills of ice water or potentially broken sample containers. The drainage hole at the bottom of the cooler will be taped shut so that the contents from possible broken containers of sample or packaged ice will not escape. The shipping container lid will be adequately secured with tape to prevent opening during shipping. The shipping container will be adequately cleaned between shipments to prevent cross-contamination of samples.

Transfer of samples from the project site to the project analytical laboratory is expected to be performed by the field personnel or via an overnight courier service. Deliveries that will arrive at a laboratory or at the courier's office to be picked up by laboratory personnel must be arranged with the laboratory before shipping occurs.

Addresses, telephone numbers, and contacts of the laboratories to which samples will be shipped is presented in Table 2-1 of the Work Plan.

5.0 FIELD CORRECTIVE ACTIONS

The ultimate responsibility for maintaining quality throughout the field investigation rests with the Project Manager. The day-to-day responsibility for ensuring the quality of field and laboratory data rests with the Field Investigation Manager, the Project QA Manager (QAM), and the laboratory program administrator.

Any nonconformance with the established QC procedures will be expeditiously identified and controlled. Where procedures are not in compliance with the established protocol, corrective actions will be taken immediately. Subsequent work that depends on the nonconforming activity will not be performed until the identified nonconformance is corrected.

The Field Investigation Manager will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, etc., will be checked for completeness. Where procedures are not strictly in compliance with the established protocol, the deviations will be field documented and reported to the Project QAM. Corrective actions will be defined by the Field Investigation Manager and Project Manager and documented as appropriate. Upon implementation of the corrective action, the Field Investigation Manager will provide the Project QAM with a written memo documenting field implementation. The memo will become part of the field record and permanent project file.

6.0 REFERENCES

American Society for Testing and Materials (ASTM). 2000. *D2488 Standard Practice for Description and Identification of Soil (Visual-Manual Procedure).*

United States Army Corps of Engineers (USACE). 2001. *Chemical Data Quality Management for Hazardous, Toxic, Radioactive Waste Remedial Activities.* EM-200-1-3.

APPENDIX A

Standard Field Forms

CONTENTS

Boring Log

Well Development Data Sheet

Groundwater Sampling Data Sheet

Chain of Custody Record

Cooler Receipt Form

Daily Chemical Quality Control Report Form

HTRW DRILLING LOG	DISTRICT	HOLE NUMBER
1. COMPANY NAME	2. DRILLING SUBCONTRACTOR	SHEET SHEETS OF

3. PROJECT	4. LOCATION
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8. HOLE LOCATION
	9. SURFACE ELEVATION
	10. DATE STARTED / 11. DATE COMPLETED
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR

LOCATION SKETCH/COMMENTS SCALE:

PROJECT	HOLE NO.

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER	
PROJECT	INSPECTOR
SHEET	OF SHEETS

ELEV. (4)	DEPTH (5)	DESCRIPTION OF MATERIALS (6)	FIELD SCREENING RESULTS (7)	DEPTH OF SAMPLE OR CORE BOX NO. (8)	ANALYTICAL SAMPLE NO. (9)	BLOW COUNT (10)	REMARKS (11)

PROJECT	HOLE NO.

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

WELL DEVELOPMENT REPORT

Project_____ Well No._____ Depth_____ Datum_____
Contractor_____ Rig_____ Operator_____ Inspector_____

Date	Method	Duration	Depth	Discharge Rate	% sand	Sediment Grain size	Volume	Remarks

GROUNDWATER SAMPLING DATA SHEET

Project Name: _____
Project/Task No.: _____
Date: _____
Weather: _____
Samplers: _____
Purge Method: _____
Sample Method: _____
Sampling Device: _____
Tubing Type: _____
Pump Intake Depth: _____
Water Disposal/quantity: _____

Sample Number: _____
Station Type: _____
Station Number: _____
Well Condition: _____
Well Diameter: _____
Screen Interval: _____
Measuring Point (MP): _____
Elevation of MP: _____
Elevation of Water: _____
Depth to bottom: _____
Depth to water: _____
Depth to NAPL: _____
NAPL thickness: _____

Field Test Kit Results:

PID: _____
DO: _____
Alkalinity: _____
Ferrous Iron: _____
Other: _____

Meter Information:

	Model	Calib. Date
pH:		
Eh:		
Conductivity:		
DO Meter:		
Turbidity:		
Temperature:		
Other:		

Containers:

Analysis	Type	#-Primary	#-MS/MSD

QA/QC Samples:

Duplicate: _____
Replicate: _____
MS/MSD: _____
Blank: _____

Comments:

Field Parameters	Units	0 Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes
Temperature								
pH								
Conductivity								
Eh								
DO								
Turbidity								
Time								
Water Level								
Flow Rate								

Field Parameters	Units	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Sample
Temperature								
pH								
Conductivity								
Eh								
DO								
Turbidity								
Time								
Water Level								
Flow Rate								

EPA
EPA Region 10
1200 Sixth Avenue
Seattle WA 98101

FIELD SAMPLE DATA AN[illegible] HAIN OF CUSTODY SHEET

Case No.: _____

Project Code: _____ Account: _____

Name/Location _____

Proj. Off.: _____ Tel.# _____

(EPA Lab Only, Leave Blank for Contract Lab)

- ☐ Enforcement/Custody
- ☐ Data Confidential
- ☐ Possible Toxic/Hazardous
- ☐ Data for STORET

Miscellaneous: _____

Sampling Crew: _____

Recorder: _____ (Signature Required)

SOURCE CODE	Matrix: Oil, Water, Sediment, Tissue, Prsrvd (Y/N)	# CONTAINERS: Qt. Cubit, Gal. Cubit, 16 oz., 8 oz., 120 mL, 40 mL, Other	LAB NUMBER: Yr., Wk, Seq	STORET STATION NUMBER	SAMPLING DATE & TIME: Yr, Mo, Dy, Time	TRAFFIC REPORT NUMBERS: Org., Inorg.	SAMPLER'S INITIALS	STATION DESCRIPTION

LAB NUMBER: Yr., Wk, Seq	DEPTH: Unit, Type	COL MTD CD	QA CODE	TEMP DEG C	pH	CNDCTVTY umho/cm	COMPOSITE ONLY: ENDING DATE: Mo., Day, Time	Type	Freq

Condition of Samples upon Receipt at Lab:

Custody Seals Intact: ☐ yes ☐ no ☐ none

CHAIN OF CUSTODY RECORD

Relinquished by: (signature)	Received by: (signature)	Date/Time
Relinquished by: (signature)	Received by: (signature)	Date/Time
Relinquished by: (signature)	Received by: (signature)	Date/Time
Relinquished by: (signature)	Received by Mobile Lab For Field Analysis: (signature)	Date/Time
Dispatched by: (signature) Date/Time	Received for Lab by: (signature)	Date/Time

Method of Shipment

Laboratory Copy White — Project Officer Copy Yellow — Field or Office Copy Pink

COOLER RECEIPT FORM

LIMS# _____

Contractor Cooler _____
QA Lab Cooler # _____
Number of Coolers _____

PROJECT: _____ DATE RECEIVED: _____

USE OTHER SIDE OF THIS FORM TO NOTE DETAILS CONCERNING CHECK-IN PROBLEMS.

A. PRELIMINARY EXAMINATION PHASE: Date cooler was opened: _____

By: (print) _____ (sign) _____

1. Did cooler come with a shipping slip (air bill, etc.)?.....YES NO

   If YES, enter carrier name & air bill number here: _____

2. Were custody seals on outside of cooler?.....YES NO

   How many & where: _____ Seal date: _____ Seal name: _____

3. Were custody seals unbroken and intact at the date and time of arrival?.....YES NO
4. Did you screen samples for radioactivity using the Geiger Counter?.....YES NO
5. Were custody papers sealed in a plastic bag & taped inside to the lid?.....YES NO
6. Were custody papers filled out properly (ink, signed, etc.)?.....YES NO
7. Did you sign custody papers in the appropriate place?.....YES NO
8. Was project identifiable from custody papers? If YES, enter project name at top of this form. YES NO
9. If required, was enough is used? .....Type of ice: _____ YES NO
10. Have designated person initial here to acknowledge receipt of cooler: _____ (date) _____

B. LOG-IN PHASE: Date samples were logged-in: _____

By (print) _____ (sign) _____

11. Describe type of packing in cooler: _____
12. Were all bottles sealed in separate plastic bags?.....YES NO
13. Did all bottles arrive unbroken & were labels in good condition?.....YES NO
14. Were all bottle labels complete (ID, date, time signature, preservative, etc.)?.....YES NO
15. Did all bottle labels agree with custody papers?.....YES NO
16. Were correct containers used for the tests indicated?.....YES NO
17. Were correct preservatives added to samples?.....YES NO
18. Was a sufficient amount of sample sent for tests indicated?.....YES NO
19. Were bubbles absent in VOA samples? If NO, list by QA#: _____ YES NO
20. Was project manager called & status discussed? If YES, give details on the back of form. YES NO
21. Who was called? _____
    By whom? _____ (date) _____

DAILY CHEMICAL QUALITY CONTROL REPORT

Project Name:
Project No.:

Date							
Day	S	M	T	W	TH	F	S

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32–50	50–70	70–85	85 up
Wind	Still	Mod.	High	Report No.	
Humidity	Dry	Mod.	Humid		

Personnel and Visitors on Site (List names and affiliations):

Equipment on Site:

Work Performed Today (Include tasks performed and progress/delays):

Safety (Include any infractions of approved safety plan or instructions from Government personnel. Specify corrective action taken):

Attached Forms (check box and describe):

☐ HTRW Drilling Log

☐ Groundwater Sampling Data Sheet

☐ Well Development Data Sheet

☐ EPA Region 9 Laboratory Analyses Required

☐ Well Development Data Sheet

☐ Field Sample Data and Chain of Custody Sheet

☐ Laboratory Data – ☐ SCAPS , ☐ FASP, ☐ Fixed

DAILY CHEMICAL QUALITY CONTROL REPORT

Project Name:	
Project No./Task No.:	**Date:**

Samples Collected (Field and QA)/Requested Analyses/Laboratories Performing Work:

Field Audit Results/Problems Encountered/Corrective Actions Taken:

Instructions to Contractors (Include names, reactions, and remarks):

By _____ **Title** _____
(Signature/Printed Name)

APPENDIX B

USACE Low-Flow Groundwater Purging and Sampling Standard Operating Procedures

LOW-FLOW GROUND WATER PURGING AND SAMPLING USING DEDICATED BLADDER PUMP SYSTEM

STANDARD OPERATING PROCEDURES

1.0 PURPOSE

This Standard Operating Procedure provides general information on low flow minimal draw down ground water purging and sample acquisition from a HTRW monitoring well with dedicated (left in place) bladder pump system. This SOP is intended to provide field personnel with a uniform approach to routine ground water sampling tasks using the low flow method.

2.0 SCOPE

This guideline describes equipment and method for the low flow purging and collection of ground water sample from the saturated zone. Review of these guidelines will also assist in the development and execution of a low flow purging and sampling plan that will provide meaningful and representative data.

3.0 DEFINITION

Low flow purging and sampling using dedicated bladder pumps is an EPA recommended method and is an acceptable method to use for USACE projects. The low flow purging and sampling technique induces laminar (non-turbulent) flow in the immediate vicinity of the sampling pump intake, thus drawing fresh ground water directly from the aquifer, horizontally through the well screen and into the sampling device. Low flow pumping rates are in the approximate range of 0.1 to 0.5 liter/minute. These low flow rates minimize disturbance in the aquifer, resulting in: (1)minimal production of artificial turbidity and oxidation; (2)minimal mixing of chemically distinct zones; (3)minimal loss of volatile organic compounds; and (4)collection of representative samples while minimizing purge volume.

4.0 GUIDELINES

4.1 General

Efficiency and cost-effectiveness of a sampling program will be increased by planning before starting the sampling operation. Well construction must be reviewed in order to specify the equipment and procedures to be used during purging and sampling. A table of well specifications that includes at least the well depths, casing diameters, screened intervals, recovery rates, and water level measurements is to be provided in the Project Sampling and Analysis Plan. Mobilization of equipment will be faster if accessibility of each well location is verified, the wells are accurately plotted on a site map, and the sampling order is determined in advance.

4.2 Purging, Sampling, and Monitoring Supplies and Equipment

The following is a general list of supplies and equipment that will be required when sampling monitoring wells.

- Accident Prevention Plan
- Project Sampling and Analysis Plan
- Personal protective equipment (e.g., gloves, rain gear or Tyvek-type disposable paper suits, steel toe boots, safety glasses)
- First aid kit
- Keys for well locks
- Dedicated purge and sample equipment (Well Wizard or equivalent dedicated pump with stainless steel casing and Teflon bladder, stainless steel inlet screen, Teflon-lined polyethylene twin bonded tubing with 3/8" OD sample tube and ¼" OD air line, 2" or 4" well caps with 3/8" OD discharge and ¼" OD air supply fittings and access hole for water level measurements, 3/8" OD dura-flex discharge adapter)
- In-line flow cell with multi-parameter meter that measures and displays pH, conductivity, temperature, dissolved oxygen, and oxygen-reduction potential (MicroPurge® Flow Cell Model FC4000 or equivalent in-line flow cell which allows for interchanging of sensor probes).
- Pump controller (MicroPurge® Smart Controller Model 400 or equivalent)
- 12 volt DC air compressor, 0.21 SFM @ 100 psi; maximum lift of 75 feet
- Oilless Air Compressor, 4.3 SCFM @ 100 psi; maximum lift of 200 feet
- Turbidity meter (LaMotte Turbidity Meter Model 2008 or equivalent)
- Photoionization detector (MicroTip Model HL-2000 or equivalent)
- Combustible gas indicator (Cannonball Biosystems. Inc. or equivalent)
- Electric water level measurement meter
- Standards and gasses for calibration (e.g., pH, conductivity, turbidity, PID, CGI)

- Pyrex measuring cup
- Stop watch
- Calculator
- Temperature and trip blanks, as specified in the SAP
- Sample preservation(e.g., deionized water, acids, pipettes, pH paper)
- Sample containers(e.g., glass or polyethylene of specific volumes)
- Sample shipment ice chest coolers
- Cold packs or ice for sample preservation in shipment coolers
- Plastic freezer bags to contain ice
- Bubble wrap plastic bags for sample containers
- Packing material to prevent sample containers from breakage during shipment
- Fiber and clear tape
- Chain-of-custody labels, record forms, custody seals, and ground water purging and sampling log sheets. Ground water purging and sampling log sheet is attached.
- Measuring tape
- Log book and indelible ink pen
- Decontamination equipment(e.g., tap and distilled water, non-phosphate soap, buckets, sponges, brushes)
- Camera and film
- Tool box
- D.O.T. approved gasoline storage container for air compressor
- Paper towels and/or rags
- Plastic sheeting (Visqueen)

- Distilled water sprayer used for decontamination
- Scissors and/or razor knife
- Trash bags
- Extra batteries and/or battery packs
- Express mail air bills

Once all the equipment is gathered and checked to determine that it is clean, properly packaged and in working order, the actual procedures for obtaining the samples must be selected. Well sampling is discussed in the next eleven sections in the order that it is performed:

1) Sample Preservation
2) Trip Blanks
3) Equipment Calibration
4) Well Condition Check and Contamination Prevention
5) Air Monitoring
6) Water Level Measurement and Monitoring
7) Initial Pump Installation
8) Low-Flow Purging
9) Sample Collection
10) After Completion of Sampling
11) Decontamination

4.3 Sample Preservation

The appropriate sample containers will be prepared in advance of actual sample collection for analytes of interest and include sample preservative where necessary. Preservatives will be added to the sample containers in a controlled setting prior to entering the field in order to reduce introducing field contaminants into the sample container while adding the preservatives. The preservatives will be transferred from the chemical bottle to the sample container using a disposable pipette. The pipette will be used for only one preservative type and then discarded after adding the specific preservative in the required group of sample containers. The pH of VOA samples will be checked by filling an extra vial with sample water and checking the pH with pH paper once per sampling event.

4.4 Trip Blanks

Trip blanks are used to assess the potential induction of contaminants from sample containers or during the transportation and storage procedures. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed for VOC analytes. Trip blanks will be prepared in the USACE Seattle District laboratory by filling 40 ml volatile organic analyses (VOA) vials with reagent grade water prior to commencement of field work.

Trip blanks will be preserved following the same procedure as investigative samples. One trip blank will accompany each cooler containing VOC samples sent to the laboratory for analysis.

4.5 Equipment Calibration

Prior to and following each day of sampling, all sampling device and monitoring equipment will be calibrated according to manufacturer's recommendations. Calibration documentation including date, time, and the initials of the person that performed the calibration will be recorded in the logbook.

A MicroPurge® Flow Cell Model FC4000 or equivalent will be used to simultaneously measure the pH, conductivity, water temperature, dissolved oxygen (DO), and oxidation reduction potential (Eh) of the water and aqueous solutions. The pH sensor will be calibrated at 2 points. One at neutral point (pH 7 buffer) and the second at pH 4 if the sample is expected to be acidic or pH 10 if the sample is expected to be basic. The conductivity sensor should be calibrated with a standard close to the conductivity range as the water to be sampled and performed at a temperature close to 25 degrees centigrade. This will minimize temperature compensation errors. Before calibrating the DO sensor, check condition of the membrane and change it if bubbles are visible under the membrane, if significant deposits of dried KCL electrolyte are visible on the membrane or O-ring, and/or if the probe shows unstable readings or other malfunction. For DO sensor calibration follow the detailed calibration procedure found in the MicroPurge® Flow Cell Model FC4000 User Guide manual or equivalent.

A dissolved oxygen Hach limnology kit or equivalent will be used on a site-specific basis as a quality control check on the DO sensor. The temperature and Eh sensors are factory calibrated, but should be checked on a regular basis. The temperature sensor should be checked by immersing it in water at a known temperature value. The Eh sensor should be checked by immersing it in a solution with a known oxidation reduction potential value, “Zobell” solution is recommended. Temperature and Eh sensors that cannot be factory recalibrated should be replaced if readings vary more than ±10 percent.

A MicroTIP, Model HL-2000, or equivalent hand held air monitor/photoionization detector(PID) will be used to measure the total concentration of airborne photoionizable gases and vapors released from the wells. The PID will first be calibrated to zero air followed by isobutylene span gas at 100 ppm +/- 5%.

A LaMotte Turbidity Meter, Model 2008, or equivalent will be used to measure the turbidity of the ground water. Turbidity standards, AMCO Turbidity Standard 0.5 NTU or 5.0 NTU, will be used to calibrate the meter.

A combustible gas indicator(CGI), Biosystems,Inc. Cannonball, or equivalent that will respond to all combustible gases and vapors will be used when specified in the Project Sampling and Analysis Plan. The CGI will first be calibrated to zero air followed by LFL propane span gas at 52.4 %.

4.6 Well Condition Check and Contamination Prevention

Check and record the condition of the well for any damage or evidence of tampering. To prevent contamination of the surface soils and the equipment, lay out a plastic sheeting around the wellhead and place the monitoring, purging and sampling equipment on the sheeting.

4.7 Air Monitoring

Measure total organic vapors upwind from the well to obtain a background reading using a PID equipped with a 10.6 eV lamp. Unlock well and remove well cap. Measure head space with the PID. For wells installed on a landfill or sites where combustible gas may be present, also measure head space with a CGI. If measurements indicate it is not safe, take necessary precautions noted in Health and Safety Plan.

4.8 Water Level Measurement and Monitoring

An electric water level meter will be used to measure the water level in the wells before purging, during purging, and after sampling. The water level probe should be carefully lowered down the well to minimize disturbance. Check water level periodically to monitor draw down as a guide to flow rate adjustment. The goal is minimal draw down, less than 4 inches during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval and may require adjustment based on site-specific conditions.

Measure the water level to the nearest 0.01 foot. Water level will be measured from the notch located at the top of the well casing. If well casing is not notched, measurement will be taken from the north edge of the top of the well casing, and a notch will be made using a decontaminated metal file.

Well depth should be obtained from well logs prior to entering the field. If well depth measurement is required, measure depth after sampling is complete.

4.9 Initial Pump Installation

The pump intake shall be positioned in the middle of the screened interval for wells with screen lengths less than or equal to 5-feet. For wells with longer screens, the pump intake shall be placed within the most productive zone. Therefore, the geologic log for each well shall first be consulted to determine the most productive zone. If at all possible, the pump intake shall not be placed within 2-feet of the well bottom or low water level.

4.10 Low-Flow Purging

Set up air compressor, pump controller, and in-line low flow cell to manufacturer specifications.

Begin purging at rate of 0.1 to 0.5 liters/minute. The appropriate and final purge rate will be determined by monitoring ground water draw down controlled by site specific conditions. If in-line flow meters are not used, pumping rates should be determined by collecting a measured

aliquot of purge water over a period of at least one minute. The discharge during purging and sampling must produce a non-pulsating flow. The water level should stabilize and ideally the pump rate should be sufficiently low to allow an equal or greater amount of water to recharge the well so little or no water level draw down is observed.

Measure and record ground water levels at least every 2 to 5 minutes until stabilization occurs. After stabilization, measure water levels at regular intervals. If significant draw down occurs, more than 4 inches, lower the speed of the pump and repeat discharge and water level measurements. Repeat until the water level stabilizes to closely match the recharge rate. Record pumping rate and any adjustments and depths to water on the purging and sampling log sheet.

Prior to and during purging, historic water quality parameter data shall be used to assist with evaluating stabilization. Any significant deviations will be recorded in the field sampling log book.

During purging, water chemistry indicator parameters will be measured continuously, every 2 to 5 minutes, until the parameters have stabilized. The water chemistry indicator parameters monitored shall include pH, temperature, conductivity, redox potential (Eh) and dissolved oxygen (DO). Turbidity shall be measured, but shall not used as a stabilizer indicator. The required indicator parameters to be monitored will be specified in the Project Sampling and Analysis Plan. As a guideline for stabilization, all indicator parameters should have stabilized for three successive readings. The 3 successive readings should be within +/- 0.1 for pH, +/- 3% for conductivity, +/- 10% for temperature, DO, and Eh. Eh and DO usually require the longest time for stabilization. A turbidity reading of 10 NTU's or less is desirable.[1] The above stabilization guidelines are provided as estimates and will not be appropriate for use in all circumstances. The purge stabilized indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable parameter values during purging. Purging will continue until the indicator parameters have stabilized to within the specified tolerance for each parameter and graph out asymptotically. It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter particularly with respect to draw down, flow rate, and sampling device. Fifteen to 30 minutes of purging at a rate of 0.1 to 0.5 liter/minute may be required to reach stabilization. If the indicator parameters do not stabilize, purging will cease after 60 minutes have elapsed.

The ground water should not be exposed to the atmosphere prior to measurement of the parameters because turbulence, degassing, aeration, heating, and depressurization can all cause significant changes in Eh, conductivity, and DO concentrations. Therefore, an in-line multi-parameter flow-through cell will be utilized when monitoring the indicator parameters.

All water produced during purging will be containerized and stored pending evaluation of acceptability for discharge or treatment.

Unless absolutely necessary, the pump will not be turned off between the purging and sampling process.

Wells installed in very low permeability formations(<0.1 L/min recharge) will require alternative purging and sampling methods. Use of the usual low flow techniques may be impractical in this type of environment, because devices to pump at such low flow rates are not readily available. The primary consideration is to avoid de-watering of the well screen and exposing the filter pack or formation in the saturated zone to atmospheric conditions. This may entail acquiring the sample with no or very little purging(volume of the tubing and pump chamber) and repeated recovery of the water. This may require that the water chemistry parameters be measured more frequently(every 1 to 2 minutes). Satisfying the usual sample volume requirements may also be a problem and some latitude will be needed on the part of the end-users. To ensure that the appropriate technique and methodology for purging and sampling collection is used, information on well construction and development is needed prior to the start of field activities. The decision on the purging and sampling collection technique and methodology to employ will be dictated by site specific conditions and objectives covered in the Project Sampling and Analysis Plan.

4.11 Sample Collection

Sampling can be initiated after the water chemistry indicator parameters have stabilized. Before collecting samples, sampling personnel will don clean, Nitrile or equivalent protective gloves. Sampling should occur in progression from least to most contaminated well if this is known. Samples will be collected directly from the end of the discharge tubing maintaining the established low flow purge rate. The sequence in which the different types of samples are collected is immaterial.

While filling the sample vial for VOC analysis, formation of air bubbles, aeration, and turbulence should be minimized by using the established low flow rate. A meniscus should be formed over the mouth of the vial to eliminate formation of air bubbles and head space prior to capping.

When pouring the sample from the discharge tubing into the sample bottle, the sample water will be poured gently down the inside of the bottle with minimal turbulence. After filling the sample container, the Teflon-lined cap will be screwed tightly to prevent the container from leaking. A sample label will be filled out and placed on the sample container as specified in the Project Sampling and Analysis Plan. The samples will be stored and shipped at 4°C. All samples will be shipped to the laboratory within 48 hours of collection.

The intent of low flow purging and sampling is to minimize disturbance in the well and thus eliminate the need for filtering samples for inorganic analyses. The unfiltered sample is meant to represent the total mobile contaminant load. However, filtering of samples collected for inorganic analyses may be recommended in some instances. The decision to filter samples will be dictated by site specific sampling objectives covered in the Project Sampling and Analysis Plan.

If filtering is performed, in-line filters will be used. The filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of one liter of ground water following purging and prior to sampling.

4.12 After Completion of Sampling

The air inlet and discharge lines shall be carefully removed from their respective well cap fittings Place protective cap on the air inlet and discharge fittings. Close and lock the well. Between all sampling locations, all sampling equipment that comes in contact with the well water(eg. water level meter, turbidity vials) will require decontamination**.** All non-dedicated supplies and equipment will be gathered and disposed of properly.

4.13 Decontamination

The water level meter and water chemistry parameter indicator sensors will be decontaminated according to the following procedures:

1. The water level meter will be hand washed with phosphate free detergent with a scrubber or sponge, then thoroughly rinsed with distilled water.

2. The parameter indicator meter probes will be rinsed with clean tap water after each measurement. No other decontamination procedures are necessary or recommended for these instrument probes and vials since they are very sensitive, and they do not contact in-situ well and sample water. After the sampling event, the flow cell chamber and sensors will be cleaned and maintained as necessary according to the care and maintenance procedures found in the MicroPurge® Flow Cell Model FC4000 User Guide manual or equivalent.

End of Standard Operating Procedures

Footnotes:
[1]Removed maximum allowed turbidity value of 10 NTU's.

LOW-FLOW GROUND WATER PURGING AND SAMPLING USING DEDICATED BLADDER PUMP SYSTEM

SEATTLE DISTRICT HTRW DESIGN CENTER
STANDARD OPERATING PROCEDURES

22 March 1999

US Army Corps
of Engineers
Seattle District

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LOW FLOW GROUND WATER PURGING AND SAMPLING USING NON-DEDICATED SUBMERSIBLE PUMPS

STANDARD OPERATING PROCEDURES

1.0 PURPOSE

This Standard Operating Procedure provides general information on low flow minimal draw down ground water purging and sample acquisition from HTRW monitoring wells with non-dedicated submersible pumps. This SOP is intended to provide field personnel with a uniform approach to routine ground water sampling tasks using the low flow method.

2.0 SCOPE

This guideline describes equipment and method for the low flow purging and collection of ground water sample from the saturated zone. Review of these guidelines will also assist in the development and execution of a low flow purging and sampling plan that will provide meaningful and representative data.

3.0 DEFINITION

Low flow purging and sampling is an EPA recommended method and is an acceptable method to use for USACE projects. The low flow purging and sampling technique induces laminar (non turbulent) flow in the immediate vicinity of the sampling pump intake, thus drawing ground water directly from the aquifer, horizontally through the well screen and into the sampling device. Low flow pumping rates are typically in the range of 0.1 to 0.5 liter/minute, however, this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations can be sampled successfully at flow rates of 0.5 to1.0 liters/minute. These low flow rates minimize disturbance in the aquifer, resulting in: (1)minimal production of artificial turbidity and oxidation; (2)minimal mixing of chemically distinct zones; (3)minimal loss of volatile organic compounds; and (4)collection of representative samples while minimizing purge volume.

4.0 GUIDELINES

4.1 General

Efficiency and cost-effectiveness of a sampling program will be increased by planning before starting the sampling operation. Well construction must be reviewed in order to specify the equipment and procedures to be used during purging and sampling. A table of well specifications that includes at least the well depths, casing diameters, screened intervals,

recovery rates, and water level measurements is to be provided in the Project Sampling and Analysis Plan. Mobilization of equipment will be faster if accessibility of each well location is verified, the wells are accurately plotted on a site map, and the sampling order is determined in advance.

4.2 Purging,Sampling,and Monitoring Supplies and Equipment

The following is a general list of supplies and equipment that will be required when sampling monitoring wells.

- Accident Prevention Plan
- Project Sampling and Analysis Plan
- Personal protective equipment(e.g., gloves, rain gear or Tyvex suits, steel toe boots, safety glasses)
- First aid kit
- Keys for well locks
- Purge and sample equipment(e.g., electrical submersible pumps or bladder pumps, generator, oilless air compressor, filters, tubing)
- In-line flow cell with multi-parameter meter that allows for interchanging of sensor probes.
- Meters, probes and standards for field measurements (e.g., turbidity, water level, PID, calibration gas)
- Pyrex measuring cup
- Graduated beaker
- Stop watch
- Calculator
- Temperature and trip blanks, as specified in the SAP
- Sample preservation(e.g., deionized water, acids, pipettes, pH paper)
- Sample containers(e.g., glass or polyethylene of specific volumes)

- Sample shipment ice chest coolers
- Cold packs or ice for sample preservation in shipment coolers
- Plastic freezer bags to contain ice
- Bubble wrap plastic bags for sample containers
- Packing material to prevent sample containers from breakage during shipment
- Fiber and clear tape
- Chain-of-custody labels, record forms, custody seals, and ground water purging and sampling log sheets. Ground water purging and sampling log sheet is attached.
- Measuring tape
- Log book and indelible ink pen
- Decontamination equipment(e.g.,tap and distilled water, non-phosphate soap,buckets,sponges,brushes)
- Camera and film
- Tool box
- D.O.T. approved gasoline storage container for generator or oilless air compressor
- Paper towels and/or rags
- Plastic sheeting(Visqueen)
- Decon sprayer
- Scissors and/or razor knife
- Trash bags
- Extra batteries and/or battery packs
- Express mail air bills

Once all the equipment is gathered and checked to determine that it is clean, properly packaged and in working order, the actual procedures for obtaining the samples must be selected. Well sampling is discussed in the next eleven sections in the order that it is performed:

1) Sample Preservation
2) Trip Blanks
3) Equipment Calibration
4) Equipment Blanks
5) Well Condition Check and Contamination Prevention
6) Air Monitoring
7) Water Level Measurement and Monitoring
8) Low-Flow Purging
9) Sample Collection
10) After Completion of Sampling
11) Decontamination

4.3 Sample Preservation

The appropriate sample containers will be prepared in advance of actual sample collection for analytes of interest and include sample preservative where necessary. Preservatives will be added to the sample containers in a controlled setting prior to entering the field in order to reduce introducing field contaminants into the sample container while adding the preservatives. The preservatives will be transferred from the chemical bottle to the sample container using a disposable pipette. The pipette will be used for only one preservative type and then discarded after adding the specific preservative in the required group of sample containers. The pH of VOA samples will be checked by filling an extra vial with sample water and checking the pH with pH paper once per sampling event.

4.4 Trip Blanks

Trip blanks are used to assess the potential induction of contaminants from sample containers or during the transportation and storage procedures. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed for VOC analytes. Trip blanks will be prepared in the USACE Seattle District laboratory by filling 40 ml volatile organic analyses (VOA) vials with reagent grade water prior to commencement of field work. Trip blanks will be preserved following the same procedure as investigative samples. One trip blank will accompany each cooler containing VOC samples sent to the laboratory for analysis.

4.5 Equipment Calibration

Prior to and following each day of sampling, all sampling device and monitoring equipment will be calibrated according to manufacturer's recommendations. Calibration documentation including date, time, and the initials of the person that performed the calibration will be recorded in the logbook.

A MicroPurge® Flow Cell Model FC4000 or equivalent will be used to simultaneously measure the pH, conductivity, water temperature, dissolved oxygen (DO), and oxidation reduction potential (Eh) of the water and aqueous solutions. The pH sensor will be calibrated at 2 points. One at neutral point (pH 7 buffer) and the second at pH 4 if the sample is expected to be acidic or pH 10 if the sample is expected to be basic. The conductivity sensor should be calibrated with a standard close to the conductivity range as the water to be sampled and performed at a temperature close to 25 degrees centigrade. This will minimize temperature compensation errors. Before calibrating the DO sensor, check condition of the membrane and change it if bubbles are visible under the membrane, if significant deposits of dried KCL electrolyte are visible on the membrane or O-ring, and/or if the probe shows unstable readings or other malfunction. For DO sensor calibration follow the detailed calibration procedure found in the MicroPurge® Flow Cell Model FC4000 User Guide manual or equivalent.

A MicroTIP, Model HL-2000, or equivalent hand held air monitor/photoionization detector(PID) will be used to measure the total concentration of airborne photoionizable gases and vapors released from the wells. The PID will first be calibrated to zero air followed by isobutylene span gas at 100 ppm +/- 5%.

A LaMotte Turbidity Meter, Model 2008, or equivalent will be used to measure the turbidity of the ground water. Turbidity standards, AMCO Turbidity Standard 0.5 NTU or 5.0 NTU, will be used to calibrate the meter.

A combustible gas indicator(CGI), Biosystems,Inc. Cannonball, or equivalent that will respond to all combustible gases and vapors will be used when specified in the Project Sampling and Analysis Plan. The CGI will first be calibrated to zero air followed by LFL propane span gas at 52.4 %.

4.6 Equipment Blanks

Equipment blank samples will be collected at a frequency of once per day to assess the effectiveness of the equipment decontamination procedures. The frequency of equipment blank collection will be specified in the Project Sampling and Analysis Plan. Equipment blanks will be collected in the field prior to purging and between sampling wells after proper equipment decontamination. Distilled or reagent grade water will be pumped through the system and will be collected in a sample container. All equipment blanks will be submitted blind to the laboratory with sample numbers that are indistinguishable from the investigative samples.

Equipment blanks will be preserved in the same manner as the investigative samples and will analyzed for the same parameters as the associated samples.

4.7 Well Condition Check and Contamination Prevention

Check and record the condition of the well for any damage or evidence of tampering. To prevent contamination of the surface soils and the equipment, lay out a plastic sheeting around the wellhead and place the monitoring, purging and sampling equipment on the sheeting.

4.8 Air Monitoring

Measure total organic vapors upwind from the well to obtain a background reading using a PID equipped with a 10.6 eV lamp. Unlock well and remove well cap. Measure head space with the PID. For wells installed on a landfill or sites where combustible gas may be present, also measure head space with a CGI. If measurements indicate it is not safe, take necessary precautions noted in Health and Safety Plan.

4.9 Water Level Measurement and Monitoring

An electric water level meter will be used to measure the water level in the wells before installing the pump. Water levels will also be measured before, during purging, and after sampling. The water level probe should be carefully lowered down the well to minimize disturbance. Check water level periodically to monitor draw down as a guide to flow rate adjustment. The goal is minimal draw down, less than 4 inches during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval and may require adjustment based on site-specific conditions.

Measure the water level to the nearest 0.01 foot. Water level will be measured from the notch located at the top of the well casing. If well casing is not notched, measurement will be taken from the north edge of the top of the well casing, and a notch will be made using a decontaminated metal file.

Well depth should be obtained from well logs prior to entering the field. If, well depth measurement is required, measure depth after sampling is complete.

4.10 Low-Flow Purging

Set up non-dedicated submersible pump, control, and power source components according to manufacturer specifications. Measure and mark desired pump intake placement depth on dedicated tubing and assemble to pump.

Slowly and carefully lower pump down to the desired sample depth where contaminants and representative ground water flow are expected. Be careful not to place the pump intake less than 2-feet above the bottom of the well as this may cause the mobilization of bottom sediments. There should be at least 2-feet of water above the pump intake to prevent pump suction from being broken or entrainment of air in the sample. The pump intake should be positioned in the middle of the screened interval for wells with screen lengths less than or equal to 5-feet. For wells with longer screens, the pump intake should be placed within the most productive zone. Therefore, the geologic log for each well shall be first consulted to determine the most productive zone. The pump intake depth will be recorded on the purging and sampling log sheet.

The water level in the well will rise due to displacement by the pump. Wait for water to equilibrate to its original level before purging.

After the well has equilibrated, begin purging at rate that minimizes stress(draw down) to the system. The appropriate and final purge rate will be determined by monitoring ground water draw down controlled by site specific conditions. The discharge during purging and sampling must produce a non-pulsating flow. The water level should stabilize and the pump rate should be sufficiently low to allow an equal or greater amount of water to recharge the well so little or no water level draw down is observed.

Measure and record ground water levels at least every 2 to 5 minutes until stabilization occurs. After stabilization, measure water levels at regular intervals. If significant draw down occurs, more than 4 inches, lower the speed of the pump and repeat discharge and water level measurements. Repeat until the water level stabilizes to closely match the recharge rate. Record pumping rate and any adjustments and depths to water on the purging and sampling log sheet.

During purging, water chemistry indicator parameters will be measured continuously, every 2 to 5 minutes, until the parameters have stabilized. The water chemistry indicator parameters monitored shall include pH, temperature, conductivity, redox potential (Eh) and dissolved oxygen (DO). Turbidity shall also be measured, but shall not used as a stabilizer indicator. However, turbidity values should not exceed 10 NTU's. The required indicator parameters to be monitored will be specified in the Project Sampling and Analysis Plan. As a guideline for stabilization, all indicator parameters should have stabilized for three successive readings. The 3 successive readings should be within +/- 0.1 for pH, +/- 3% for conductivity, +/- 10% for temperature, DO, and Eh. Eh and DO usually require the longest time for stabilization. A turbidity reading of 10 NTU's or less is desirable.[1] The above stabilization guidelines are provided as estimates and will not be appropriate for use in all circumstances. The purge stabilized indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable parameter values during purging. Purging will continue until the indicator parameters have stabilized to within the specified tolerance for each parameter and graph out asymptotically. It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter particularly with respect to draw down, flow rate, and sampling device. Purging will cease if the indicator parameters do not stabilize within 60 minutes of elapsed purging time.

The ground water should not be exposed to the atmosphere prior to measurement of the parameters because turbulence, degassing, aeration, heating, and depressurization can all cause significant changes in Eh, conductivity, and DO concentrations. Therefore, an in-line multi-parameter flow-through cell will be utilized when monitoring the indicator parameters.

All water produced during purging will be containerized and stored pending evaluation of acceptability for discharge or treatment.

Unless absolutely necessary, the pump will not be turned off between the purging and sampling process.

Wells installed in very low permeability formations(<0.1 L/min recharge) will require alternative purging and sampling methods. Use of the usual low flow techniques may be impractical in this type of environment, because devices to pump at such low flow rates are not readily available. The primary consideration is to avoid dewatering of the well screen and exposing the filter pack or formation in the saturated zone to atmospheric conditions. This may entail acquiring the sample with no or very little purging(volume of the tubing and pump chamber) and repeated recovery of the water. This may require that the water quality parameters be measured more frequently(every 1 to 2 minutes). Satisfying the usual sample volume requirements may also be a problem and some latitude will be needed on the part of the end-users. To ensure that the appropriate technique and methodology for purging and sampling collection is used, information on well construction and development is needed prior to the start of field activities. The decision on the purging and sampling collection technique and methodology to employ will be dictated by site specific conditions and objectives covered in the Project Sampling and Analysis Plan.

4.11 Sample Collection

Sampling can be initiated after the water quality indicator parameters have stabilized. Before collecting samples, sampling personnel will don clean, nitrile or equivalent protective gloves. Sampling should occur in progression from least to most contaminated well if this is known. Samples will be collected directly from the end of the discharge tubing maintaining the established low flow purge rate. The sequence in which the different types of samples are collected is immaterial.

While filling the sample vial for VOC analysis, formation of air bubbles, aeration, and turbulence should be minimized by using the established low flow rate. A meniscus should be formed over the mouth of the vial to eliminate formation of air bubbles and head space prior to capping.

When pouring the sample from the discharge tubing into the sample bottle, the sample water will be poured gently down the inside of the bottle with minimal turbulence. After filling the sample container, the Teflon-lined cap will be screwed tightly to prevent the container from

leaking. A sample label will be filled out and placed on the sample container as specified in the Project Sampling and Analysis Plan. The samples will be stored and shipped at 4°C. All samples will be shipped to the laboratory within 48 hours of collection.

The intent of low flow purging and sampling is to minimize disturbance in the well and thus eliminate the need for filtering samples for inorganic analyses. The unfiltered sample is meant to represent the total mobile contaminant load. However, filtering of samples collected for inorganic analyses may be recommended in some instances. The decision to filter samples will be dictated by site specific sampling objectives covered in the Project Sampling and Analysis Plan.

If filtering is performed, in-line filters will be used. The filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of one liter of ground water following purging and prior to sampling.

4.12 After Completion of Sampling

Unless the pump has been dedicated to the well, the pump assembly should be carefully removed from the well. Close and lock the well. Between all sampling locations, all sampling equipment that comes in contact with the well water will require decontamination. All non-dedicated supplies and equipment will be gathered and disposed of properly.

4.13 Decontamination

The non-dedicated ground water pump system (e.g., pump, power source cable, tubing) that will be used in multiple wells will be decontaminated according to the following procedures:

1. The outside surfaces of the pump and other components that contacts the ground water will be hand washed with phosphate free detergent and warm water, up to 100°F maximum, with a scrubber sponge; thoroughly rinsed with warm water, then rinsed with distilled water.

2. The inside and outside surfaces of the pump will be flushed with phosphate free detergent and warm water, up to 100 °F maximum, then thoroughly flushed with warm water followed with distilled water. It is recommended that the Teflon lined tubing used to draw the ground water be dedicated to each well sampled.

3. The sampling crew will be required to clean the pump system using procedures 1 and 2 between well sampling. For rental pumps, the rental company shall be required to decontaminate the equipment following above procedures 1 and 2. In addition, the pump shall be disassembled, all internal parts shall be cleaned, and all Teflon parts shall be replaced.

The water level meter and water quality parameter indicator probes will be decontaminated according to the following procedures:

1. The water level meter will be hand washed with phosphate free detergent with a scrubber or sponge, then thoroughly rinsed with distilled water.

2. The parameter indicator meter probes will be rinsed with distilled water after each measurement. No other decontamination procedures are necessary or recommended for these instrument probes and vials since they are very sensitive, and they do not contact in-situ well and sample water. After the sampling event, the meter probes will be decontaminated again by hand washing with phosphate free detergent and warm water with a scrubber sponge and then thoroughly rinsed with deionized water in the USACE Seattle District laboratory or equivalent.

End of Standard Operating Procedures

LOW-FLOW GROUND WATER PURGING AND SAMPLING USING NON-DEDICATED SUBMERSIBLE PUMPS

SEATTLE DISTRICT HTRW DESIGN CENTER
STANDARD OPERATING PROCEDURES

23 March 1999

US Army Corps
of Engineers
Seattle District

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Part II

Quality Assurance and Project Plan

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ABBREVIATIONS AND ACRONYMS

AA	atomic absorption
ASTM	American Society for Testing and Materials
COC	chain of custody
CLP	Contract Laboratory Program
COPC	chemical of potential concern
CVAA	cold vapor atomic absorption spectophotometry
DQO	data quality objective
ECD	electron capture detector
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
FPD	flame photometric detector
FSP	field sampling plan
GB	sarin
GC/MS	gas chromatograph/mass spectrometry
HD	mustard gas
HPLC	high-performance liquid chromatography
HTRW	hazardous, toxic, and radiological waste
ICP	inductively coupled plasma
ICP/MS	inductively coupled plasma/mass spectrometry
LC/MS	liquid chromatograph/mass spectrometry
LCS	laboratory control sample
LIMS	laboratory information management system
MB	method blank
MCL	maximum contaminant level
MDL	method detection limit
mL	milliliter
MRL	method reporting limit
MS/MSD	matrix spike/matrix spike duplicate
NIST	National Institute of Standards and Technology
NPD	North Pacific Division
NWTPH-Dx	Northwest total petroleum hydrocarbons – diesel extended
ODEQ	Oregon Department of Environmental Quality
ORP	oxidation-reduction potential
PCBs	polychlorinated biphenyls
PID	photoionization detector
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goal
QA/QC	quality assurance/quality control

ABBREVIATIONS AND ACRONYMS (Continued)

QAM	quality assurance manager
QAPP	quality assurance project plan
RPD	relative percent difference
SAP	sampling analysis plan
SAS	Sound Analytical Services
SI	site investigation
SOP	standard operating procedure
SOW	Statement of Work
SPE	solid-phase extraction
SVOCs	semivolatile organic compounds
SWRI	Southwest Research Institute
TAL	Target Analyte List
TCL	Target Compound List
TIC	tentatively identified compound
TPH-Dx	total petroleum hydrocarbons–diesel range extended
URS	URS Corporation and subsidiaries
USACE	U.S. Army Corps of Engineers
UV	ultraviolet
VOCs	volatile organic compounds

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP), in conjunction with the Field Sampling Plan (FSP), make up the Sampling and Analysis Plan (SAP), which is an integral part of the Management Plan for the former North Pacific Division (NPD) laboratory site investigation (SI) in Troutdale, Oregon. The purpose of the SAP is to ensure production of high quality data that meet project objectives and requirements and accurately characterize measurement parameters. The SAP provides protocols for collecting samples, measuring and controlling data, and documenting field and laboratory methods so that the data are technically and legally defensible. The SAP was prepared in accordance with guidelines set forth by the U.S. Army Corps of Engineers requirements (USACE 1994).

The SAP has two major components: Part I - the FSP and Part II - this QAPP. The FSP presents the detailed scope of work associated with field activities (e.g., sample types, sample locations) and specifies the procedures to be used for sampling and other field operations. The QAPP describes the analytical data quality objectives, field and laboratory analytical procedures, quality assurance/quality control (QA/QC) procedures, and data quality evaluation criteria.

Sampling and analysis procedures for the field exploration are designed to be sufficient to satisfy the data quality objectives (DQOs) identified in Section 6.0 of the Work Plan. This plan presents the analytical methods and associated QA/QC procedures selected to meet the project DQOs.

2.0 ANALYTICAL DATA QUALITY OBJECTIVES

The purpose of the SI at the NPD laboratory site is to complete a consistent sampling and analysis scope that can be used to fill the data gaps left following previous investigations. Soil, sediment, groundwater, and concrete samples will be collected for the following purposes:

- To collect the data required to better define the type and extent of groundwater, soil, sediment, groundwater, and concrete contamination
- To determine if previous removal of contaminated soil was complete
- To determine if pole-mounted transformers have adversely impacted the soil around the existing transformer pad
- To evaluate any adverse impacts to the environment from past laboratory activities
- To determine the concentration of any contamination in the Umatilla Army Depot Borrow Site (borrow site) soils

2.1 CHEMICALS OF POTENTIAL CONCERN

Soil, sediment, groundwater, and concrete samples will be collected and analyzed for chemicals of potential concern (COPCs). For this site, the COPCs include the following:

- U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) Target Compound List (TCL) volatile and semivolatile organic compounds (VOCs and SVOCs), chlorinated pesticides, and polychlorinated biphenyls (PCBs)
- EPA CLP Target Analyte List (TAL) metals and cyanide
- Northwest Total Petroleum Hydrocarbons-diesel range extended (NWTPH-Dx)

In addition to these analytes, samples of the Umatilla borrow site materials will be analyzed for the following:

- EPA SW-846 Method 8330 list explosives

- Breakdown compounds from the chemical agents HD (mustard gas), VX, and GB (sarin).

Concentrations of COPCs detected during analysis will be compared to EPA maximum contaminant levels (MCLs), Oregon Department of Environmental Quality (ODEQ) Groundwater Quality Protection Standards, ODEQ Soil Cleanup Levels, and EPA Region 9 Preliminary Remedial Goals (PRGs). For some analytes, the laboratories will be unable to achieve reporting limits that are as low as the screening criteria for those analytes. Screening criteria that are lower than the laboratory reporting limits are highlighted in the table provided in Appendix A. When sample data cannot be compared to low-concentration screening criteria (because reporting limits exceed screen criteria), the data will be evaluated qualitatively by the Project Chemist. For example, the data will be evaluated for the presence or absence of the compound and for the presence of other collocated contaminants.

2.2 DATA QUALITY LEVELS

The sampling and analysis program was developed to generate data to meet project objectives and support the conclusions made by the technical staff. A more detailed description of the sampling rationale and project DQOs can be found in Section 6.2 of the Work Plan. The following section describes the approach to be used for data generation in the field and at off-site laboratories, and describes sources of uncertainty and how uncertainty will be managed. The quality control program associated with this approach and documented in this QAPP has been developed to address these uncertainties.

Two levels of data quality and analysis are applicable for this project:

- Screening-level data
- Definitive data

2.2.1 Screening-Level Data

Groundwater parameters will be measured during monitoring well development and sampling to evaluate conditions prior to sampling. These parameters include turbidity, temperature, pH, oxidation-reduction potential (ORP), specific conductance, and dissolved oxygen. A photoionization detector (PID) will be used to perform headspace screening. A discussion of field measurement quality assurance is presented in Section 3.

2.2.2 Definitive Level Data

Definitive data will be generated to determine the presence and concentration of COPCs at the site and to compare the detected concentrations to regulatory screening criteria. To generate data of sufficient quality for these uses, the following approach will be followed:

- The laboratories will be validated by the U.S. Army Corps of Engineers (USACE).
- Methods approved by the EPA will be used. Quality control samples and procedures will be used by the laboratories for analysis, as specified in Sections 4 through 6 and Appendix B.
- The laboratories will provide EPA CLP-like data reports for all analyses requiring definitive data. The complete data report and documentation must be sufficient to perform data validation if required.
- Documents will be retained in the project files for a minimum of 10 years from the time of receipt from the laboratories.
- Data quality review and validation will be performed on the analytical data according to the procedures specified in Section 10.

2.3 ANALYTICAL METHODS

Samples collected for the NPD laboratory SI will be analyzed according to EPA-approved methods. Analytical methods to be performed for the SI are presented in Section 5. The laboratories' standard operating procedures (SOPs) must be in compliance with the USACE *Engineer Manual EM 200-1-3*, Appendix I (USACE 2001) with modifications where appropriate. All method modifications must be documented and approved by the USACE.

Southwest Research Institute (SWRI) located in San Antonio, Texas, will conduct the analyses for the breakdown products of chemical agents, and Sound Analytical Services (SAS), Inc., located in Fife, Washington, will conduct all other analyses.

2.4 ANALYTICAL METHOD DETECTION LIMITS AND METHOD REPORTING LIMITS

Sensitivity requirements for all methods and matrices are driven by the DQOs. Laboratory data for the COPCs will be compared to applicable screening criteria as listed in Appendix A; therefore, method reporting limits (MRLs) should be less than the applicable matrix-specific screening criteria whenever possible. Method detection limits (MDLs) and MRLs are defined below.

The sensitivity of some of the analytical methods identified for this project is insufficient to allow comparison of all the target analytes to the screening criteria. Screening criteria concentrations that are lower than the analyte MRLs are highlighted in Appendix A. Values reported below the MRL but above the MDL and flagged as estimated (J) may be used as semiquantitative data points. However, when there are no analytes reported below the MRL, the data value used for comparison will be the MRL.

2.4.1 Method Detection Limit

The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDLs are determined from analysis of a sample in a given matrix containing the analyte (Appendix B of 40 CFR 136).

2.4.2 Method Reporting Limit

The Method Reporting Limit (also called the Practical Quantitation Limit [PQL] by SAS) is a threshold value below which the laboratory reports a result as non-detected. It may be based on project-specific criteria, regulatory action levels, or sensitivity capability of method and instrument. MRLs are adjusted based on the sample matrix and any necessary sample dilutions. The MRL represents the value for which the laboratory has demonstrated the ability to reliably quantitate target analytes within prescribed performance criteria for the method performed. Analytes whose concentrations fall below the MRL will be considered estimated.

3.0 METHODS AND QUALITY CONTROL FOR FIELD ACTIVITIES

This section describes field measurement procedures, sample handling, and coordination procedures between the sampling team and analytical laboratories. Detailed sampling procedures are presented in the FSP.

3.1 FIELD MEASUREMENT METHODS

Groundwater will be monitored during sampling for specific conductance, pH, turbidity, dissolved oxygen, temperature, and ORP using a water quality meter with flow-through chamber. A PID will be used to perform headspace screening. Both instruments will be used and calibrated daily according to the manufacturer's instructions.

3.2 FIELD MEASUREMENT INSTRUMENT CALIBRATION PROCEDURES

Field instruments used for this investigation will be rented; however, the calibration and general maintenance of field instruments will be the responsibility of the Field Investigation Manager. All calibration procedures and measurements will be made in accordance with manufacturers' specifications and the USACE SOP for low-flow purging and sampling (Appendix B to the FSP). Field instruments will be checked and calibrated before their use on site, and batteries will be charged and checked daily.

Instrument calibration will be conducted at the beginning of each workday, at midday, and if necessary through the course of the day in accordance with URS SOPs "Equipment Calibration, Operation, and Maintenance" and "Water Quality Monitoring Equipment." A final calibration will be conducted at the end of the day after the last field sample has been analyzed. Special attention will be given to instruments that may drift with change in ambient temperature or humidity. A three-point initial calibration will be conducted if applicable to the instrument being used. One-point calibrations will be conducted thereafter. If an instrument is found to be out of compliance during a calibration, sampling personnel may be required to reanalyze samples collected subsequent to the failed recalibration.

Equipment that fails calibration and/or becomes otherwise inoperable during the field investigation will be removed from service and segregated to prevent inadvertent use. Such equipment will be properly tagged to indicate that it should not be used until repaired. Equipment that cannot be repaired or recalibrated will be replaced.

All documentation pertinent to the calibration and/or maintenance of field equipment will be maintained in an active field logbook. Logbook entries regarding the status of field equipment will contain, but will not necessarily be limited to, the following information:

- Date and time of calibration
- Name of person conducting calibration
- Type of equipment being used or serviced and identification (make and model)
- Reference standard used for calibration (such as pH of buffer solutions)
- Calibration and/or maintenance procedure used
- Adjustments made based on calibration results
- Other pertinent information (e.g., operational problems such as drift)

3.3 SAMPLE HANDLING, CONTAINERS, PRESERVATION, AND HOLDING TIMES

Sample containers, preservation, and holding times are summarized in Tables 3-2 and 3-3 in the FSP. Samples will be collected in glass or plastic containers. The containers will have screw-type lids to ensure adequate sealing of the bottles. Lids of the glass containers will have Teflon inserts to prevent sample reaction with the lid and to improve the quality of the seal.

Commercially available precleaned jars will be used. The bottle shipment documentation will record batch numbers for the bottles. With this documentation, bottles can be traced to the supplier and bottle wash analysis results can be reviewed. The bottle wash certificate documentation will be archived in the permanent project file.

Before making shipment to the field, the project laboratories will add the required preservatives to the sample bottles. Sample preservation procedures are used to maintain the character of analytes as sampled (i.e., representative concentrations and/or speciation in situ) during storage and shipment. Regardless of the nature of the sample, absolute stability for all constituents cannot be achieved. Preservation techniques, such as pH control and refrigeration, may retard physiochemical and biochemical changes. As a general rule, analyzing the sample as soon as possible is the best way to minimize physicochemical and biochemical changes.

Samples will be placed in the appropriate sample container and refrigerated (on ice in a cooler) immediately upon sample collection. The samples will be transferred to the project laboratories as soon as possible using chain of custody (COC) procedures, as described in the FSP. Based on the potential levels of contaminants, samples for all analyses will be hand-delivered or shipped as environmental samples. Upon receipt at the project laboratories, a cooler receipt form will be filled out to document sample condition. The laboratories must fax the COC and cooler receipt

forms to the contractor within 8 hours of sample receipt. The laboratories will make every effort to meet all specified holding times.

3.4 COORDINATION WITH ANALYTICAL LABORATORIES

Team members will work closely with the project laboratories to ensure that samples are handled and analyzed following procedures described in this QAPP. A schedule of fieldwork and sampling will be established approximately 2 weeks before commencement of fieldwork. Each day that samples are shipped to the laboratories, a designated team member will contact the laboratories to confirm that samples have been received.

The project laboratories will contact the Project Chemist after it is suspected that reanalysis of a sample by the laboratory is unsuccessful due to matrix interference. The Project Chemist will immediately notify the URS Project Manager, who will notify the USACE Project Manager and the USACE Project Chemist, if necessary.

4.0 QUALITY CONTROL SAMPLES

Field QC and laboratory QC samples will be employed to evaluate data quality. QC samples are controlled samples introduced into the analysis stream, whose results are used to assess data quality and to calculate the accuracy and precision of the chemical analysis program. The purpose of each type of QC sample, collection and analysis frequency, and evaluation criteria are described in this section. Collection frequency for field QC samples is summarized in Table 4-1. Laboratory reporting limits and regulatory screening criteria are presented in Appendix A. Required QC criteria (including frequency and corrective action) and laboratory performance-based QC limits are listed in Appendix B and C, respectively.

QC procedures for the project laboratories will be consistent with the requirements described in this QAPP. This document defines and adds procedures and QC elements that an analytical method may leave ambiguous. The laboratories will be required to conduct all QC measurements for this project on samples from and within batches of samples from this project alone; in other words, no “other project” samples will be used with samples from this project for assessment of data quality.

4.1 FIELD QUALITY CONTROL SAMPLES

Field QC is accomplished through the analysis of controlled samples that are introduced to the laboratories from the field. Rinsate blanks, reagent blanks (preservatives), trip blanks, field duplicates, and temperature blanks will be collected and submitted to the project laboratories to provide a means of assessing the quality of data resulting from the field sampling program.

4.1.1 Rinsate Blanks

Rinsate blanks are collected to determine the potential for cross-contamination of samples during collection when improperly cleaned field equipment are used. Rinsate blanks are used to assess the quality of the decontamination process and to quantify COPCs that might have been transferred. If non-dedicated sampling equipment is used, rinsate blanks will be collected and analyzed at the rate of 5 percent of all groundwater, soil, sediment, and concrete samples submitted to the fixed laboratories. If dedicated or disposable sampling equipment is used, no rinsate blank is required.

Rinsate blanks will consist of laboratory-provided, analyte (COPCs)-free, deionized water collected from the final rinse of the sampling equipment after completion of the decontamination procedures described in Section 2 of the FSP. Blank sample collection frequency is listed in Table 4-1.

All rinsate blanks will be submitted blind to the laboratories with sample numbers that are indistinguishable from primary samples. Blank samples will be analyzed for the same parameters as associated field samples. The concentrations of analytes detected in the blanks will not be subtracted from the sample concentrations.

4.1.2 Trip Blanks

Trip blanks will be used to check for procedural contamination, cross-contamination, and contamination during shipment and storage of solid and aqueous samples collected for VOC analysis. One trip blank (40-milliliter [mL] vial with preserved contaminant-free water provided by the laboratory) will be submitted to the project laboratory for each cooler containing aqueous samples for VOC analysis. One trip blank (4-ounce glass container with methanol or sodium bisulfate provided by the laboratory) will be submitted to the project laboratory for each cooler containing soil, sediment, or concrete samples for analysis of VOCs. At no time after their preparation are the sample containers to be opened until they return to the laboratories. Each trip blank will be inspected for bubbles and overall condition, which will be noted in the field notebook. Each trip blank will be assigned a number to identify the cooler it accompanies, which will be recorded in the field logbook and on the COC. Trip blanks will be placed in the cooler with the first environmental sample collected. The self-sealing bag containing the trip blanks will be left open in the cooler throughout the sampling day.

The trip blanks will be indistinguishable from the other samples to the extent possible and will be prepared using sample containers and labels identical to those used for the primary samples. The concentrations of analytes detected in the trip blanks will not be subtracted from the sample concentrations.

4.1.3 Field Duplicates

Field duplicate samples are used to check for sampling and analysis reproducibility. Field duplicates will be submitted to the project laboratories at a frequency of 10 percent of the field samples for every matrix and analytical method. Field duplicate samples should be collected from areas most likely to be contaminated. Field duplicate samples will be collected in conjunction with and analyzed by the same methods as the primary samples. Control limits for field duplicate precision are 30 percent relative percent difference (RPD) for aqueous samples and 50 percent RPD for soil, sediment, and concrete samples.

Field duplicates will be submitted blind to the laboratories, with sample numbers that are indistinguishable from primary samples. Calculation and reporting of the RPD for field duplicates are described in Section 7.1.

4.1.4 Temperature Blanks

Temperature blanks are used to measure cooler temperatures upon receipt of the coolers at the laboratories. One temperature blank will be prepared and submitted to the project laboratory with each cooler. The temperature blank will consist of a sample jar containing water, which will be packed on ice in the cooler in the same manner as the rest of the samples and labeled "temperature blank."

4.2 LABORATORY QUALITY CONTROL SAMPLES

Laboratory QC is accomplished by analyzing initial and continuing calibration samples, method blanks, surrogate spikes, matrix spike (MS)/matrix spike duplicate (MSD) pairs, laboratory control samples (LCS), and laboratory duplicate samples. Project-specific QC criteria (including frequency, QC limits, and corrective actions) are presented in Appendix B. The criteria presented in Appendix B are derived from USACE guidance and the referenced methods. The laboratory analysts will process the data, and the laboratory QA manager will review data for overall reasonableness and transcription or calculation errors in compliance with the QC criteria presented in these tables.

4.2.1 Initial and Continuing Calibration Standards

Laboratory instrument calibration and maintenance requirements are discussed in Section 6.

4.2.2 Method Blanks

Method blanks are used to check for laboratory and reagent contamination, instrument bias, and accuracy. Laboratory method blanks will be analyzed at a minimum frequency of 5 percent or one per analytical batch for all chemical parameter groups.

QC criteria require that minimum contamination be detected in the blank(s). If a chemical is detected, the action taken will follow the criteria established by this QAPP. Blank samples will be analyzed for the same parameters as the associated field samples. The concentrations of analytes detected in the method blanks will not be subtracted from the sample concentrations.

4.2.3 Surrogate Spikes

The accuracy of an analytical measurement may be evaluated by using surrogate spikes. Surrogate compounds are compounds not expected to be found in environmental samples; however, they are chemically similar to several compounds analyzed in the methods and behave similarly in extracting solvents. Samples for organic compound analysis will be spiked with

surrogate compounds consistent with the requirements described in the analytical methods and in the laboratory SOPs.

Percent recovery of surrogates is calculated concurrently with the analytes of interest. Because sample characteristics will affect the percent recovery, the percent recovery is a measure of accuracy of the overall analytical method on each individual sample.

4.2.4 Laboratory Control Samples

LCSs are used to monitor the laboratories' day-to-day performance of routine analytical methods, independent of matrix effects. LCSs are prepared by spiking reagent water with standard solutions that contain the same compounds used in establishing instrument calibration. Spiking levels will be between the low and mid-level calibration standards used for the primary samples. LCSs are extracted and analyzed with each batch of samples. Results are compared on a per-batch basis and are used to evaluate the laboratories' performance for accuracy. LCSs may also be used to identify any background contamination of the analytical system that may lead to the reporting of elevated concentration levels or false-positive measurements.

4.2.5 Matrix Spike/Matrix Spike Duplicates

MS/MSD sample pairs are used to assess sample matrix interferences and analytical errors, as well as to measure the accuracy and precision of the analysis. For MS or MSD samples, known concentrations of analytes are added to environmental samples; the samples are then processed through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery of the known spiked amount (and RPD for MS/MSD).

Spiked samples will contain all the target compound required by the CLP. Spiking concentrations for all MS/MSD samples analyses will be at concentrations in the middle of the calibration range that is used to analyze the primary sample.

Because MS/MSD samples are used to measure the matrix interference of a specific matrix, only samples from this investigation will be analyzed as MS/MSD. The MS/MSD samples will be analyzed for the same parameters as the associated field samples in the same QC analytical batch. Poor MS/MSD recoveries may not be attributed to matrix interference until the laboratories reprepare the samples, with accompanying cleanup procedures and reanalysis, and the results indicate similarly poor recoveries.

Generally, a specific sampling location will be used to collect field QC samples; however, it may not be possible to collect MS/MSD samples for all analyses at the same sampling locations because of the limited volume of material available. In those instances, MS/MSD samples for various analyses will be collected from different locations. Additionally, samples for MS/MSD

analyses will be designated in the field but will not be collected from locations with potentially high concentrations of target analytes that may mask the added spike compounds. Required laboratory QC criteria and corrective actions for MS/MSD samples are presented in Appendix B.

4.2.6 Laboratory Duplicate Samples

Precision of the analytical system is evaluated by analyzing MS/MSD pairs and laboratory duplicates. Laboratory duplicates are two portions of a single homogeneous sample analyzed for the same parameter. Laboratory duplicates will be prepared and analyzed with project samples being analyzed for metals and other inorganic analytes. If a sample contains high native concentrations of organic compounds, a laboratory duplicate (instead of MSD) should be analyzed.

Table 4-1
Field Quality Control Sample Collection Summary

Sample Type	Frequency
Rinsate blanks	5 percent
Temperature blanks	1/cooler
Water trip blanks	1 per cooler for VOC analyses (per matrix)
Reagent trip blanks (preservatives)	1 per cooler for VOC analyses (per matrix)
Field duplicates	10 percent

5.0 METHODS AND QUALITY CONTROL FOR LABORATORY ACTIVITIES

This section describes the analytical procedures to be used for project laboratory measurements. The analytical methods and associated QA/QC procedures were selected based on consideration of the project DQOs.

5.1 ANALYTICAL METHODS

The analytical methods, calibration procedures, and QC measurements and criteria are based on current analytical protocols in the following documents:

- EPA SW-846 *Test Methods for Evaluation of Solid Waste* (SW-846) (USEPA 1998)
- USACE *Engineer Manual EM 200-1-3, Appendix I* (USACE 2001)
- Washington State Department of Ecology, Analytical Methods for Petroleum Hydrocarbons, ECY 97-602 (June 1997)
- SWRI Standard Operating Procedures (proprietary)

Samples will be analyzed using the following methods described in Sections 5.1.1 through 5.1.7 below. Tables 3-2 and 3-3 in the FSP provide requirements for sample containers, preservation, holding times, and analytical methods. Refer to Appendix B for a complete description of required QC criteria for each method.

Samples collected for dissolved metals will be filtered and preserved in the field. Concrete samples will be sent to the laboratory as collected in small chips (less than 1 inch in diameter), and the laboratory will analyze the samples in chip form. To prevent volatilization of any VOCs that may be present in the chip sample, the laboratory will not pulverize, grind, or sift the sample. The contracted laboratory has stated that it does not modify its methods for concrete chips.

5.1.1 Volatile Organic Compounds

CLP TCL VOCs will be analyzed by SW-846 methods including Method 8260B for analysis, Method 5030B for preparation of aqueous samples, and Method 5035 for preparation of solid samples. These methods are used to determine low-level concentrations of VOCs in soil and water. Soil samples will be preserved in the field with methanol or sodium bisulfate. Water

samples will be preserved in the field with hydrochloric acid. A purge-and-trap system is used to concentrate the volatile compounds prior to analysis by gas chromatography/mass spectrometry (GC/MS) with an ion trap (Table B-1 in Appendix B).

5.1.2 Semivolatile Organic Compounds

CLP TCL SVOCs will be analyzed by SW-846 methods including Method 8270C for analysis, Method 3510C for preparation of aqueous samples, and Method 3550B for preparation of solid samples. These methods are used to determine low-level concentrations of SVOCs in extracts prepared from all types of matrices. Water samples are extracted with methylene chloride and analyzed by GC/MS-ion trap. Soil samples are extracted with methylene chloride and acetone using a heated ultrasonic bath for extraction and a GC/MS-ion trap for analysis (Table B-2 in Appendix B).

5.1.3 Chlorinated Pesticides and PCBs

CLP TCL chlorinated pesticides and CLP TCL PCBs will be analyzed by SW-846 methods including Method 8081A for chlorinated pesticides, and Method 8082 for PCBs. Method 3510C will be used to prepare aqueous samples and Method 3550B will be used to prepare solid samples. These methods provide procedures for determining low-level concentrations of certain chlorinated pesticides and PCBs. Samples are extracted and then analyzed by GC equipped with a duel electron capture detector (ECD) (Tables B-3 and B-4 in Appendix B).

5.1.4 Metals and Mercury

CLP TAL total and dissolved metals, including strontium and uranium, will be analyzed by SW-846 methods including Method 6010B (inductively coupled plasma [ICP]) and Method 6020 (inductively coupled plasma/mass spectrometry [ICP/MS]). Method 3010A will be used for preparation of aqueous samples, and Method 3051 will be used for preparation of solid samples.

Aqueous samples will be analyzed for mercury by Method 7470A (cold vapor atomic absorption spectrophotometry [CVAA]) and solid samples will be analyzed by Method 7471A (CVAA).

These methods provide procedures for the preparation, operation, tuning, optimization, and analysis of samples for metals and mercury in solids and groundwater (Tables B-5 and B-6 in Appendix B).

5.1.5 Total Cyanide

Total cyanide in solid and aqueous samples will be analyzed by SW-846 Method 9012A. Method 9013 will be used for preparation of solid samples. These methods provide the

procedure for the analysis of total cyanide in most aqueous and solid matrices. The analysis uses a strong acid distillation and pyridine-barbituric acid colorimetric titration (Table B-7 in Appendix B).

5.1.6 Petroleum

Petroleum will be analyzed by NWTPH-Dx. This method provides a procedure for the quantitative and qualitative analyses of semivolatile petroleum products in soil and water. The samples are extracted with methanol and a portion of the extract is injected directly into a GC with flame ionization detector (FID) (Table B-8 in Appendix B).

5.1.7 Ordnance (Explosive) Compounds

Ordnance (explosive) compounds will be analyzed by SW-846 Method 8330A. Method 3535 will be used for preparation of aqueous samples, and Method 3550B will be used for preparation of solid samples. This method is used for the trace analysis of explosives residues. Water samples (rinsate blank) are extracted using solid-phase extraction (SPE) and are analyzed by high-performance liquid chromatography (HPLC) with an ultraviolet (UV) detector (Table B-9 in Appendix B).

5.2 MODIFICATION OF STANDARD METHODS

SAS uses a modification of Method 3550B to extract semivolatile organic analytes from soils and solids. The modification includes the use of a heated ultrasonic bath. SAS is validated for semivolatile soil extractions by the USACE based on this modified procedure.

Chemical agent breakdown products (HD [mustard], VX, and GB [sarin]) will be analyzed by SWRI SOPs. These SOPs are proprietary modifications of standard HPLC, ion chromatography, and GC/MS methods. QC criteria for these methods are provided in Tables B-10 through B-13 in Appendix B. SWRI performance-based QC limits are presented in Appendix C. A summary of the methods follows.

- HD (mustard gas) degrades to thiodiglycol and hydrochloric acid and oxidizes (e.g., by incineration) to dithiane and oxathiane. Thiodiglycol is determined by leaching the compound from soil with methanol and analyzing the extract using liquid chromatography/mass spectrometery (LC/MS) or HPLC with a UV detector. Dithiane and oxathiane are determined by extraction from soil at a slightly basic pH and injection of the concentrated extract into a gas chromatograph with a flame photometric (FPD) detector.

- The nerve agent GB (sarin) degrades to methylphosphonic and hydrofluoric acid. GB is determined by leaching the compound from soil and analyzing the leachate by ion chromatography with a UV detector.

- The nerve agent VX degrades to a number of decomposition products called VX thiols. VX is analyzed using EPA SW-846 modified Method 8270. The samples are extracted, and the extract is analyzed by GC/MS. Results are reported as tentatively identified compounds (TICs) because external standards are not commercially available.

5.3 LABORATORY PERFORMANCE

Laboratories selected for this project are USACE validated (see Appendix D). The laboratories' in-house statistical control limits, based on historical data, demonstrate their ability to meet project-specific control limits on a routine basis. Laboratory procedures will be implemented according to the laboratories' QA plans and SOPs. In addition, laboratories will be required to meet the QA/QC standards established in this QAPP.

The laboratories will ensure the quality of results by maintaining an integrated quality assurance system of activities involving the planning, implementation, assessment, reporting, and quality improvement of data. These activities will be performed or facilitated by the Laboratory QA officer and include the (1) performance of periodic audits (system and technical); (2) participation in proficiency testing programs/interlaboratory comparisons, (3) routine analysis of certified reference materials or second source reference materials, and (4) monitoring method performance (sensitivity, precision and bias) through an evaluation of the MDL study or MDL check sample, and batch QC sample (method blank [MB], LCS) control ranges/charts. Refer to *ISO/IEC Guide 25, General Requirements for the Competence of Calibration and Testing Laboratories* and *ANSI/ASQC E4, Specification and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* for additional information.

The selected laboratories must ensure that all possible procedures for achieving minimum reporting limits are applied. These procedures will include sample cleanup, increased aliquot size, and concentration of extracts. In addition, the laboratories will report (as estimated) all detected compounds whose concentrations are below the MRL but above the MDL. If dilutions are necessary to bring individual target analytes within the calibration range, these analytes will be reported from the dilution while the remaining analyte results will be reported from the nondiluted analytical run.

The laboratories will demonstrate that they tried cleanup procedures or method of standard additions, as recommended in the methods, to deal with suspected matrix effects. Sample dilution may be used to deal with matrix interferences only after extensive cleanups have been tried and have been unsuccessful.

If target analytes in LCS samples are out of control limits, corrective action will be taken. Initially, the effect the QC failure has on the samples will be evaluated. Regardless of the results of this assessment, the laboratory will take steps to find the source of the problem and correct it. Typically, the laboratory will reanalyze the LCS for the failed analytes only. If the second analysis fails, the LCS, method blank, and all associated samples of the batch will be reprepared and reanalyzed for the failed analytes only. When there are multiple target analytes (more than five), sporadic marginal failures of a few target analytes included in the LCS may be acceptable without requiring reanalysis of the entire batch.

USACE guidance states that the method blank is acceptable if "the concentration of all target analytes is below one-half the MRL for each target analyte, or less than 5 percent of the regulatory limit associated with that analyte, or less than 5 percent of the sample result for the same analyte, whichever is greater." The laboratories will be required to comply with the USACE guidance for analysis of the method blank as follows:

- If an analyte is found only in the method blank, but not in the batch samples, no further corrective action is necessary. Steps should be taken to find and reduce or eliminate the source of this contamination in the method blank.

- If an analyte is found in the method blank at concentrations that exceed criteria, and in some or all of the other batch samples, the laboratory shall reanalyze (within the holding times) the method blank and any samples containing the same contaminant.

- If the contamination remains at concentrations that exceed criteria, the laboratory shall re-prepare and reanalyze (within the holding times) the contaminated samples, a new method blank, and batch-specific QC samples.

- If holding times are exceeded before reanalysis occurs, the laboratory must notify the URS Project Chemist immediately. The URS Project Manager will decide if reanalysis or re-extraction outside of holding times should be undertaken.

Laboratory requirements for compound identification are prescribed within the SW-846 analytical methods used. In some organic methods, the information is included directly within the method used (e.g., GC/MS Methods 8260B, 8270C), or this information is referenced to a general EPA SW-846 method (such as 8000B) that outlines procedures applicable to several

chromatographic methods (GC, HPLC, etc.). Laboratory SOPs present procedures required to establish retention time windows (window width and location) for each target analyte for each chromatographic column employed in the analysis.

Laboratory requirements for compound confirmation are prescribed within the EPA SW-846 analytical methods employed. For GC/MS methods, compound confirmation is obtained from the mass spectrum following specified procedures included within the methods, and no additional measures are needed. For GC and HPLC methods, EPA SW-846 procedural options are presented in Method 8000B, Section 7.9. The USACE guidance recommends in preferential order the use of the GC/MS or other analytical technique (if applicable), a dissimilar column (if available), or a second detector as a means for confirmation. When using a secondary column, Method 8000B Section 7.9 states that the analysis should meet the QC criteria (for example, for calibration or retention time). The USACE guidance further recommends that if quantitative results are to be reported from the secondary column (i.e., when interferences are noted on the primary column), additional documentation must be furnished. This documentation must show that the same procedures for calibration and batch QC that are applied to the primary column are applied and successful on the secondary column.

When confirmed, the agreement between the primary and secondary columns (or detectors) is compared to evaluate method performance and decide the value to report (if applicable). The difference between the results is calculated as the RPD for comparability purposes only. These RPD values are generally not used to determine presence/absence of the target analyte. Presence/absence is determined by the signal being present on both columns. When disparity in the results occurs, the laboratory must review the chromatograms to evaluate potential sources of error (such as overlapping peaks or matrix interference). When no evidence of interference is found, the larger of the values should be reported to ensure that any decisions made based on the data are conservative with regard to the environment.

For HPLC analyses, the laboratories are required to analyze each sample on the primary column and again on the secondary column (as opposed to split column confirmation on a GC that allows the sample to be analyzed on two columns simultaneously). Therefore, the usual QC protocol for the HPLC secondary column is to analyze only one calibration standard whose concentration is within 50 percent of the sample concentration.

The selected methods and QC requirements listed in this section are sufficient to meet the project objectives. While a best effort will be made to achieve the project objectives, there may be cases in which it is not possible to meet the specified goals. Any significant limitation to data quality caused by analyses that fail to meet the data quality indicators specified in this QAPP will be identified and brought to the attention of the USACE Technical Lead as described in Section 5.4.

5.4 QUALITY CONTROL

The following procedures will be instituted to ensure that data to be used in decision making comply with QC criteria presented in this QAPP. The following procedures will be part of the overall project QA/QC activities:

- Data review will be performed on 100% of all analytical data. Data validation will be performed on 10% of all the analytical data.

- A laboratory monitoring program will be employed to institute corrective actions in laboratory procedures, as necessary, to provide defensible, quality data.

The laboratories will receive copies of the final Management Plan, including the QAPP. Approximately 1 week prior to the commencement of fieldwork, a telephone conference call will be conducted that will include participation by key project personnel such as laboratory representatives, the URS Project Manager, and URS Project Chemist. The USACE Project Manager and USACE Project Chemist may also choose to participate. The purpose of the telephone conference call will be to ensure that the field sampling program and required analytical procedures are clear to the laboratories, that the laboratories are prepared to receive and analyze the project samples, and that all personnel involved understand how data acquisition will be accomplished.

The laboratories will be required to prepare briefing reports that will be forwarded to URS. The briefings will include numbers of samples received, conditions of samples, requested analytical methods, and any other pertinent information regarding sample receipt. In addition, the briefings will provide information related to laboratory QC issues, such as matrix effects or surrogate recoveries. The purpose of these briefings is to institute corrective actions as soon as they arise to ensure that the final data packages provide reliable, accurate, and defensible data.

6.0 LABORATORY INSTRUMENT CALIBRATION

Instrument calibration will be in compliance with EPA-approved methods, this QAPP, and the manufacturer's instructions. General requirements are discussed below.

6.1 STANDARD SOLUTIONS

A critical element in the generation of quality data is the purity/quality and ability to trace the standard solutions and reagents used in the analytical operations. To ensure the highest purity possible, the laboratories will obtain all primary reference standards and standard solutions from the National Bureau of Standards, the EPA repository, or other reliable commercial source. The laboratories will maintain a written record of the supplier, lot number, purity/concentration, receipt/preparation date, name of the analyst , method of preparation, expiration date, and all other pertinent information for all standards, standard solutions, and individual standard preparation logs.

Standard solutions will be validated prior to use. Validation procedures can range from a check for chromatographic purity to verification of the concentration of the standard solution using another standard solution prepared at a different time or obtained from a different source. Stock and working standard solutions will be checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change of concentration. Care will be exercised in the proper storage and handling of standard solutions, and all containers will be labeled as to compound, concentration, solvent, expiration date, and preparation data (initials of preparer/date of preparation). Reagents will be examined for purity by subjecting an aliquot or subsample to the corresponding analytical method as well.

6.2 BALANCES

The laboratories will calibrate analytical balances annually according to manufacturer's instructions and have a calibration check before each daily use by laboratory personnel. All balance calibrations will use Class 1 or S weights and will be within a range appropriate to the sample mass. Acceptance criteria are 1 percent for top-loading balances and 0.1 percent for analytical balances. Annual calibrations and calibration checks will be documented in appropriate hardbound logbooks with prenumbered pages.

6.3 REFRIGERATORS

The laboratories will monitor all refrigerators for proper temperature by measuring and recording internal temperatures on a daily basis using National Institute of Standards and Technology (NIST)-certified or NIST-traceable thermometers. At a minimum, thermometers used for these measurements will be calibrated annually according to manufacturer's instructions. Refrigerators will be maintained at 4°C ± 2°C and freezers at -10°C to -20°C. Refrigerator and freezer temperatures will be documented in appropriate hardbound logbooks with prenumbered pages.

6.4 VOLUMETRIC MEASUREMENTS

Before use, volumetric glassware or other laboratory ware will be inspected for cracks or damages. Eppendorf-type pipettes will be verified (weekly, at a minimum) at the volume to be used or at two different volumes that bracket the range of use. Fixed volume Eppendorf-type pipettes will be verified monthly. All non-standard laboratory ware used to measure the initial sample volume or the final volume of the extracts/digestates will be verified to be accurate within 3 percent. Each calibration check will be documented in appropriate hardbound logbooks with prenumbered pages.

6.5 WATER SUPPLY SYSTEM

The project laboratories will maintain an appropriate water supply system that is capable of furnishing American Society for Testing and Materials (ASTM) Type II polished water to the various analytical areas. ASTM Type I or equivalent water should be used for trace metal analysis.

Initial calibration blanks and continuing calibration blanks will be used to document that the laboratory water supply system produces water that is free of the analytes of concern at the level of concern for the project. Method blanks will be used to ensure that none of the reagents used for the requested analyses are contaminated with the analytes of concern.

6.6 LABORATORY INSTRUMENTS

As stated in laboratory SOPs, calibration of all analytical instrumentation is required to ensure that the analytical system is operating correctly and functioning at the sensitivity required to meet project-specific objectives. Each instrument will be calibrated with standard solutions appropriate to the instrument and analytical method, in accordance with the methodology specified, and at the QC frequency specified in the laboratory SOPs.

The calibration history of the fixed laboratory instrumentation is an important aspect of the project's overall QA/QC program. As such, all initial and continuing calibration procedures will be implemented by trained personnel following the manufacturer's instructions and in accordance with applicable EPA protocols to ensure the equipment is functioning within the tolerances established by the manufacturer and the method-specific analytical requirements.

7.0 ANALYTICAL DATA QUALITY INDICATORS

The methods for the NPD laboratory SI are selected to ensure that the accuracy and precision of the data will be sufficient and that the data will be useful for identifying and quantifying COPCs at the site.

The data quality indicators presented in this section are precision, accuracy (bias), representativeness, comparability, completeness, and sensitivity. Table 7-1 presents a summary of QC samples and parameters that will be used to evaluate data quality. Project-specific QC criteria for laboratory analyses are summarized in Appendix B.

7.1 PRECISION

Precision is defined as the degree of agreement between or among independent, similar, or repeated measures. Precision is expressed in terms of analytical variability. For this project, analytical variability will be measured as the RPD or coefficient of variation between analytical laboratory duplicates and between the MS and MSD analyses. Monitoring variability will be measured by analysis of blind field duplicate samples.

Precision will be calculated as the RPD as follows:

$$\text{RPD (\%)} = 100 \times \frac{|S - D|}{(S + D)/2}$$

where:

S	=	Analyte concentration in a sample
D	=	Analyte concentration in a duplicate sample

The resultant RPD will be compared to criteria established by this QAPP, and deviations from these criteria will be reported. If the QAPP criteria are not met, the laboratories will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. The RPD will be evaluated during data review and validation. The data reviewer will note deviations from the specified limits and will comment on the effect of the deviations on reported data.

7.2 ACCURACY

Accuracy is the amount of agreement between a measured value and the true value. It will be measured as the percent recoveries of MS and MSD, organic surrogate compounds, and the LCS. Additional potential bias will be quantitated by the analysis of calibration standards and blank samples (e.g., method, rinsate, and trip blanks).

In cases where accuracy is determined from spiked samples, accuracy will be expressed as the percent recovery. The closer these values are to 100, the more accurate the data. Surrogate recovery will be calculated as follows:

$$\text{Recovery (\%)} = \frac{\text{MC}}{\text{SC}} \times 100$$

where:

SC	=	Spiked concentration
MC	=	Measured concentration

Matrix spike percent recovery will be calculated as follows:

$$\text{Recovery (\%)} = \frac{\text{MC} - \text{USC}}{\text{SC}} \times 100$$

where:

SC	=	Spiked concentration
MC	=	Measured concentration
USC	=	Unspiked sample concentration

The resultant percent recoveries will be compared to criteria established by this QAPP, and deviations from these criteria will be reported. If the objective criteria are not met, the laboratories will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. Percent recoveries will be evaluated during data review and validation and the data reviewer will comment on the effect of the deviations on the reported data.

7.3 REPRESENTATIVENESS

Representativeness is the degree to which sample results represent the system under study. This component is generally considered during the design phase of a program. This program will use the results of all analyses to evaluate the data in terms of its intended use. Site sampling locations for this project are placed using a biased approach to maximize the likelihood of locating and identifying site contamination, if present. Areas of apparent contamination have been selected to be representative of potential impacts from past activities. Representativeness will also be determined by evaluating hold time, sample preservation, and blank contamination. Samples with expired hold times, improper preservation, or contamination may not be representative.

7.4 COMPARABILITY

Comparability is the degree to which data from one study can be compared with data from historical studies at the site, other similar studies, reference values (such as background), reference materials, and screening values. This goal will be achieved through using standard techniques to collect samples, EPA-approved methods to analyze samples, and consistent units to report analytical results. Data comparability also depends on data quality. Data of unknown quality cannot be compared.

7.5 COMPLETENESS

Completeness for usable data is defined as the percentage of the total data set minus the rejected or missing data compared to the total data set generated. Specifically, the basis for calculation of completeness is the total number of planned data results (number of samples × number of analyses × number of analytes) relative to the total number of valid results generated. Data are considered valid if they fulfill the DQO requirements established in the QAPP. When feasible, the amount of sample collected will be sufficient to reanalyze the sample, should the initial results not meet QC requirements. Because the number of sample aliquots that will be collected to measure each parameter exceeds that required for the analysis, thus allowing for reanalysis, 100 percent completeness is anticipated. Less than 100 percent completeness could result if sufficient chemical contamination exists to require sample dilutions, resulting in an increase in the project-required detection/quantitation limits for some parameters. Highly contaminated environments can also be sufficiently heterogeneous to prevent the achievement of specified precision and accuracy criteria. Therefore, the overall project target goal for completeness will be 98 percent for laboratory analyses. Quality data are data obtained in a sample batch for which all QC criteria were met. Completeness will be calculated as follows:

$$Completeness\ (\%) = \frac{V}{P} \times 100$$

where:

V	=	Number of valid measurements
P	=	Number of planned measurements

Valid and nonvalid data (i.e., data qualified as "R" rejected) will be identified during data review and validation (Section 10.2).

7.6 SENSITIVITY

Sensitivity will be determined by reviewing MDLs, and MRLs. The sensitivity of some of the analytical methods identified for this project is insufficient to allow comparison of all the target analytes to all the screening criteria presented in the table in Appendix A. Screening criteria concentrations that are lower than the laboratory MRLs are highlighted in Appendix A .

The laboratories will be directed to report compounds detected below the MRL and above the MDL as detected estimated (J flag). These estimated compound concentrations will be used, in addition to the fully quantitated concentrations, for comparison to screening criteria.

Table 7-1
Parameters Used to Evaluate Data Quality

Data Quality Indicator	QA Parameter
Precision	Field duplicate Blank spike duplicate Laboratory duplicate Matrix spike duplicate
Accuracy	Matrix spike Surrogate spike Initial calibration standards and blanks Continuing calibration standards and blanks Laboratory control sample Trip blank Rinse blank Method blank
Representativeness	Trip blank Rinse blank Method blank Chain of custody Holding times and preservation status
Comparability	Method detection limits Method reporting limits Sample collection methods Laboratory analytical methods
Completeness	Data qualifiers Laboratory deliverables Requested/reported valid results
Sensitivity	Method detection limits Method reporting limits

8.0 PREVENTIVE MAINTENANCE

8.1 PREVENTIVE MAINTENANCE

Manufacturers have established guidelines for preventive maintenance of their instruments and equipment. Preventive maintenance is implemented on a schedule based on the type and stability of the instruments and equipment, project-required accuracy, intended use, and environmental factors. Preventive maintenance minimizes down time and ensures the accuracy, precision, sensitivity, and traceability of data collected while using the instruments and equipment. Maintenance is conducted by trained technicians, using service manuals or through service agreements with qualified maintenance contractors. Instruments and equipment that are identified to be out of calibration or malfunctioning are removed from operation until they are recalibrated or repaired. In addition, backup for instruments/equipment and critical spare parts are maintained to quickly correct malfunctions. Examples of typical equipment maintenance spare parts may include but not be limited to filters, tubing, and fittings.

8.2 FIELD INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Calibration of equipment and instrumentation ensures that accurate and reliable measurements are obtained. All instruments and equipment used on the project are calibrated and adjusted to operate within manufacturers' specifications and with a frequency stipulated by the maintenance schedule or by analytical method. Instrument calibration will be conducted at the beginning of each workday and at midday in accordance with URS SOPs “Equipment Calibration, Operation, and Maintenance” and “Water Quality Monitoring Equipment.” A final calibration will be conducted at the end of the day after the last field sample has been analyzed. The initial calibration will include three calibration standards if appropriate to the instrument being used. One-point calibrations will be conducted thereafter. In addition, one-point calibrations will be made when sampling conditions change, when sample matrices change, and/or if the instrument readings become unstable.

The water quality meter and PID used during the collection of groundwater samples will be factory serviced and calibrated before the project is initiated and will be field-checked daily in accordance with the manufacturer’s instructions.

8.3 LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION

The procedures for maintenance and calibration used by the analytical laboratories are included in their laboratory QA plans and analytical methods. The laboratories supplied information regarding their preventive maintenance programs and their inventory of backup instrumentation

for review by URS during the procurement process. Laboratories selected for this project have demonstrated their ability to analyze project samples within holding time by having well-maintained instruments and adequate backup instrumentation.

All laboratory calibration standards must be traceable to the NIST or other primary standards. Methods and intervals of calibration are based on the type of equipment, stability characteristics, required accuracy, intended use, and environmental conditions. Section 6 provides detailed requirements for laboratory instruments. The tables in Appendix B provide additional QC criteria required for laboratory instrument calibration.

8.4 CALIBRATION AND MAINTENANCE RECORDS

Calibration and maintenance schedules and records are maintained for laboratories' instruments and URS-owned field equipment. Both equipment and equipment records are located in a controlled-access facility when not in use. This is done to minimize equipment damage, theft, and tampering that may jeopardize either field or laboratory measurements and, ultimately, data quality.

9.0 CORRECTIVE ACTIONS

The project plans, SOPs, and training establish the baseline for field quality control. The ultimate responsibility for maintaining quality throughout the NPD laboratory SI rests with the URS Project Manager. The day-to-day responsibility for ensuring the quality of field and laboratory data rests with the Field Investigation Manager, Project Chemist, Project Quality Assurance Manager (QAM) or QA/QC Designee, and the laboratory program administrator.

Results of QA reviews and audits typically identify the requirement for a corrective action. The Project QAM/Designee is responsible for reviewing all audit and nonconformance reports to determine areas of poor quality or failure to adhere to established procedures. Nonconformances are reported formally by the Project QAM/Designee to the URS Project Manager. The URS Project Manager is responsible for evaluating all reported nonconformances, determining the root cause, conferring with the Project QAM/Designee on the steps to be taken for correction, and ensuring that the corrective action is developed and scheduled. Corrective action measures are selected to prevent or reduce the likelihood of future occurrences and address the root causes to the extent identifiable. Selected measures are appropriate to the seriousness of the nonconformance and are realistic in terms of the resources required for implementation.

Any nonconformance with the established QC procedures will be expeditiously identified, corrected, and controlled. Where procedures are not in compliance with the established protocol, corrective actions will be taken immediately. Subsequent work that depends on the nonconforming activity will not be performed until the identified nonconformance is corrected.

In summary, corrective action involves the following steps:

- Discovery of a nonconformance
- Identification of the responsible party
- Determination of root causes
- Planning and scheduling of corrective/preventive action
- Review of the corrective action taken
- Confirmation that the desired results were produced

9.1 FIELD CORRECTIVE ACTION

The Field Investigation Manager will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, and other procedures will be checked for completeness. Where procedures are not in compliance with the

established protocol, the deviations will be field documented and reported to the Project QAM/Designee.

Examples of field nonconformances include, but are not limited to, the following:

- Items provided by a subcontractor supplier that do not meet the contractual requirements
- Errors made in following work instruction or improper work instruction
- Unforeseen or unplanned circumstances that result in services that do not meet quality/contractual/technical requirements
- Unapproved or unwarranted deviations from established procedures
- Nonvalidated or nonverified computer programs
- Sample chain-of-custody missing or deficient
- Data falling outside established objective criteria

Corrective actions will be defined by the Field Investigation Manager and Project Manager and documented. Problems that require corrective action are documented by the use of a corrective action report. Upon implementation of the corrective action, the Field Investigation Manager will provide the Project QAM/Designee with a written memo documenting field implementation. The memo will become part of the SI project file.

9.2 LABORATORY CORRECTIVE ACTION

The laboratory QA managers will review the data generated to ensure that all samples have been analyzed as specified in this QAPP (Appendices A and B). Percent recoveries of surrogates and spiked analytes from LCS samples and MS samples will be evaluated for accuracy. RPDs for laboratory duplicate or MSD samples will be evaluated for precision. Corrective action requirements for noncompliant data are presented in Appendix B and in laboratory SOPs.

The laboratory project manager will fax the COCs and cooler receipt forms to URS within 8 hours of sample receipt. URS will be notified immediately if discrepancies occur between the contracted analyses and the analyses listed on the COCs. The laboratory project manager will contact the URS Project Chemist to discuss noncompliant data sets within 72 hours of first discovering that any analysis failed to meet the required data quality criteria. If the analyses

cannot produce data sets that are within control limits, the USACE Technical Lead will be notified. At a minimum, corrective actions are necessary if any of the following occur:

- Initial calibration verification and continuing calibration verification do not meet QC criteria.
- Any changes in the MDL or MRL occur.
- Blanks contain contaminants at concentrations greater than one-half the MRL for any target analyte. Refer to Section 5.3.
- The QC data are outside the acceptance windows for precision and accuracy established for LCS.
- Undesirable trends are detected in surrogate, MS or LCS recoveries.
- Undesirable trends are detected in RPD for MS/MSD or laboratory duplicates.
- The laboratory QA manager detects deficiencies during internal or external audits.

If laboratory personnel identify any nonconformance in analytical methodologies or QC sample results, corrective actions will be implemented immediately. Corrective action procedures will be handled initially at the bench level by the analyst, who will review the preparation or extraction procedure for possible errors and perform various checks such as the instrument calibration, spike, calibration mixes, and instrument sensitivity. The analyst will immediately notify his/her supervisor of the identified problem and the investigation that is being conducted. If the problem persists or the cause cannot be identified, the matter will be referred to the laboratory supervisor and laboratory QA manager for further investigation. When the problem has been resolved, the laboratory QA manager will file full documentation of the corrective action procedure, and if data are affected, the URS Project Chemist will be provided a corrective action memo for inclusion into the project file.

Corrective action may include, but will not be limited to, the following:

- Recalibrating analytical instruments
- Reanalyzing suspect samples if holding time criteria permit. The need for reanalysis is dependent on the number of analytes that are out of compliance, the importance of the outlier to the decisionmaking process, and the magnitude of the

outlying data. For example, an LCS sample with one analyte recovery at 125%, representing a sample batch where the average sample concentration was 10 parts per million (ppm), would not necessarily require reanalysis of the LCS or the entire sample batch.

- Resampling and analyzing newly collected samples
- Evaluating and amending sampling and/or analytical procedures (with USACE concurrence)
- Accepting data with an acknowledged level of uncertainty (with USACE concurrence)
- Evaluating and attempting to identify limitations of the data

Following the implementation of the required corrective action measures, data still deemed unacceptable will not be accepted by the Laboratory Project Manager and followup corrective actions will be explored.

9.3 CORRECTIVE ACTIONS FOLLOWING DATA REVIEW

The URS Project Chemist or qualified subcontractor will review the field and laboratory data generated for this project to ensure that all project QA objectives are met. If any nonconformances in the data have resulted from the field procedures, sample collection procedures, field documentation procedures, or laboratory analytical and documentation procedures, the impact of those nonconformances on the overall project QA objectives will be assessed. Appropriate actions, including resampling and reanalysis may be recommended to the URS Project Manager so that the project objectives can be accomplished.

10.0 LABORATORY DATA REDUCTION, DELIVERABLES, VALIDATION, AND REPORTING

This section describes the processes of data generation, reduction, reporting, review, and validation. First, the laboratories will generate and reduce the raw data and prepare data reports. Then, the laboratory QA manager will review and finalize the data report. When URS receives the completed data report, the Project Chemist, or a qualified subcontractor, will review one hundred percent of the data. Ten percent of the data will be validated by an independent third party. Based on the results of the reviews and validations, additional validation may be undertaken. The Project QAM will prepare a final QC summary report. Data quality review responsibilities are summarized in Table 10-1.

10.1 LABORATORY DATA REDUCTION, REVIEW, AND DELIVERABLES

Data generated by the analytical laboratories will undergo generation, reduction, and verification procedures described in the laboratories' QA plans and SOPs.

10.1.1 Data Reduction Procedures

The laboratories will perform in-house analytical data reduction under the direction of the laboratory QA manager. Laboratory data reduction procedures will be those specified in EPA-approved methods and those described in the laboratory SOPs. The data reduction steps will be documented, signed, and dated by the analyst. Data reduction will be conducted as follows:

- Raw data produced by the analyst will be processed and reviewed for compliance with QC criteria established in this QAPP. The analyst will also review the raw data for overall reasonableness and for transcription or calculation errors.

- After the data have been entered into the laboratory information management system (LIMS), a computerized report will be generated and sent to the laboratory supervisor or senior chemist.

- The laboratory supervisor will decide whether any sample reanalysis is required. The laboratory Project Manager will contact the URS Project Chemist to discuss noncompliant data sets upon discovering that any analysis fails to meet the required data quality criteria. If corrective actions have been taken and data still do not meet project QA requirements, the USACE Technical Lead will be notified.

- Upon acceptance of the preliminary reports by the laboratory QA manager, final reports will be generated. Final data reports will be available within approximately 30 calendar days of sample submittal.

The laboratory analyst will assign QC qualifiers, as described and defined in the laboratory QA plans, if any of the following occurs:

- The concentration of the chemical is below required reporting limit or above calibration limit.
- The concentration of the chemical is below required reporting limit but above the MDL.
- The chemical is also found in the laboratory blank.
- Spiking analyte recoveries (bias) are outside project-specified control limits (inorganic analyses only).
- Laboratory duplicate precision is outside project-specified control limits (inorganic analyses only).

Other sample-specific qualifiers will be added, as necessary, to describe QC conditions.

The laboratories will maintain detailed procedures for laboratory recordkeeping to support the validity of all analytical work. Each data report package submitted will contain the laboratories' written certification that the requested analytical method was run and that all QA/QC checks were performed. The laboratory program administrators will provide copies of applicable independent third party external audits, which will become part of the central project files.

10.1.2 Data Review Procedures

The laboratory analysts have the initial responsibility for verifying the correctness and completeness of the data based on an established set of guidelines and on the project QC criteria. The analysts will ensure that the following QC elements have been satisfactorily completed:

- Documentation of sampling receipt and handling is complete.
- Sample preparation information is correct and complete.
- Analysis information is correct and complete.

- Raw data, including manual integrations, have been correctly interpreted.
- Appropriate preparation and analysis procedures have been followed.
- Site specific special sample preparation and analytical requirements have been met.
- Analytical results are correctly calculated and complete.
- QC sample results are within project QC limits.
- Laboratory blanks are within project QC limits.
- Documentation is complete. All anomalies in the preparation and analysis have been documented; holding times are documented; and all data (including data generated before and after corrective actions or cleanup are conducted) are included in the laboratory data report.

The laboratory supervisor or QA manager will provide an independent peer review of the analytical data package to ensure that the following QC elements are acceptable:

- Appropriate laboratory SOPs have been referenced.
- Calibration data are scientifically sound and appropriate to the method.
- QC sample data are within project-specific limits.
- Qualitative and quantitative results are correct.
- Raw data, including manual interpretations, have been correctly interpreted.
- Documentation is complete and correct.

10.1.3 Data Deliverables

To ensure that project chemical data are sufficient to meet both qualitative and quantitative objectives, laboratory data deliverables that will permit a data quality assessment consistent with the requirements of this QAPP are required.

The laboratories will prepare and retain full analytical and associated QC documentation. The laboratories will report the data as analytical batches of 20 samples or less, along with associated QC reporting data. The analytical results will be submitted in both hard copy and electronic formats (see Appendix E) for review by URS. Data packages will be unbound and paginated.

Information provided will be sufficient to review the data with respect to:

- Holding times and conditions
- Calibrations and instrument tunes
- Detection/quantitation limits
- Spike and surrogate recoveries
- Duplicate analyses (laboratory duplicates and MS/MSDs)
- Laboratory control samples
- Blank contamination
- Precision and accuracy
- Representativeness
- Comparability
- Completeness

The analytical data will be provided in a complete CLP-type deliverable data format including the following hard copy information for each analytical data package:

- Cover sheet listing the samples included in the report

- Narrative comments describing problems encountered in analysis, identification of any analyses not meeting quality control criteria, including holding times, and cautions regarding nonquantitative use or unusability due to out-of-control-limit QC results

- Chain-of-custody forms and cooler receipt forms

- Tabulated results of inorganic and organic compounds identified and quantified, with analyte-specific MRL as presented in Appendix A. All analytes will be reported for each sample as a detected concentration or as not detected above the specific limits of quantitation, which must be stated. The laboratories will also report MDLs, dilution factors, date of extraction, extraction batch number, cleanup procedures used, date of analysis, surrogate percent recoveries, batch run logs, and analytical batch number for each sample, with corresponding sample results.

- Analytical results for QC sample spikes, laboratory duplicates, initial and continuing calibration, verifications of standards and laboratory blanks, standard procedural blanks, LCSs, laboratory reference materials, ICP interference check samples, and detection limit check samples

- Documentation of rationale for the use of method of standard addition if required

- Documentation of any cleanup procedures used

- Raw data system printouts (or legible photocopies) identifying date of reported analysis, analyst, parameters analyzed, calibration curves, calibration verifications, second column confirmations, method blanks, any reported sample dilutions, cleanup logs, laboratory duplicates, spikes, control samples, sample spiking levels, preparation/extraction logs, run logs, and chromatograms

- Chromatograms labeled with analyte peaks, internal standards, and surrogate standards where applicable

- Mass calibration and mass spectral tuning data for GC and GC/MS analyses

Data reduction and QC review steps will be documented, signed, and dated by an authorized representative.

10.2 INDEPENDENT DATA REVIEW

One hundred percent of all field and laboratory data will receive an independent data review. Ten percent of the data will be validated.

Independent data review involves three steps:

- Assessment of the reliability of data based on quality control sample results

- Verification that requirements contained in the project planning documents have been met

- Assessment of the data usability

The data quality review will include evaluation of laboratory summary forms for precision, accuracy, representativeness, comparability, completeness, and a summary of qualified data, but will not include review of raw data or recalculation of reported results. The review report

provides a list of all samples being reviewed, a narrative summarizing each review topic (e.g., calibration or hold times), qualified results, worksheets, and any data resubmitted by the laboratories at the request of the reviewer.

The data review process for this project will follow the procedures in EPA's Functional Guidelines (USEPA 1994, 1999, and 2001) modified for the methods used and project-specific criteria . The review will include verification of the following:

- Compliance with the QAPP
- Proper sample preservation and handling procedures
- Holding times
- Initial and continuing calibrations
- MDL and MRL
- QC results (for example, surrogate, MS/MSD and LCS recoveries; MS/MSD and laboratory duplicate RPDs; serial dilutions)
- Laboratory blank and trip blank analyses
- Data completeness and format
- Data qualifiers assigned by the laboratories

Qualifiers will be added to data during review as necessary. Qualifiers applied to the data as a result of the independent review will be limited to:

U The analyte was analyzed for but was not detected above the sample-specific reporting limit.

J The analyte was positively identified; the associated numerical value is an estimate of the concentration of the analyte in the sample.

UJ The analyte was not detected above the sample reporting limit. However, the reporting limit is approximate and may or may not represent the actual limit of quantitation.

B The analyte was also detected in the method blank (organic analyses only)

R The analyte's results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Data validation will include all the elements of the data review, but will also include evaluation of raw data and recalculation of 10% of the data results.

Results of the QA review will be included in a data quality review report that will provide a basis for meaningful interpretation of the data quality and evaluate the need for corrective actions and/or comprehensive data validation. This report will be used to generate the quality control summary report.

10.3 QUALITY CONTROL SUMMARY REPORT

After the fieldwork and the final analytical data have been completed and reviewed, a final QC summary report will be prepared by the project QAM. The report will summarize QA and audit information, including the results of the data review; evaluate field QC sample data, such as field duplicates and trip blanks; indicate any corrective actions taken; and describe overall compliance with the SAP and the project DQOs. The report will also list the number of field QC samples collected and the number of laboratory QC analyses conducted. When control limits are exceeded, the result will be listed along with the applicable control limit.

Proposed topics to be included in the Quality Control Summary Report are:

- Project scope
- Project description
- Sampling procedures
- Quality control activities
- Analytical procedures
- Chemical data quality assessment (field duplicate results, detected analyte table, total results table(s), and rejected or qualified results table)
- Conclusions and recommendations

The QC summary report will be included in the central project file and incorporated as part of the final SI report, will provide a basis for meaningful interpretation of the data quality, and evaluate the need for further corrective actions.

Table 10-1
Data Quality Review Responsibilities

Task	Project Laboratories	URS
Laboratory data quality review and data reduction	X	
Independent data review/validation		X
Quality control summary report		X

11.0 PERFORMANCE AND SYSTEM AUDITS

Performance and systems audits may be conducted to determine whether:

- The QA program has been conducted and documented in accordance with specified requirements
- The documented program has been implemented
- Any nonconformances were identified and corrective actions were implemented

The URS Project Manager will be responsible for seeing that the project performance satisfies the QA objectives as set forth in this SAP. The Project QAM will be responsible for initiating audits, selecting the audit team, and overseeing audit implementation.

The Field Investigation Manager will be responsible for supervising and ensuring that samples are collected and handled in accordance with this Management Plan and that documentation of work is adequate and complete. Field performance will be evaluated using field blanks, trip blanks, equipment decontamination rinsates, and field duplicates.

Reports and technical correspondence will be peer reviewed by qualified individuals before being finalized.

11.1 SYSTEMS AUDITS

Technical systems audits are used to confirm the adequacy of the data collection (field operation) and data generation (laboratory operation) systems. The on-site audits are conducted to determine whether the project-specific plans and field and laboratory SOPs are being properly implemented. Systems audits of the field and laboratory procedures are not expected during this project. However, in the event that an on-site field audit is required, the audit procedures described in this section will be followed.

Internal systems audits of the laboratories will be performed when the laboratory QA manager identifies the need, which may be throughout this project. An additional laboratory systems audit may be requested by the Project QAM, if warranted. The frequency of on-site audits will depend on the type of interaction and communications the Project QAM experiences with the laboratory staff, and on the frequency of observations of noncompliance with QC criteria and SOPs.

The laboratory QA manager will regularly conduct the following internal audits:

- Technical audit, including reviews of calibration and equipment monitoring records, laboratory logbooks, maintenance records, and instrument control charts
- Data quality audit reviews, including all aspects of data collection, reporting, and review
- Management system audits, verifying that management and supervisory staff are effectively implementing and monitoring all QC activities necessary to support the laboratories' QA program

Various government agencies and programs, such as the EPA CLP, the ODEQ, and the USACE frequently conduct external laboratory systems audits.

11.2 AUDIT PROCEDURE

This subsection provides requirements and guidance for performing internal and external audits to verify compliance with the elements of the SAP.

The URS Project Manager and, if appropriate, other audited entity (e.g., Field Investigation Manager, Subcontractor Manager) will be notified by the Project QAM of an audit a reasonable time before the audit is performed. This notification will be in writing and include information such as the general scope and schedule of the audit, and the name of the audit team leader.

A pre-audit conference will be conducted at the audit site with the appropriate manager or designated representative (e.g., Field Investigation Manager, laboratory project manager). The purpose of the conference will be to confirm the audit scope, present the audit plan, discuss the audit sequence, and plan for the post-audit conference.

The audit team will then implement the audit. Selected elements of the SAP will be audited to the depth necessary to evaluate the effectiveness of implementation. Checklists prepared by the audit team and approved by the Project QAM will be sufficiently detailed to document major audit components. Conditions requiring immediate corrective action will be reported immediately to the Project QAM.

At the conclusion of the audit, a post-audit conference will be held with the audited entities, or their designated representatives. The audit team leader will concisely state the audit findings and clarify any misunderstandings. The findings will be acknowledged by signature of the Project Manager or designated representative upon completion of the post-audit conference.

An audit report will be prepared by the audit team leader and signed by the Project QAM. The report will include the following:

- Description of the audit scope
- Identification of the audit team
- Persons contacted during pre-audit, audit, and post-audit activities
- A summary of audit results, including an evaluation statement regarding the effectiveness of the SAP elements that were audited
- Details of findings and program deficiencies
- Recommendations for corrective actions to the Project QAM, with a copy to the URS Project Manager and others as appropriate

11.3 AUDIT RESPONSE

The URS Project Manager and audited entities, or their designated representatives, will respond to an audit report within 7 days of receipt. The response will clearly state the corrective action for each finding, including action to prevent recurrence and the date the corrective action will be completed.

The Project QAM, upon receipt of the response, will take the following actions:

11.4 FOLLOWUP ACTION

Follow-up action will be performed by the Project QAM or designated representative to:

- Evaluate the adequacy of the URS Project Manager's or other audited entity's response
- Determine that corrective action is appropriate and scheduled for each finding
- Confirm that corrective action has been accomplished as scheduled

Follow-up action may be accomplished through written communications, re-audit, or other appropriate means. When all corrective actions have been verified, the Project QAM will send a

memo to the URS Project Manager or other audited entity signifying the satisfactory closeout of the audit.

11.5 AUDIT RECORDS

Original records generated for all audits will be retained in the central project files. Records will include audit reports, written responses, the record of completion of corrective actions, and documents associated with the conduct of audits that support audit findings and corrective actions as appropriate.

12.0 REFERENCES

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APPENDIX A

Laboratory Reporting Limits and Regulatory Screening Criteria

Laboratory Reporting Limits and Regulatory Screening Criteria

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
Volatile Organic Compounds									
Dichlorodifluoromethane	0.4	—	—	11,000[g]	—	—	0.4	310 nc	—
Chloromethane	0.4	—	—	11,000[g]	—	—	0.4	2.7 ca	—
Vinyl chloride	0.4	2	2	—	—	—	0.4	0.83 ca	0.008
Bromomethane	0.4	—	—	11,000[g]	—	—	0.4	13 nc	60
Chloroethane	0.4	—	—	—	—	—	0.4	6.5 ca	—
Trichlorofluoromethane	0.4	—	—	11,000[g]	—	—	0.4	2,000 sat	1,000
1,1-Dichloroethene	0.4	7	7	11,600	—	—	0.4	0.12 ca	0.01
1,1,2-Trichloro-1,2,2-trifluoroethane	0.4	—	—	—	—	—	0.4	5,600 sat	—
Acetone	2	—	—	—	—	—	0.4	6,200 nc	—
Carbon disulfide	0.4	—	—	—	—	—	0.4	720 sat	—
Methyl acetate	2	—	—	—	—	—	2	96,000 nc	—
Methylene chloride	0.4	—	—	—	—	—	0.4	21 ca	0.1
trans-1,2-Dichloroethene	0.4	100	—	11,600	—	—	0.4	210 nc	5
Methyl tert butyl ether (MTBE)	0.4	—	—	—	—	—	0.4	37 ca	—
1,1-Dichloroethane	0.4	—	—	—	—	—	0.4	7.1 ca	—
cis-1,2-Dichloroethene	0.4	70	—	11,600	—	—	0.4	150 nc	4
2-Butanone (MEK)	2	—	—	—	—	—	0.4	28,000 nc	—
Chloroform	0.4	See trihalo-methanes	See trihalo-methanes	28,900	1,240	—	0.4	0.52 ca	0.4
1,1,1-Trichloroethane	0.4	200	200	—	—	—	0.4	1,400 sat	9
Cyclohexane	0.4	—	—	—	—	—	0.4	140 sat	—
Carbon tetrachloride	0.4	5	5	35,200	—	—	0.4	0.53 ca	0.2
Benzene	0.4	5	5	5,300		—	0.4	1.5 ca	0.1

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
1,2-Dichloroethane (Ethylene dichloride)	0.4	5	5	118,000	20,000	—	0.4	0.76 ca	0.008
Trichloroethene	0.4	5	5	45,000	21,900	—	0.4	6.1 ca	0.4
Methylcyclohexane	0.4	—	—	—	—	—	0.4	8,800 nc	—
1,2-Dichloropropane	0.4	5	—	23,000	5,700	—	0.4	0.77 ca	—
Bromodichloromethane	0.4	See trihalo-methanes	See trihalo-methanes	11,000	—	—	0.4	2.4 ca	0.01
1,3-Dichloropropene (DCP), total	0.8	—	—	6,060	244	—	0.8	1.6 ca	—
cis-1,3-Dichloropropene (see 1,3-DCP, total)	0.4	—	—	6,060	244	—	0.4	—	—
4-Methyl-2-pentanone (Methyl isobutyl ketone)	2	—	—	—	—	—	0.4	2,900 nc	—
Toluene	0.4	1,000	—	17,500	—	—	0.4	520 sat	80
trans-1,3-Dichloropropene (see 1,3-DCP, total)	0.4	—	—	6,060	244	—	0.4	—	—
1,1,2-Trichloroethane	0.4	5		—	9,400	—	0.4	1.9 ca	0.08
Tetrachloroethene	0.4	5	—	5,280	840	—	0.4	19 ca	0.3
2-Hexanone	2	—	—	—	—	—	0.4	—	—
Dibromochloromethane	0.4	See trihalo-methanes	See trihalo-methanes	11,000	—	—	0.4	2.7 ca	10
1,2-Dibromoethane (Ethylene dibromide [EDB])	0.4	0.05	—	—	—	—	0.4	0.048 ca	—
Chlorobenzene	0.4	100	—	250	50	—	0.4	540 nc	50
Ethylbenzene	0.4	700	—	32,000	—	—	0.4	230 sat	100
Xylenes (total)	1.2	10,000	—	—	—	—	1.2	210 sat	800
Styrene	0.4	100	—	—	—	—	0.4	1,700 sat	—

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
Bromoform	0.4	See trihalo-methanes	See trihalo-methanes	—	—	—	0.4	310 ca	0.3
Isopropylbenzene (cumene)	0.4	—	—	—	—	—	0.4	520 nc	—
1,1,2,2-Tetrachloroethane	0.4	—	—	—	2,400	—	0.4	0.9 ca	—
1,3-Dichlorobenzene	0.4	600	—	1,120	763	—	0.4	52 nc	—
1,4-Dichlorobenzene	0.4	75	75	1,120	763	—	0.4	8.1 ca	—
1,2-Dichlorobenzene	0.4	—	—	1,120	763	—	0.4	370 sat	—
1,2-Dibromo-3-chloropropane	0.4	0.2	—	—	—	—	0.4	4.0 ca	—
1,2,4-Trichlorobenzene	0.4	70	—	250[h]	50[h]	—	0.4	3,000 sat	—
Total trihalomethanes	1.6	100	100	11,000	—	—	1.6	—	—
Semivolatile Organic Compounds									
Benzaldehyde	0.1	—	—	—	—	—	100	88,000 nc	—
Phenol	0.05	—	—	10,200	2,560	—	50	100,000 max	—
bis(2-Chloroethyl) ether	0.05	—	—	—	—	—	50	0.62 ca	0.0002
2-Chlorophenol	0.05	—	—	4,380	2,000	—	50	240 nc	—
2-Methylphenol	0.05	—	—	—	—	—	50	44,000 nc	—
2,2'-Oxybis(1-chloropropane)=[bis (2-chloroisopropyl) ether]	0.05	—	—	—	—	—	50	0.62 ca	—
Acetophenone	0.1	—	—	—	—	—	100	1.6 nc	—
4-Methylphenol	0.05	—	—	—	—	—	50	4,400 nc	—
n-Nitroso-di-n-propylamine	0.05	—	—	—	—	—	50	0.35 ca	0.00003
Hexachloroethane	0.05	—	—	980	540	—	50	180 ca	100
Nitrobenzene	0.05	—	—	27,000	—	—	50	110 nc	—
Isophorone	0.05	—	—	117,000	—	—	50	2,600 ca	—
2-Nitrophenol	0.05	—	—	230	150	—	50	—	—
2,4-Dimethylphenol	0.05	—	—	2,120	—	—	50	1,800 nc	—

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
bis(2-Chloroethoxy)methane	0.05	—	—	—	—	—	50	—	—
2,4-Dichlorophenol	0.05	—	—	2,020	365	—	50	2,600 nc	—
Naphthalene	0.01	—	—	2,300	620	—	10	190 nc	30
4-Chloroaniline	0.05	—	—	—	—	—	50	3500 nc	—
Hexachlorobutadiene	0.05	—	—	90	9.3	—	50	32 ca	—
Caprolactam	0.1	—	—	—	—	—	100	100,000 max	—
4-Chloro-3-methylphenol	0.05	—	—	30	—	—	50	—	—
2-Methylnaphthalene	0.01	—	—	—	—	—	10	—	—
Hexachlorocyclopentadiene	0.05	50	—	7	5.2	—	50	5,900 nc	—
2,4,6-Trichlorophenol	0.05	—	—	—	970	—	50	220 ca	2
2,4,5-Trichlorophenol	0.05	—	—	—	—	—	50	88,000 nc	—
1,1'-Biphenyl	0.1	—	—	—	—	—	50	350 sat	—
2-Chloronaphthalene	0.01	—	—	1,600	—	—	10	27,000 nc	—
2-Nitroaniline	0.05	—	—	—	—	—	50	50 nc	—
Dimethylphthalate	0.05	—	—	—	—	—	50	100,000 max	—
2,6-Dinitrotoluene	0.05	—	—	330	230	—	50	880 nc	0.002
Acenaphthylene	0.01	—	—	—	—	—	10	—	—
3-Nitroaniline	0.05	—	—	—	—	—	50	—	—
Acenaphthene	0.01	—	—	1,700	520	—	10	38,000 nc	2,000
2,4-Dinitrophenol	0.05	—	—	—	—	—	50	1,800 nc	—
4-Nitrophenol	0.05	—	—	230	150	—	50	7,000 nc	—
Dibenzofuran	0.05	—	—	—	—	—	50	5,100 nc	—
2,4-Dinitrotoluene	0.05	—	—	330	230	—	50	1,800 nc	—
Fluorene	0.01	—	—	—	—	—	10	33,000 nc	2,000
Diethylphthalate	0.05	—	—	—	—	—	50	100,000 max	—
4-Chlorophenyl-phenyl-ether	0.05	—	—	—	—	—	50	—	—
4-Nitroaniline	0.05	—	—	—	—	—	50	—	—
4,6-Dinitro-2-methylphenol	0.05	—	—	—	—	—	50	—	—

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
n-Nitrosodiphenylamine	0.01	—	—	—	—	—	50	500 ca	2
4-Bromophenyl-phenyl ether	0.05	—	—	—	—	—	50	—	—
Hexachlorobenzene	0.05	1	—	—	—	—	50	1.5 ca	—
Atrazine	0.1	3	—	—	—	—	50	11 ca	—
Pentachlorophenol	0.05	1	—	20[l]	13[l]	—	50	11 ca	5
Phenanthrene	0.01	—	—	—	—	—	10	—	—
Anthracene	0.01	—	—	—	—	—	10	100,000 max	20,000
Carbazole	0.05	—	—	—	—	—	50	120 ca	—
Di-n-butylphthalate	0.05	—	—	—	—	—	50	88,000 nc	—
Fluoranthene	0.01	—	—	3,980	—	—	10	30,000 nc	8,000
Pyrene	0.01	—	—	—	—	—	10	54,000 nc	6,000
Butylbenzylphthalate	1	—	—	—	—	—	50	100,000 max	—
3,3'-Dichlorobenzidine	0.5	—	—	—	—	—	50	5.5 ca	0.05
Benzo(a)anthracene	0.01	—	—	—	—	—	10	2.9 ca	0.1
Chrysene	0.01	—	—	—	—	—	10	290 ca	0.1
bis-(2-Ethylhexyl) phthalate	1	6	—	—	—	—	50	180 ca	4
Di-n-octylphthalate	0.05	—	—	—	—	—	50	10,000 sat	—
Benzo(b)fluoranthene	0.01	—	—	—	—	—	10	2.9 ca	0.1
Benzo(k)fluoranthene	0.01	—	—	—	—	—	10	29 ca	0.1
Benzo(a)pyrene	0.01	0.2	—	—	—	—	10	0.29 ca	0.1
Indeno(1,2,3-c,d)pyrene	0.01	—	—	—	—	—	10	2.9 ca	0.1
Dibenzo(a,h)anthracene	0.01	—	—	—	—	—	10	0.29 ca	—
Benzo(g,h,i)perylene	0.01	—	—	—	—	—	10	—	—
Pesticides and PCBs									
Aldrin	0.01	—	—	3	—	—	1	0.15 ca	0.04
α-BHC	0.01	—	—	—	—	—	1	0.59 ca	0.008
β-BHC	0.01	—	—	—	—	—	1	2.1 ca	—
χ-BHC (Lindane)	0.01	0.2	4	2	0.08	4	1	2.9ca	0.03

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
δ-BHC	0.01	—	—	—	—	—	1	—	—
Chlordane, technical	0.1	2	—	2.4	0.0043	—	10	11 ca	0.5
α-Chlordane	0.01	—	—	—	—	—	1	—	
χ-Chlordane	0.01	—	—	—	—	—	1	—	—
4,4'-DDD	0.02	—	—	—	—	—	2	17 ca	3
4,4'-DDE	0.02	—	—	1,050	—	—	2	12 ca	2
4,4'-DDT	0.02	—	—	1.1	0.001	—	2	12 ca	2
Dieldrin	0.02	—	—	2.5	0.0019	—	2	0.15 ca	0.001
Endosulfan	0.02	—	—	0.22	0.0056	—	2	53,000 nc	—
Endosulfan I	0.01	—	—	0.22[j]	0.056[j]	—	1	(see Endosulfan)	0.0006
Endosulfan II	0.02	—	—	0.22[j]	0.056[j]	—	2	(see Endosulfan)	0.0006
Endosulfan sulfate	0.02	—	—	0.22[j]	0.056[j]	—	2	—	—
Endrin	0.02	2	0.2	0.18	0.0023	0.2	2	260 nc	0.05
Endrin aldehyde	0.02	—	—	—	—	—	2	—	—
Endrin ketone	0.02	—	—	—	—	—	2	—	—
Heptachlor	0.01	0.4	—	0.52	0.0038	—	1	0.55 ca	0.0002
Heptachlor epoxide	0.01	0.2	—	—	—	—	1	0.27 ca	0.0003
Methoxychlor	0.1	40	100	—	0.03	100	10	4,400 nc	—
Toxaphene	1.0	3	5	0.73	0.0002	5	100	2.2 ca	0.01
Aroclor® 1016	0.1	0. 5	—	2[k]	0.014[k]	—	10	29 ca	0.08
Aroclor® 1221	0.2	0. 5	—	2[k]	0.014[k]	—	20	1.0 ca	0.08
Aroclor® 1232	0.1	0. 5	—	2[k]	0.014[k]	—	10	1.0 ca	0.08
Aroclor® 1242	0.1	0. 5	—	2[k]	0.014[k]	—	10	1.0 ca	0.08
Aroclor® 1248	0.1	0. 5	—	2[k]	0.014[k]	—	10	1.0 ca	0.08
Aroclor® 1254	0.1	0. 5	—	2[k]	0.014[k]	—	10	1.0 ca	0.08
Aroclor® 1260	0.1	0. 5	—	2[k]	0.014[k]	—	10	1.0 ca	0.08

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
Metals	**(mg/L)**	**(mg/L)**	**(mg/L)**			**(mg/L)**	**(mg/kg)[l]**	**(mg/kg)**	**(mg/kg)**
Aluminum	0.005	—	—	—	—	—	40	100,000 max	—
Antimony	0.003	0.006	—	9,000	1,600	—	100	820 nc	—
Arsenic (soil by 6020)	0.001	0.05	0.05	360[m]	190[m]	0.05	1	2.7 ca	0.004
Barium	0.001	2,000	1.0	—	—	1	1	100,000 max	100
Beryllium	0.0005	0.004	—	130	5.3	—	0.4	2,200 ca	0.002
Cadmium (soil by 6020)	0.0005	0.005	0.01	3.9[n]	1.1[n]	0.01	0.5	810 nc	0.5
Calcium	0.5	—	—	—	—	—	200	—	—
Chromium, total	0.001	0.1	0.05	16 (1,700[n])[o]	11 (210[n])[o]	0.05	2	450 ca	10
Cobalt	0.0005	—	—	—	—	—	2	100,000 max	—
Copper	0.001	1.3	1,000	18[n]	12[n]	—	4	76,000 nc	100
Iron	0.1	—	300	—	—	—	20	100,000 max	—
Lead (soil by 6020)	0.0005	0.015	0.05	82[n]	3.2[n]	0.05	0.5	750 nc	2
Magnesium	0.5	—	—	—	—	—	200	—	—
Manganese	0.0005	—	50	—	—	—	3	32,000 nc	400
Mercury	0.0002	0.002	0.002	2.4	0.012	0.002	0.1	610 nc	0.2
Nickel	0.001	—	—	1,400[n]	160[n]	—	8	41,000 nc	10
Potassium	1.0	—	—	—	—	—	400	—	—
Selenium	0.003	0.050	0.01	260	35	0.01	80	10,000 nc	—
Silver (soil by 6020)	0.0005	—	0.05	4.1[n]	0.12[n]	0.05	0.5	10,000 nc	5
Sodium	1.0	—	—	—	—	—	100	—	—
Strontium	0.0005	—	—	—	—	—	10	100,000 max	—
Thallium	0.0005	0.002	0.5	1,400	40	—	100	130 nc	—
Uranium (soil by 6020)	0.1	30	—	—	—	—	0.1	410 nc	—
Vanadium	0.001	—	—	—	—	—	10	14,000 nc	—
Zinc	0.004	—	5,000	120[n]	110[n]	—	4	100,000 max	—

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
Cyanide									
	0.01	0.2	—	2.2	5.2	—	0.2	35 nc	20
TPH-Diesel									
	NA	—	—	—	—	—	25	—	—
Explosives									
1,3,5-Trinitrobenzene	NA	NA	NA	—	—	—	0.05	26,000 nc	—
1,3-Dinitrobenzene	NA	NA	NA	—	—	—	0.05	88 nc	—
2,4,6-Trinitrotoluene	NA	NA	NA	—	—	—	0.05	82 ca	—
2,4-Dinitrotoluene	NA	NA	NA	—	—	—	0.05	1,800 nc	—
2-Aminodinitrotoluene	NA	NA	NA	—	—	—	0.05	—	—
2-Nitrotoluene	NA	NA	NA	—	—	—	0.1	1,000 sat	—
3-Nitrotoluene	NA	NA	NA	—	—	—	0.1	1,000 sat	—
4-Aminonitrotoluene	NA	NA	NA	—	—	—	0.05	—	—
4-Nitrotoluene	NA	NA	NA	—	—	—	0.1	1,000 sat	—
Nitrobenzene	NA	NA	NA	27,800	—	—	0.05	110 nc	—
HMX	NA	NA	NA	—	—	—	0.05	44,000 nc	—
Tetryl	NA	NA	NA	—	—	—	0.05	—	—
Chemical Agent Breakdown Products									
Thiodiglycol	NA	NA	NA	—	—	—	0.020	—	—
Dithiane	NA	NA	NA	—	—	—	0.020	8,800 nc	—
Oxathiane	NA	NA	NA	—	—	—	1	—	—
Methylphosphonic acid	NA	NA	NA	—	—	—	10	18,000 nc	—

Chemicals of Concern[a]	Lab Water PQLs (mg/L)	EPA MCLs[b] (mg/L)	ODEQ GW Quality Protection[c] (mg/L)	ODEQ GW Protection of Aquatic Life (mg/L)[d]		ODEQ GW Protection of Human Health (mg/L)[d]	Lab Soil, Sediment, Concrete PQLs (mg/Kg)	EPA Region 9 Soil PRGs[e] (mg/kg)	ODEQ Soil Cleanup Levels[f] (mg/kg)
				Fresh Acute	Fresh Chronic	Drinking Water MCL			
VX thiols: Diisopropylaminoethane thiol, bis-(Diisopropylaminoethane) disulfide bis-Diisopropylaminosulfide, Other isopropylaminoethane compounds	NA	NA	NA	—	—	—	0.5	—	—

[a] **Screening criteria that are lower than the laboratory PQL (reporting limit) are highlighted**. Compounds listed for VOCs, SVOCs, pesticides and PCBs, and analytes listed for metals and cyanide are based on the EPA Contract Laboratory Program Target Compound Lists and Target Analyte Lists.
[b] Current drinking water standards, Http://www.epa.gov/safewater/mcl.html
[c] ODEQ Groundwater Quality Protection, OAR 340-040-0020, Tables 1 through 3.
[d] ODEQ Water Quality Standards and Beneficial Uses, OAR 340-041-0001 to 340-041-0975, Table 20. There were insufficient data to develop criteria for all compounds listed; value presented is the L.O.E.L. – Lower Observed Effect Level (does not apply to pesticides and PCBs except 4,4'-DDE and metals except beryllium and thallium).
[e] 1998 EPA Region 9 PRGs for industrial soils.
[f] ODEQ Soil Cleanup Levels, Hazardous Substance Remedial Action, OAR 340-122-045, soil cleanup table.
[g] These analytes are halomethanes
[h] This analyte is a chlorinated benzene
[i] pH dependent criteria (7.8 pH used)
[j] Criteria are for Endosulfan
[k] Based on total PCB results
[l] Lab metals analysis method for soil matrix, unless otherwise indicated, is SW-846 6010B.
[m] Criteria are for trivalent arsenic
[n] Hardness dependent criteria (100 mg/L used)
[o] Cr^{+6} (Cr^{+3})

Notes:
ca - cancer
GW - groundwater
max - maximum soil contamination level
MCL - maximum contaminant level
NA - not applicable
nc - noncancer
OAR - Oregon Administrative Rules
ODEQ - Oregon Department of Environmental Quality
PQL - practical quantitation limit equivalent to the method reporting limit (MRL)
PRG - preliminary remedial goal
sat - saturated soil
— - criteria not established

APPENDIX B

Quality Control Criteria for Laboratory Analyses

Table B-1
Summary of Method Quality Control Criteria for Volatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/ SURROGATES	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Instrument Tune	Check mass spectral ion intensities using BFB. (4-bromofluorobenzene)	Every 12 hours.	Refer to method narrative.	Not Applicable	1. Retune instrument. 2. Repeat BFB analysis.
Initial Calibration (ICal)	Five-point calibration to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria	Instrument Evaluation: SPCCs: minimum RF values per method requirements CCCs: verify %RSD = 30% Primary Evaluation : r = 0.995, %RSD = 15%; r^2 = 0.990 Alternative Evaluation: Mean %RSD for all target analytes = 15%; none > 30%	No allowance No allowance Alternative Evaluation: Maximum allowable %RSD for each target analyte = 30%	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A mid-level standard from an independent source other than that used for the instrument calibration, and analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the initial calibration prior to any sample analysie.	%Recovery = 80% - 120% of known concentration.	No allowance	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.

Table B-1 (Continued)
Summary of Method Quality Control Criteria for Volatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/ SURROGATES	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Continuing Calibration Verification (CCV)	A mid-level standard f analyzed in the exact same manner as the calibration standards.	Analyzed daily before sample analysis, every 12 hours and at the end of the analytical sequence.	Instrument Evaluation: SPCCs: minimum RF values per method requirements Primary Evaluation (CCCs): %Drift = 20%, %D = 20%	No Allowance No allowance	1. Evaluate system. 2. Reanalyze CCV. 3. Reanalyze samples subsequent to failed CCV. 4. Recalibrate
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Target Analytes: Less than one-half MRL.	Common Lab Contaminants: ≤ MRL	1. Check calculations. 2. Reanalyze MB. 3. Reprepare and reanalyze samples unless target compound concentrations are 5 x blank concentration. 4. If insufficient sample volume is available to reprepare samples, narrate outliers and discuss implications to data usability.

Table B-1 (Continued)
Summary of Method Quality Control Criteria for Volatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/ SURROGATES	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Internal Standards (IS)	Organic compounds with retention times similar to the target compounds.	Three internal standards added to every environmental sample, calibration standard, QC sample, and blank.	RT of the IS must be within 30 sec. of the RT in the last CCV (12 hour). [Area of the IS must be <2 x area in the daily CCV.]	No Allowance	1. Check calculations and sensitivity of instrument. 2. Reanalyze sample. 3. Narrate outliers and discuss implications to data usability.
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	3 surrogates added to every environmental sample, QC sample, calibration standard, and blank.	Interference-Free Matrix: Water: %Recovery = 80%-120% Solids: %Recovery = 75%-125% Project Sample Matrix: %Recovery = 70% - 130%	Not Applicable	1. Check calculations. 2. Reanalyze sample once. 3. If chromatographic interference is evident and LCS recovery is acceptable, flag data for matrix interference.
Laboratory Control Sample (LCS)	A certified standard that is processed using the same analytic preparations as the samples.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	Water: %Recovery = 80% - 120% of known concentration. Solids: %Recovery = 75% - 125% of known concentration	Sporadic Marginal Failures[a]: %Recovery = 60% - 140% of known concentration.	1. Check calculations. 2. Reanalyze LCS. 3. Reprepare and reanalyze samples. 4. If insufficient sample volume is available to reprepare samples, narrate outliers and discuss implications to data usability.

Table B-1 (Continued)
Summary of Method Quality Control Criteria for Volatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/ SURROGATES	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes or subset of the target analytes. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 70% - 130% of known concentration.	Sporadic Marginal Failures[a]: %Recovery = 60% - 140% of known concentration.	1. Check calculations. 2. Reanalyze once, unless the target compound concentrations in the native sample are > 4x the amount spiked. 3. Evaluate LCS. If it meets acceptable limits, flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	Water: RPD = 30% Solids: No RPD limits	Sporadic Marginal Failures[a]: Water: RPD = 40% Solids: No RPD limits	1. Check calculations. 2. Reanalyze once, unless the target compound concentrations in the native sample are > 4x the amount spiked. 3. Evaluate LCS and MS. If they meet QC limits, flag data for matrix interference.

Table B-1 (Continued)
Summary of Method Quality Control Criteria for Volatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/ SURROGATES	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Target Compound Identification	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT = ± 0.06 minutes compared to the ICal.(criteria used by SAS Laboratory)	No Allowance	1. Reanalyze standard 2. Recalculate RT windows 3. Verify that all target analytes fall within newly established RT windows
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 14 days if preserved with HCl to pH <2. Soil: methanol or sodium bisulfate; cool to 4°C ± 2ºC.	Holding time may not be exceeded.	Holding time may not be exceeded.	Recollect samples.

*The number of Sporadic Marginal Failure (SMF) allowances depend upon the number of target analytes reported from the analysis. For instance, if the full list of target compounds is reported, then five SMFs are allowed to exceed the expanded criteria presented for the ICV and LCS. If the MS includes only a subset of compounds, allow only one SMF.

Note:
Information presented is based on EPA SW-846 Method 8260B and the USACE Shell.

Table B-2
Summary of Method Quality Control Criteria for Semivolatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	QC CRITERIA FOR POOR PURGERS/GASES/ SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Instrument Tune	Check mass spectral ion intensities using DFTPP (decafluorotriphenylphosphine)	Every 12 hours.	Refer to method narrative.	Not applicable	1. Retune instrument 2. Repeat DFTPP analysis.
Initial Calibration (ICal)	5 Point calibration to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria.	Instrument Evaluation: SPCCs: minimum Response Factor (RF) values per method requirements CCCs: verify %RSD = 30% Primary Evaluation (all target analytes) : r = 0.995, %RSD = 15%; r^2 = 0.990 Alternative Evaluation: Mean %RSD for all target analytes = 15%; none > 40%	No allowance No allowance No allowance	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A mid-level standard from an independent source other than that used for the instrument calibration, analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the ICAL.	%Recovery (Rec)= 70% - 130% of known concentration.	No allowance	1. Evaluate system. 2. Reanalyze ICV. 3. Recalibrate.
	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed daily before analysis, every 12 hours, and at the end of the analytical sequence.	Instrument Evaluation: SPCCs: minimum RF values per method requirements Primary Evaluation (CCCs): %Drift = 20%, %Difference = 20%	No allowance No allowance	1. Evaluate system. 2. Reanalyze CCV. 3. Reanalyze sample subsequent to failed 4. Recalibrate

Table B-2 (Continued)
Summary of Method Quality Control Criteria for Semivolatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	QC CRITERIA FOR POOR PURGERS/GASES/ SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, calibration standard, QC sample, and blank.	Recovery Interference-Free Matrix Water/Solids[b]: = 60%-120% B/N analytes = 45%-135% A analytes %Recovery Project Sample Matrix Water/Solids: = 45%-135% B/N analytes = 35% - 140% A analytes	%Recovery Sporadic Marginal Failures[a]: Water: %Recovery = 15% - 150% of known concentration. Solids: %Recovery = 20% - 150% of known concentration.	1. Check calculations 2. Reanalyze sample 3. Reextract if 2- (or 1 fraction) are outside limits; if %Rec = <10 4. If surrogate recove still outside limits, na outliers and discuss implications to data usability.
Internal Standards (IS)	Organic compounds with retention times similar to the target compounds.	Every environmental sample, calibration standard, QC sample, and blank.	Retention time of the IS must be within 30 sec. of the RT in the last CCV (12 hours). Area of the IS must be <2x area of the IS in the daily CCV.	No allowance	1. Check calculations instrument sensitivity 2. Reanalyze sample 3. If three surrogates out reprepare and reanalyze samples. 4. If one or two intern standards are out, fla data and comment in narrative.

Table B-2 (Continued)
Summary of Method Quality Control Criteria for Semivolatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	QC CRITERIA FOR POOR PURGERS/GASES/ SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Target Analytes: Less than one-half MRL.	Common Lab Contaminants: Analytes < MRL	1. Check calculations 2. Reanalyze MB. 3. Reprepare and reanalyze samples u target compound concentrations are 5 blank concentration. 4. If insufficient samp volume is available t reprepare samples, narrate outliers and discuss implications t data usability.
Laboratory Control Sample (LCS)	A certified standard that is processed using the same analytic preparations as the samples.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	%Recovery of known analyte concentration. Water: = 60% - 120% (~15 analytes = 45% - 135% (~30 analytes) = 20% - 150% (~15 analytes) Solids: = 60% - 120% (~20 analytes = 45% - 135% (~25 analytes) = 30% - 150% (~15 analytes)	%Recovery Sporadic Marginal Failures[a]: Water: 15% - 150% Solids: 25% - 150%	1. Check calculations 2. Reanalyze LCS. 3. Reprepare and reanalyze samples u recoveries are high a target compound are undetected in the samples. 4. If insufficient samp volume is available t reprepare samples, narrate outliers and discuss implications t data usability.

Table B-2 (Continued)
Summary of Method Quality Control Criteria for Semivolatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	QC CRITERIA FOR POOR PURGERS/GASES/ SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes or subset of the target analytes. Documents method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery Water/Solids = 45% - 135% of known concentration.	%Recovery Sporadic Marginal Failures[a]: Water: 15% - 150% of known concentration. Solids: 20% - 150% of known concentration.	1. Check calculations 2. Reanalyze once 3. Evaluate LCS. If L meets acceptable lim flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	% Recovery same as MS Relative Percent Difference (RPD) Water: = 50% Solids: = 60%	% Recovery same as MS RPD Sporadic Marginal Failures[a]: Water/Solids: = 60%	1. Check calculations 2. Reanalyze once. 3. Evaluate LCS. If it meets acceptable lim flag data for matrix interference.
Target Compound Identifica-tion	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period. All succeeding standards in an analysis sequence should fall within the daily RT window established by the first standard of the sequence.	No Allowance	1. Reanalyze standar 2. Recalculate RT windows 3. Verify that all targe analytes fall within ne established RT windc

Table B-2 (Continued)
Summary of Method Quality Control Criteria for Semivolatile Organic Compounds (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	QC CRITERIA FOR POOR PURGERS/GASES/ SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Other	Holding time is the length of time allowable between sampling and analysis.	Cool to 4°C. Water: 7 days before extraction, 40 days from extraction to analysis. Soil: 14 days before extraction, 40 days from extraction to analysis.	Hold time may not be exceeded.	Hold time may not be exceeded.	Recollect samples

*The number of Sporadic Marginal Failure (SMF) allowances depend upon the number of target analytes reported from the analysis. For instance, if the full list of target compounds is reported, then five SMFs are allowed to exceed the expanded criteria presented for the ICV and LCS. If the MS includes only a subset of compounds and for surrogates, allow up to one SMF for each base/neutral (B/N) and acid (A) grouping.

Note:
Information presented is based on EPA SW-846 Method 8270C and the USACE Shell.

Table B-3
Summary of Method Quality Control Criteria for Pesticides (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Initial Calibration (Ical)	Standards analyzed to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria. Minimum of 5 standards.	Primary Evaluation: $r \geq 0.0095$; %RSD ≤20% $r^2 \geq 0.990$. Alternative Evaluation: Mean %RSD for all target analytes ≤20%.	No allowance Alternative Evaluation: Maximum allowable %RSD for each target analyte ≤40%.	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A standard from an independent source other than that used for the instrument calibration, but within the calibration range and analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the initial calibration.	%Recovery = ± 15% of known concentration.	No allowance	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed after every 10 samples, daily before sample analysis, and at the end of the analytical sequence.	Primary Evaluation: %Drift ≤ 15%; %Difference ≤ 15% Alternative Evaluation: Mean % Drift/%D for all target analytes ≤ 15%.	No allowance Alternative Evaluation: Maximum allowable %Drift/%D for each target analyte ≤30%.	1. Evaluate system. 2. If %D >15% and targe analytes are undetected (U), report results. 3. Reanalyze samples subsequent to failed CCV. 4. Recalibrate
DDT/Endrin Breakdown	Measures the extent of 4,4'-DDT and endrin breakdown during analysis.	Every 24 hours	4'4"-DDT and endrin breakdown = 15% each.	Not applicable	

Table B-3 (Continued)
Summary of Method Quality Control Criteria for Pesticides (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples	Target analytes: Less than one-half MRL	Not applicable	1. Check calculations. 2. Reanalyze MB. 3.If target analytes are undetected (U) or 20x blank concentration, no action. 4. If sample concentrations <20x blank, reextract and reanalyze samples analyzed before the last clean blank.
Laboratory Control Sample (LCS)	A standard that is processed using the same analytic preparations as the samples. Documents laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	%Recovery water/solid = 50% - 130% of known concentration.	Sporadic Marginal Failures: %Recovery = 30% - 150% of known concentration.	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze samples unless LCS recoveries are high and target analytes are undetected (U) in the samples. 4. If insufficient sample to reprepare, narrate outliers and discuss implications to data usability.

Table B-3 (Continued)
Summary of Method Quality Control Criteria for Pesticides (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes or a subset of the target analytes. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery water/solid = 40% - 140% of known concentration	Sporadic Marginal Failures: %Recovery = 30% - 150% of known concentration.	1. Check calculations. 2. Reanalyze once, unless the target analyte concentration is 4x the amount spiked. 3. If chromatographic interference is evident and LCS recovery is acceptable, flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	%Recovery = same as MS Relative Percent Difference (RPD) $\leq$ 50%	Sporadic Marginal Failures: RPD $\leq$ 60%	Same as MS
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, QC sample, calibration standard, and blank.	Interference-free Water/Solid Matrix: %Recovery = 50% - 130% of known concentration; Sample: %Recovery = 40% - 140% of known concentration.	Not applicable	1. Check calculations, standards, and the system. 2. Reanalyze once. 3. If chromatographic interference is evident in the samples and surrogate recovery is acceptable in the LCS and MB, flag data for matrix interference.

Table B-3 (Continued)
Summary of Method Quality Control Criteria for Pesticides (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	QC CRITERIA FOR POOR PURGERS/ GASES/SPORATIC MARGINAL FAILURES*	CORRECTIVE ACTION
Target Compound Identification	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate for each chromatographic column employed in the analysis.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period. All succeeding standards in an analysis sequence should fall within the daily RT window established by the first standard of the sequence.	No allowance	1. Reanalyze standard 2. Recalculate RT windows 3. Verify that all target analytes fall within newly established RT windows
Target Compound Confirmation	Qualitative confirmation of detected target compounds using a second column dissimilar to the primary column. Quantitative confirmation of detected target compounds is required when interferences are noted on the primary column.	All samples with detected target compounds.	For qualitative confirmation, the second column must meet QC criteria for calibration and retention times. For quantitative confirmation, the second column must meet criteria for calibration, retention times, and batch QC. RPD = ≤40%	RPD = ≤40%	Not Applicable
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 7 days to extraction, 40 days from extraction to analysis. Soil: 14 days to extraction, 40 days from extraction to analysis, 4°C ± 2°.	Hold time may not be exceeded.	Recollect samples.	

Table B-3 (Continued)
Summary of Method Quality Control Criteria for Pesticides (by Gas Chromatography)

*The number of Sporadic Marginal Failure (SMF) allowances depend upon the number of target analytes reported from the analysis. For instance, if the full list of target compounds is reported from the GC/ECD, then two SMFs are allowed to exceed the expanded criteria presented for the ICV and LCS. If the MS includes only a subset of compounds, allow only one SMF for that QC element.

Note:
Information presented is based on EPA SW-846 Method 8081A and the USACE Shell

Table B-4
Summary of Method Quality Control Criteria for PCBs (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Initial Calibration (Ical)	Standards analyzed to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria. Minimum of 5 standards.	Primary Evaluation: $r \geq 0.0095$; %RSD ≤20% $r^2 \geq 0.990$. Alternative Evaluation: Mean %RSD for all target analytes ≤20%.	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A standard from an independent source other than that used for the instrument calibration, but within the calibration range and analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the initial calibration.	%Recovery = ± 15% of known concentration.	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed after every 10 samples, daily before sample analysis, and at the end of the analytical sequence.	Primary Evaluation: %Drift ≤ 15%; %Difference ≤ 15% Alternative Evaluation: Mean % Drift/%D for all target analytes ≤ 15%.	1. Evaluate system. 2. If %D >15% and target analyte concentrations are undetected (U), report results. 3. Reanalyze samples subsequent to failed CCV. 4. Recalibrate
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Target analytes: Less than one-half MRL.	1. Check calculations. 2. Reanalyze MB. 3. If target analytes are undetected (U) or 20x blank concentration, no action. 4. If sample concentrations <20x blank, reextract and reanalyze samples analyzed before the last clean blank.

Table B-4 (Continued)
Summary of Method Quality Control Criteria for PCBs (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	A standard that is processed using the same analytic preparations as the samples. Documents laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	Water/Solid: %Recovery = 50% - 130% of known concentration.	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze samples unless LCS recoveries are high and target analytes are undetected (U) in the samples. 4. If insufficient sample to reprepare, narrate outliers and discuss implications to data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes or subset of the target analytes. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 40% - 140% of known concentration.	1. Check calculations. 2. Reanalyze once, unless the target analyte concentration is 4x the amount spiked. 3. If chromatographic interference is evident and LCS recovery is acceptable, flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	%Recovery same as MS. Relative Percent Difference (RPD) $\leq$ 50%	Same as MS

Table B-4 (Continued)
Summary of Method Quality Control Criteria for PCBs (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, QC sample, calibration standard, and blank.	Interference-free Water/Solid Matrix: %Recovery = 50% - 130% of known concentration; Sample: %Recovery = 40% - 140% of known concentration.	1. Check calculations, standards, and the system. 2. Reanalyze once. 3. If chromatographic interference is evident in the samples and surrogate recovery is acceptable in the LCS and MB, flag data for matrix interference.
Target Compound Identification	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate for each chromatographic column employed in the analysis.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period. All succeeding standards in an analysis sequence should fall within the daily RT window established by the first standard of the sequence.	1. Reanalyze standard 2. Recalculate RT windows 3. Verify that all target analytes fall within newly established RT windows
Target Compound Confirmation	Qualitative confirmation of detected target compounds using a second column dissimilar to the primary column. Quantitative confirmation of detected target compounds is required when interferences are noted on the primary column.	All samples with detected target compounds.	For qualitative confirmation, the second column must meet QC criteria for calibration and retention times. For quantitative confirmation, the second column must meet criteria for calibration, retention times, and batch QC. RPD = ≤40%	Not Applicable

Table B-4 (Continued)
Summary of Method Quality Control Criteria for PCBs (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 7 days to extraction, 40 days from extraction to analysis. Soil: 14 days to extraction, 40 days from extraction to analysis, 4°C ± 2°.	Hold time may not be exceeded.	

Note:
Information presented is based on EPA SW-846 Method 8082 and the USACE Shell

Table B-5
Summary of Method Quality Control Criteria for Metals (by ICP and ICP/MS)

QC ELEMENT	DESCRIPTION OF ELEMENT	FREQUENCY	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICal)	Option 1 - standard and blank, and a low-level check standard at the MRL. Option 2 - 3 standards and a blank	Daily	Option 1 - Low-level check standard ± 20% Option 2 - r ≥ 0.995	1. Recalibrate
Instrumental Precision	% RSD 3 integrations (exposures)	Each calibration and calibration verification standard (ICV/CCV).	%Relative Standard Deviation (RSD) < 5%	1. Recalibrate
Initial Calibration Verification (ICV)	Mid-level (2nd source) verification.	After initial calibration.	% Recovery ± 10%	1. Terminate analysis 2. Correct the problem 3. Recalibrate
Initial Calibration Blank (ICB)	Interference-free matrix to assess analysis contamination.	After initial calibration.	Analytes < Method Detection Limit (MDL)	1. Terminate analysis 2. Correct the problem 3. Recalibrate
Interelement Check Standards (ICS)	ICS-A: interferents only ICS-B: interferents and target analytes.	Beginning of analytical sequence.	% Recovery ± 20% for target analytes	1. Narrate the possibility of physical or chemical interference
Continuing Calibration Blank (CCB)	Interference-free matrix to assess analysis contamination.	Every 10 samples and at the end of analytical sequence.	Target analytes < MDL	1. Terminate analysis 2. Correct the problem 3. Recalibrate and rerun all samples not bracketed by acceptable CCB
Continuing Calibration Verification (CCV)	Mid-level verification.	Every 10 samples and at the end of analytical sequence.	% Recovery = ± 10% of known concentration.	1. Terminate analysis 2. Correct the problem 3. Recalibrate and rerun all samples not bracketed by acceptable CCV

Table B-5 (Continued)
Summary of Method Quality Control Criteria for Metals (by ICP and ICP/MS)

QC ELEMENT	DESCRIPTION OF ELEMENT	FREQUENCY	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Method Blank (MB)	Interference-free matrix to assess overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Target analytes Less than one-half the MRL	1. Redigest and reanalyze samples associated with the MB
Laboratory Control Sample (LCS)	Interference-free matrix containing all target analytes.	One LCS for each analytical batch or a minimum of one LCS per 20 samples.	% Recovery = 80% - 120% of known concentration. Sporadic Marginal Failures: * % Recovery = 60% - 140%.	1. Terminate analysis 2. Correct the problem 3. Redigest and reanalyze samples associated with the LCS
Matrix Spike (MS)	Sample matrix spiked with all/subset of target analytes prior to digestion.	One MS for each analytical batch or a minimum of one MS per 20 samples.	% Recovery = 75% - 125% of known concentration.	1. Flag the data; no flag required if the sample level is >4x the spike added
Matrix Duplicate (MD)	Environmental sample that is divided into two separate aliquots by the laboratory.	One MD for each analytical batch or a minimum of one MD per 20 samples.	RPD ≤ 25%	1. Flag the data; no flag required if the sample level is >4x the spike added
Post Digestion Spikes (PDS)	Sample digestate spiked with all/subset of target analytes.	One MD for each analytical batch or a minimum of one MD per 20 samples.	% Recovery = 75% -125% of known concentration.	1. Check calculations 2. Repeat PDS
Serial Dilution (SD)	1:4 dilution analyzed to assess matrix effects.	As needed to assess new and unusual matrix effects.	Agreement between undiluted and diluted results ± 10%	1. Narrate the possibility of physical or chemical interference
Method of Standard Additions	Method of quantitation.	As needed for samples with suspected or confirmed matrix effects.	r = 0.995	1. Check calculations 2. Repeat MSA
Other	Holding time is the length of time allowable between sampling and analysis.	6 months.	Hold time may not be exceeded.	Recollect samples.

Table B-5 (Continued)
Summary of Method Quality Control Criteria for Metals (by ICP and ICP/MS)

'he number of Sporadic Marginal Failure (SMF) allowances depends upon the number of target analytes reported from the analysis. For instance, if between 7 to 15 metals are eported from the ICP analysis, one (1) SMF is allowed to the expanded criteria presented. If greater than 15 metals are reported from the ICP analysis, two (2) SMFs are allowed.

lotes:

ıformation presented is based on EPA SW-846 Methods 6010B and 6020 and the USACE Shell.

CP – Inductively coupled plasma spectroscopy

CP/MS – Inductively coupled plasma spectroscopy/mass spectroscopy

Table B-6
Summary of Method Quality Control Criteria for Mercury (by CVAA)

QC ELEMENT	DESCRIPTION OF ELEMENT	FREQUENCY	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICal)	5 standards and blank.	Daily	$r \geq 0.995$	1. Check calculations 2. Recalibrate 3. Reprep standards as needed.
Initial Calibration Verification (ICV)	Mid-level (2nd source) verification.	After initial calibration.	% Recovery = ± 10% of known concentration.	1. Check calculations 2. Rerun ICV 3. Recalibrate as necessary
Initial Calibration Blank (ICB)	Interference-free matrix to assess analysis contamination.	After initial calibration.	Analytes < Method Detection Limit (MDL)	1. Check calculations 2. Clean system 3. Reanalyze samples analyzed after the last clean blank
Continuing Calibration Blank (CCB)	Interference-free matrix to assess analysis contamination.	Every 10 samples and at the end of analytical sequence.	Analytes < MDL	1. Check calculations 2. Clean system 3. Reanalyze samples analyzed after the last clean blank
Continuing Calibration Verification (CCV)	Mid-level verification.	Every 10 samples and at the end of analytical sequence.	% Recovery = ± 20% of known concentration.	1. Check calculations 2. Repeat CCV 3. Reanalyze samples back to last good CCV 4. Recalibrate if necessary
Method Blank (MB)	Interference-free matrix to assess overall method contamination.	1 per sample batch of 20 samples or less.	Analytes less than one-half the MRL	1. Check calculations 2. Reanalyze 3. Redigest samples if reanalysis fails unless sample results are >5x the blank result 4. If insufficient sample amount to reprep, narrate any outliers and discuss implications on data usability

Table B-6 (Continued)
Summary of Method Quality Control Criteria for Mercury (by CVAA)

QC ELEMENT	DESCRIPTION OF ELEMENT	FREQUENCY	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	Interference-free matrix containing all target analytes.	1 per sample batch of 20 samples or less.	% Recovery = 80% - 120% known concentration	1. Check calculations 2. Reanalyze 3. If still out, reprep samples unless recoveries were high and sample results were ND 4. If insufficient sample amount to reprep, narrate any outliers and discuss implications on data usability
Matrix Spike (MS)	Sample matrix spiked with all/subset of target analytes prior to digestion.	1 per sample batch of 20 samples or less.	% Recovery = 80% - 120% known concentration	1. Check calculations 2. Reanalyze once, unless the native sample concentration is >4x the amount spiked 3. If recoveries still out and sample concentration is <4x the spike amount, analyze by the Method of Standard Additions (MSA) 4. Evaluate LCS. If it meets acceptable limits, flag the data for matrix interference
Matrix Duplicate (MD)	Environmental sample that is divided into two separate aliquots by the laboratory.	1 per sample batch of 20 samples or less.	% RPD = ≤ 20%	1. Same as matrix spike
Method of Standard Additions (MSA)	Method of quantitation.	As needed for samples with suspected or confirmed matrix effects.	$r \geq 0.995$	1. Check calculations 2. Repeat MSA

Table B-6 (Continued)
Summary of Method Quality Control Criteria for Mercury (by CVAA)

QC ELEMENT	DESCRIPTION OF ELEMENT	FREQUENCY	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Other	Holding time is the length of time allowable between sampling and analysis.	28 days.	Hold time may not be exceeded.	Recollect samples.

Notes:
Information presented is based on EPA SW-846 Methods 7470A and 7471A and the USACE Shell
GFAA/CVAA – graphite furnace atomic absorption/cold vapor atomic absorption spectrophotometry

Table B-7
Summary of Method Quality Control Criteria for Total Cyanide (by Distillation)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICal)	Determine the linear range of the method using four standards and a blank. .	Once per analytical sequence	± 0.05 mg CN/ml. Regression coefficient for standard curve > 0.99 and all standards must be regressed within 10% of their known concentration.	1. Check calculations. 2. Recalibrate.
Initial Calibration Verification (ICV)	A mid-level standard from an independent source other than that used for the instrument calibration, analyzed in the exact same manner as the calibration standards.	Third in sequence after ICal and ICB .	% Recovery = ± 10% of known concentration.	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Initial and Continuing Calibration Blanks (ICB, CCB)	Laboratory reagent-grade water that is used for the preparation of the ICal (ICB), ICV (CCB) and CCV (CCB) and that has not gone through any preparation process.	After the ICV, CCV, and high concentration samples.	< ½ Method Reporting Limit (MRL)	1. Reanalyze. 2. Clean system. 3. Reanalyze samples analyzed after last c blank.
Method Blank (MB)	Interference-free laboratory reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	< ½ Method Reporting Limit (MRL)	1. Check calculations. 2. Reanalyze. 3. Redistill and reanalyze samples if reanal unless sample concentrations are >5x the l result. 4. If insufficient sample to redistill, narrate c and discuss implications to data usability.

Table B-7 (Continued)
Summary of Method Quality Control Criteria for Total Cyanide (by Distillation)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	A cyanide standard, that is processed using the same analytic preparations as the samples. Documents laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample volume exists for MSD.	% Recovery = 80% - 120% of known concentrations.	1. Check calculations. 2. Reanalyze. 3. Redistill and reanalyze samples unless recoveries are high and cyanide is undetec in the samples. 4. If insufficient sample to redistill, narrate and discuss implications to data usability.
Matrix Spike (MS)	A sample spiked with a known concentration cyanide prior to sample preparation and processed using the same analytic preparations as the samples. Used to document method bias in a given sample matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	% Recovery = 75% - 125% If the spike sample concentration is less than the unspiked sample value, rerun the spike.	1. Check calculations. 2. Reanalyze once, unless the native samp concentration is 4x the amount spiked. 3. If recoveries are still out and sample concentration is <4x the spike amount, ana the Method of Standard Additions (MSA). 4. Evaluate LCS. If LCS meets acceptable limits, flag data for matrix interference.
Laboratory Duplicate (LD)	An environmental sample that is divided into two aliquots by the laboratory and processed using the same analytical preparations as the samples. Used to document method precision.	One LD for each analytical batch or a minimum of one LD per 20 samples.	RPD = ≤ 20%	1. Check calculations. 2. Reanalyze once. 3. Evaluate LCS and MS. If they meet acc limits, flag data for matrix interference.
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 14 days if preserved with NaOH to pH >12. Pretreat samples containing residual chlorine or sulfide. Soil: 14 days.	Hold time may not be exceeded.	Recollect samples.

Notes:
Information presented is based on EPA SW-846 Method 9012A and Sound Analytical Services Laboratories SOP.

Table B-8
Summary of Method Quality Control Criteria for Petroleum Hydrocarbons (Diesel)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICal)	Standards analyzed to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria. Minimum of five standards.	Primary Evaluation: r ≥ 0.0095; r^2 ≥0.990. Alternative Evaluation: ± 15% of known concentration.	1. Evaluate system. 2. Recalibrate. 3. If motor or jet fuel is detected, a second ICAL will be analyzed and quantitated usin the second ICAL.
Initial Calibration Verification (ICV)	A mid-level standard from an independent source other than that used for the instrument calibration, analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the initial calibration.	± 15% of known concentration.	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed daily before sample analysis after every 10 samples, and at the end of the analytical sequence.	Primary Evaluation: %Drift ≤ 15%; %D ≤ 15% Alternative Evaluation: Mean % Drift/%D for all target analytes ≤ 15%.	1. Evaluate system. 2. Repeat CCV. 3. Reanalyze samples subsequent to failec CCV. 4. If %D is >15% for the CCV and the end CCV, and TPH is undetected (U) in the samples, then recalibration and reanalysis will not be performed. Narrate the anomaly 5. Recalibrate.
Method Blank (MB)	Interference-free reagent-grade water (or sodium sulfate for solid samples) treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	< ½ Method Reporting Limit (MRL).	1. Run a system blank. 2. Reanalyze MB. 3. Bake out system. 4. Perform instrument maintenance. 5. Rerun samples back to last clean blank.

Table B-8 (Continued)
Summary of Method Quality Control Criteria for Petroleum Hydrocarbons (Diesel)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	A standard that is processed using the same analytic preparations as the samples. Documents laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample volume exists for MS/MSD.	%Recovery = 60% - 140% of known concentration .	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze samples unles LCS recoveries are high and TPH is undetected (U) in the samples". 4. If insufficient sample to reprepare, narrat outliers and discuss implications to data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	% Recovery = 60% - 140% of known concentration	1. Check calculations. 2. Reanalyze once, unless the native sample concentration is 4x the amount spiked. 3. Evaluate LCS. If the LCS meets acceptable limits, flag the data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	% Recovery = 50% - 180% of known concentration RPD = ≤ 22%.	1. Check calculations. 2. Reanalyze once. 3. Evaluate LCS and MS. If they meet acceptable limits, flag as matrix interferenc
Surrogates	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, and QC sample.	%Recovery = 50% – 150% of known concentration	1. Check calculations. 2. Reanalyze once. 3. Assess the impact on the samples and narrate the outliers. 4. Reprepare and reanalyze the samples.

Table B-8 (Continued)
Summary of Method Quality Control Criteria for Petroleum Hydrocarbons (Diesel)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 7 days to extraction, 40 days to analysis. Soil: 14 days to extraction, 40 days from extraction to analysis. Cool to 4°C.	Hold time may not be exceeded.	Recollect samples.

Notes:
Information presented is derived from *Analytical Methods for the Analysis of Petroleum Hydrocarbons* (Washington State Department of Ecology, June 1997) and Sound Analytical SOP.

Table B-9
Summary of Method Quality Control Criteria for Nitroaromatics and Nitramines (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	TETRYL/SPORATIC MARGINAL FAILURES[b]	CORRECTIVE ACTION
Initial Calibration (ICal)	5 Point calibration to evaluate instrument performance with respect to analyte concentration.	At system startup, whenever ICV or CCV does not meet quality control criteria, and when major instrument maintenance is performed.	Primary Evaluation: r = 0.995; %Relative Standard Deviation (RSD) = 20%; r^2 = 0.990 Alternative Evaluation: Mean %RSD for all target analytes = 20%	No Allowance Alternative Evaluation: Maximum allowable %RSD for each target analyte = 40%	1. Evaluate system 2. Recalibrate
Initial Calibration Verification (ICV)	A mid-level second source standard analyzed in the exact same manner as the calibration standards, processed to verify that Retention Time (RT), calibration and calculations are correct.	Analyzed immediately after the ICAL.	%Recovery = 85% - 115%	No allowance	1. Evaluate system 2. Repeat ICV 3. Recalibrate if ICV fails to meet criteria
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards, processed to verify that RT, calibration and calculations are correct.	Analyzed daily before sample analysis, after every 10 samples and at the end of the analytical sequence.	Primary Evaluation: %Drift = 15%; %Difference (D) = 15% Alternative Evaluation: Mean %Drift/%D for all target analytes = 15%	No allowance Alternative Evaluation: Maximum allowable %Drift/%D for each target analyte = 30%	1. Evaluate system 2. Repeat CCV 3. Reanalyze samples subsequent to failed CCV 4. Recalibrate as needed
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the samples. Evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Less than one-half the MRL.	Not applicable	1. Check calculations 2. Reanalyze e. If reanalysis falls, reprepare and reanalyze samples unless sample results are >5x the blank

Table B-9 (Continued)
Summary of Method Quality Control Criteria for Nitroaromatics and Nitramines (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	TETRYL/SPORATIC MARGINAL FAILURES[b]	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	Second source standard in reagent-grade water matrix that is processed using the same analytic preparations as the samples. Used to document laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples.	%Recovery Water/Solids: 60% - 120% [b]	Sporadic Marginal Failures[b]: %Recovery = 40% - 150%	1. Check calculations 2. Reanalyze 3. Reprepare and reanalyze samples unless LCS recoveries are high and target compound concentrations are undetected (U) 4. If sample volume is insufficient to reprepare samples, narrate outliers and discuss implications on data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the each target analyte prior to sample preparation and processed using the same analytic preparations as the samples. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 50% - 140% [c] Spike must contain all target compounds.	Sporadic Marginal Failures[b]: %Recovery = 40% - 150%	1. Check calculations 2. Reanalyze once, unless the native sample concentration is >4x the amount spiked 3. Evaluate LCS. If LCS meets QC limits, flag data for matrix interference.
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	An environmental sample that is divided into two aliquots by the laboratory and processed using the same analytic preparations as the samples. Documents precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	Relative Percent Difference (RPD) = 50%	Sporadic Marginal Failures[b] RPD = 60%	1. Check calculations 2. Reanalyze once, unless the native sample concentration is >4x the amount spiked 3. Evaluate LCS . If LCS meets acceptable limits, flag data for matrix interference.

Table B-9 (Continued)
Summary of Method Quality Control Criteria for Nitroaromatics and Nitramines (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	TETRYL/SPORATIC MARGINAL FAILURES[b]	CORRECTIVE ACTION
Surrogate Spikes	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, QC sample and calibration standard.	%Recovery for Interference-Free Matrix: Water: 60%-140% Solids: 50%-150% %Recovery for Project Sample Matrix: Water/Solids: 50% - 150%	Not applicable	1. Check calculations; 2. Reanalyze once; 3. If chromatographic interference is evident in the samples and surrogate recovery is acceptable in the LCS and MB, flag the data for matrix interference
Target Compound Identification	Calculation of retention time (RT) windows for each target analyte and surrogate for each chromatographic column employed in the analysis.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period.	No Allowance	Not Applicable
Target Compound Confirmation	Qualitative confirmation of detected target compounds using a second column dissimilar to the primary column. Quantitative confirmation of detected target compounds is required when interferences are noted on the primary column.	All samples with detected target compounds.	For qualitative confirmation, the second column must meet QC criteria for calibration and retention times For quantitative confirmation, the second column must meet QC criteria for calibration, retention times, and batch QC (MS/MSD optional). RPD =40%	No Allowance No Allowance	Not Applicable
Other	Holding time: Time allowable between sampling and analysis.	Water: 7 days to extraction, 40 days to analysis. Soil: 14 days to extraction, 40 days from extraction to analysis. Dark, 4°C ± 2°C.	Holding time may not be exceeded.	Holding time may not be exceeded.	Not Applicable

Notes:
Information presented is based on EPA SW-846 Method 8330 and the USACE Shell.

Table B-10
Summary of Method Quality Control Criteria for Thiodiglycol in Soil (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	CORRECTIVE ACTION
Initial Calibration (ICal)	5 Point calibration to evaluate instrument performance with respect to analyte concentration.	At system startup, whenever ICV or CCV does not meet quality control criteria, and when major instrument maintenance is performed.	Primary Evaluation: r = 0.995; %Relative Standard Deviation (RSD) = 20%; r^2 = 0.990 Alternative Evaluation: Mean %RSD for all target analytes = 20%	1. Evaluate system 2. Recalibrate
Initial Calibration Verification (ICV)	A mid-level second source standard analyzed in the exact same manner as the calibration standards, processed to verify that Retention Time (RT), calibration and calculations are correct.	Analyzed immediately after the ICAL.	%Recovery = 85% - 115%	1. Evaluate system 2. Repeat ICV 3. Recalibrate if ICV fails to meet criteria
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards, processed to verify that RT, calibration and calculations are correct.	Analyzed daily before sample analysis, after every 10 samples and at the end of the analytical sequence.	Primary Evaluation: %Drift = 15%; %Difference (D) = 15% Alternative Evaluation: Mean %Drift/%D for all target analytes = 15%	1. Evaluate system 2. Repeat CCV 3. Reanalyze samples subsequent to failed CCV 4. Recalibrate as needed
Initial and Continuing Calibration Blanks (ICB, CCB)	Laboratory reagent-grade water that has not gone through any preparation process.	Analyzed after the ICV, CCV, and before analysis of samples.	< 1/2 method reporting limit (MRL)	1. Rerun 2. Clean system 3. Rerun samples analyzed after last clean blank
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the samples. Evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	< 1/2 MRL or < 5% of sample result for the same analyte, whichever is greater.	1. Check calculations 2. Reanalyze e. If reanalysis falls, reprepare and reanalyze samples unless sample results are >5x the blank

Table B-10 (Continued)
Summary of Method Quality Control Criteria for Thiodiglycol in Soil (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	Second source standard in reagent-grade water matrix that is processed using the same analytic preparations as the samples. Used to document laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples.	%Recovery 60% - 120% [b]	1. Check calculations 2. Reanalyze 3. Reprepare and reanalyze samples unless LCS recoveries are high and target compound concentrations are undetected (U) 4. If sample volume is insufficient to reprepare samples, narrate outliers and discuss implications on data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the each target analyte prior to sample preparation and processed using the same analytic preparations as the samples. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 50% - 140% [c] Spike must contain all target compounds.	1. Check calculations 2. Reanalyze once, unless the native sample concentration is >4x the amount spiked 3. Evaluate LCS. If LCS meets QC limits, flag data for matrix interference.
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	An environmental sample that is divided into two aliquots by the laboratory and processed using the same analytic preparations as the samples. Documents precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	Relative Percent Difference (RPD) = 50%	1. Check calculations 2. Reanalyze once, unless the native sample concentration is >4x the amount spiked 3. Evaluate LCS for the compound(s) that are not within control limits. If LCS meets acceptable limits, flag data for matrix interference.
Surrogate Spikes	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, QC sample and calibration standard.	Not Applicable	Not Applicable
Target Compound Identification	Calculation of retention time (RT) windows for each target analyte and surrogate for each chromatographic column employed in the analysis.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT $\pm$ 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period.	Not Applicable

Table B-10 (Continued)
Summary of Method Quality Control Criteria for Thiodiglycol in Soil (by HPLC)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES and SURROGATES	CORRECTIVE ACTION
Target Compound Confirmation	Qualitative confirmation of detected target compounds using a second column dissimilar to the primary column. Quantitative confirmation of detected target compounds is required when interferences are noted on the primary column.	All samples with detected target compounds.	For qualitative confirmation, an alternate instrument (liquid chromatography/mass spectrometry) must meet QC criteria for calibration and retention times For quantitative confirmation, an alternate instrument (liquid chromatography/mass spectrometry) must meet QC criteria for calibration, retention times, and batch QC (MS/MSD optional). RPD = <40%	Not Applicable
Other	Holding time: Time allowable between sampling and analysis.	Water: 14 days to extraction, 40 days to analysis; dark, 4°C ± 2°C.	Holding time may not be exceeded.	Not Applicable

Notes:
Information presented is based on EPA SW-846 modified Method 8330A, Southwest Research SOPs, and Southwest Research performance-based criteria.

Table B-11
Summary of Method Quality Control Criteria for Dithiane and Oxathiane in Soil (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Initial Calibration (Ical)	Standards analyzed to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria. Minimum of 5 standards.	Primary Evaluation: r ≥ 0.0095; %RSD ≤20% r^2 ≥0.990. Alternative Evaluation: Mean %RSD for all target analytes ≤20%.	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A standard from an independent source other than that used for the instrument calibration, but within the calibration range and analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the initial calibration.	%Recovery = ± 25% of known concentration.	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed after every 10 samples, daily before sample analysis, and at the end of the analytical sequence.	Primary Evaluation: %Drift ≤ 25%; %Difference ≤ 25% Alternative Evaluation: Mean % Drift/%D for all target analytes ≤ 25%.	1. Evaluate system. 2. If %D >15% and herbicide concentrations are undetected (U), report results. 3. Reanalyze samples subseque to failed CCV. 4. Recalibrate

Table B-11 (Continued)
Summary of Method Quality Control Criteria for Dithiane and Oxathiane in Soil (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Initial and Continuing Calibration Blanks (ICB, CCB)	Laboratory reagent water that is used for the preparation of the IC, ICV and CCV and that has not gone through any preparation process.	After the ICV, CCV, and high concentration samples.	< ½ Method Reporting Limit (MRL)	1. Check calculations. 2. Reanalyze ICB or CCB. 3. If herbicide concentrations are undetected (U) or 20x blank concentration, no action. 4. If sample concentrations <20x blank, reanalyze samples analyzed before the last clean blank.
DDT/Endrin Breakdown	Measures the extent of 4,4'-DDT and endrin breakdown during analysis.	Every 24 hours	4'4"-DDT and endrin breakdown < 15% each.	
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	< ½ Method Reporting Limit (MRL) or < 5% of sample result for the same analyte, whichever is greater.	1. Check calculations. 2. Reanalyze MB. 3. If herbicide concentrations are undetected (U) or 20x blank concentration, no action. 4. If sample concentrations <20x blank, reextract and reanalyze samples analyzed before the last clean blank.
Laboratory Control Sample (LCS)	A standard, prepared from the same certified standard as the ICV and CCV but at a different concentration, that is processed using the same analytic preparations as the samples. Documents laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	Water/Solid: %Recovery = 50% - 150% of known concentration.	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze samples unless LCS recoveries are high and herbicides are undetected (U) in the samples. 4. If insufficient sample to reprepare, narrate outliers and discuss implications to data usability.

Table B-11 (Continued)
Summary of Method Quality Control Criteria for Dithiane and Oxathiane in Soil (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes. Used to document method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 40% - 140% of known concentration.	1. Check calculations. 2. Reanalyze once, unless the sample herbicide concentration 4x the amount spiked. 3. If chromatographic interferenc is evident and LCS recovery is acceptable, flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	%Recovery = 40% - 140% of known concentration; Relative Percent Difference (RPD) ≤ 50%	Same as MS
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, QC sample, calibration standard, and blank.	Not Applicable	Not Applicable
Target Compound Identification	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate for each chromatographic column employed in the analysis.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period. All succeeding standards in an analysis sequence should fall within the daily RT window established by the first standard of the sequence.	1. Reanalyze standard 2. Recalculate RT windows 3. Verify that all target analytes within newly established RT windows

Table B-11 (Continued)
Summary of Method Quality Control Criteria for Dithiane and Oxathiane in Soil (by Gas Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC CRITERIA FOR TARGET ANALYTES/SURROGATES*	CORRECTIVE ACTION
Target Compound Confirmation	Qualitative confirmation of detected target compounds using a second column dissimilar to the primary column. Quantitative confirmation of detected target compounds is required when interferences are noted on the primary column.	All samples with detected target compounds.	For qualitative confirmation, the second column must meet QC criteria for calibration and retention times. For quantitative confirmation, the second column must meet criteria for calibration, retention times, and batch QC. RPD = ≤40%	Not Applicable
Other	Holding time is the length of time allowable between sampling and analysis.	Water: 14 days to extraction, 40 days to analysis. Soil: 14 days to extraction, 40 days to analysis, 4°C ± 2°C.	Hold time may not be exceeded.	

Notes:
Information presented is based on EPA SW-846 modified Method 8181A, Southwest Research SOPs, and Southwest Research performance-based criteria.

Table B-12
Summary of Method Quality Control Criteria for Methylphosphonic Acid in Soil (By Ion Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICal)	Standards analyzed to evaluate instrument performance with respect to analyte concentration. Minimum of three standards.	Daily or before each analytical sequence.	Linearity from 0.2 mg/L to 4.0 mg/L	1. Check calculations. 2. Recalibrate.
Initial Calibration Verification (ICV)	An independent, second source mid-level standard analyzed in the exact same manner as the calibration standards, processed to verify that the procedure and calculations are correct.	Analyzed immediately after the initial calibration.	% Recovery = 25% - 140% of known concentrations.	1. Evaluate system. 2. Repeat ICV. 3. Recalibrate.
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards, processed to verify that the procedure and calculations are correct.	Analyzed after every 10 samples and at the end of the analytical sequence.	% Recovery = 25% - 140% of known concentrations.	1. Evaluate system. 2. Repeat CCV. 3. Reanalyze samples subsequent to failed CCV. 4. Recalibrate.
Initial and Continuing Calibration Blanks (ICB, CCB)	Laboratory reagent-grade water that is used for the preparation of the IC, ICV and CCV standards and that has not gone through any preparation process.	After the ICV, CCV, and high concentration samples.	< ½ Method Reporting Limit (MRL)	1. Reanalyze. 2. Clean system. 3. Reanalyze samples analyzed after the last clean blank.
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the actual samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	< ½ Method Reporting Limit (MRL)	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze all samples associated with the unacceptable MB. 4. If insufficient sample to reprepare, narrate outliers and discuss implications to data usability.

Table B-12 (Continued)
Summary of Method Quality Control Criteria for Methylphosphonic Acid in Soil (By Ion Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	An independent standard in an interference-free matrix that is processed using the same analytic preparations as the samples. Used to document laboratory performance.	One LCS for each analytical batch or a minimum of one LCS per 20 samples.	% Recovery = 25% - 140% of known concentrations.	1. Check calculations. 2. Reanalyze. 3. Reprepare and reanalyze samples unless recoveries are high and analytes are undetected (U) in the samples. 4. If insufficient sample to reprepare, narrate outliers and discuss implications to data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the each analyte prior to sample preparation and processed using the same analytic preparations as the samples. Used to document method bias in a given sample matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	% Recovery = 25% - 140%. If the concentration is >4 times the spike level, recovery limits do not apply.	1. Check calculations. 2. Reanalyze once, unless the native sample concentration is 4x the amount spiked. 3. If recoveries are still out and sample concentration is <4x the spike amount, analyze by the Method of Standard Additions (MSA). 4. Evaluate LCS. If LCS meets acceptable limits, flag data for matrix interference.
Laboratory Duplicate (LD)	An environmental sample that is divided into two aliquots by the laboratory and processed using the same analytic preparations as the samples. Used to document precision.	One LD for each analytical batch or a minimum of one LD per 20 samples.	RPD = ≤ 50%. If either the sample concentration and/or duplicate concentration is less than the reporting limit concentration, the absolute difference between the two should be < MRL.	1. Check calculations. 2. Reanalyze once. 3. Evaluate LCS and MS. If they meet acceptable limits, flag data for matrix interference.

Table B-12 (Continued)
Summary of Method Quality Control Criteria for Methylphosphonic Acid in Soil (By Ion Chromatography)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Other	Holding time: The length of time allowable between sampling and analysis.	14 days to extraction, 40 days to analysis. Store at 4°C ± 2ºC.	Hold time may not be exceeded.	Recollect samples.

Notes:
Information presented is based on Southwest Research SOPs and Southwest Research performance-based QC criteria.

Table B-13
Summary of Method Quality Control Criteria for VX Thiol Compounds* in Soil (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	CORRECTIVE ACTION
Instrument Tune	Check mass spectral ion intensities using DFTPP (decafluorotriphenylphosphine)	Every 12 hours.	Refer to method narrative.	1. Retune instrument. 2. Repeat DFTPP analysis.
Initial Calibration (ICal)	5 Point calibration to evaluate instrument performance with respect to analyte concentration.	Once to establish method performance and thereafter when ICV or CCV does not meet QC criteria.	Instrument Evaluation: SPCCs: minimum Response Factor (RF) values per method requirements CCCs: verify %RSD = 30% Primary Evaluation (all target analytes) : r = 0.995, %RSD = 15%; r^2 = 0.990 Alternative Evaluation: Mean %RSD for all target analytes = 15%; none > 30%	1. Evaluate system. 2. Recalibrate.
Initial Calibration Verification (ICV)	A mid-level standard from an independent source other than that used for the instrument calibration, analyzed in the exact same manner as the calibration standards.	Analyzed immediately after the ICAL.	%Recovery (Rec)= 70% - 130% of known concentration.	1. Evaluate system. 2. Reanalyze ICV. 3. Recalibrate.

Table B-13 (Continued)
Summary of Method Quality Control Criteria for VX Thiol Compounds* in Soil (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	CORRECTIVE ACTION
Continuing Calibration Verification (CCV)	A mid-level standard analyzed in the exact same manner as the calibration standards.	Analyzed daily before analysis, every 12 hours, and at the end of the analytical sequence.	Instrument Evaluation: SPCCs: minimum RF values per method requirements CCCs: verify %D = 30% Primary Evaluation (CCCs): %Drift = 20%, %Difference = 20%	1. Evaluate system. 2. Reanalyze CCV. 3. Reanalyze samples subsequent to failed CCV. 4. Recalibrate
Initial Calibration Blank (ICB)/ Continuing Calibration Blank (CCB)	Laboratory reagent-grade water that is used for the preparation of the IC, ICV and CCV and that has not gone through any preparation process.	After the ICV, CCV, and high concentration samples.	Target Analytes 1/2 Reporting limit	1. Reanalyze ICB or CCB. 2. Clean system. 3. Reanalyze samples analyzed after the last clean blank.
Surrogate Spike	Organic compounds similar to target compounds but normally not found in environmental samples.	Every environmental sample, calibration standard, QC sample, and blank.	Recovery Interference-Free Matrix[b]: = 45%-135% %Recovery Project Sample Matrix: = 35% - 140%	1. Check calculations 2. Reanalyze sample. 3. Reextract if 2- (or 1 per fraction) are outside limits; if %Rec = <10%. 4. If surrogate recovery is still outside limits, narrate outliers and discuss implications to data usability.

Table B-13 (Continued)
Summary of Method Quality Control Criteria for VX Thiol Compounds* in Soil (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	CORRECTIVE ACTION
Internal Standards (IS)	Organic compounds with retention times similar to the target compounds.	Every environmental sample, calibration standard, QC sample, and blank.	Retention time of the IS must be within 30 sec. of the RT in the last CCV (12 hours). Area of the IS must be <2x area of the IS in the daily CCV.	1. Check calculations and instrument sensitivity. 2. Reanalyze sample. 3. If three surrogates are out reprepare and reanalyze samples. 4. If one or two internal standards are out, flag the data and comment in the narrative.
Method Blank (MB)	Interference-free reagent-grade water treated exactly like the samples and used to evaluate overall method contamination.	One MB for each analytical batch or a minimum of one MB per 20 samples.	Target Analytes: 1/2 Reporting limit < 5% of the sample result for the same analyte, whichever is greater.	1. Check calculations. 2. Reanalyze MB. 3. Reprepare and reanalyze samples unless target compound concentrations are 5 x blank concentration. 4. If insufficient sample volume is available to reprepare samples, narrate outliers and discuss implications to data usability.

Table B-13 (Continued)
Summary of Method Quality Control Criteria for VX Thiol Compounds* in Soil (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	CORRECTIVE ACTION
Laboratory Control Sample (LCS)	A standard, prepared from the same certified standard as the ICV and CCV but at a different concentration, and processed using the same analytic preparations as the samples.	One LCS for each analytical batch or a minimum of one LCS per 20 samples. Analyze LCSD when insufficient sample is available for MSD.	%Recovery of known analyte concentration. = 30% - 160%	1. Check calculations. 2. Reanalyze LCS. 3. Reprepare and reanalyze samples unless recoveries are high and target compound are undetected in the samples. 4. If insufficient sample volume is available to reprepare samples, narrate outliers and discuss implications to data usability.
Matrix Spike (MS)	A sample spiked with a known concentration of the target analytes. Documents method bias in a given matrix.	One MS for each analytical batch or a minimum of one MS per 20 samples.	%Recovery = 30% - 160% of known concentration.	1. Check calculations. 2. Reanalyze once 3. Evaluate LCS. If LCS meets acceptable limits, flag data for matrix interference.
Matrix Spike Duplicate (MSD)	A sample spiked with a known concentration of the target analytes, identical to the MS, used to determine method precision.	One MSD for each analytical batch or a minimum of one MSD per 20 samples.	%Recovery = 45% - 135% of known concentration; Relative Percent Difference (RPD): = 60%	1. Check calculations. 2. Reanalyze once. 3. Evaluate LCS. If it meets acceptable limits, flag data for matrix interference.

Table B-13 (Continued)
Summary of Method Quality Control Criteria for VX Thiol Compounds* in Soil (by GC/MS)

QC ELEMENT	DESCRIPTION OF QC ELEMENT	FREQUENCY OF QC	QC ACCEPTANCE CRITERIA FOR TARGET ANALYTES/SURROGATES	CORRECTIVE ACTION
Target Compound Identifica-tion	Calculation of retention time (RT) windows to determine the presence and identification of each target analyte, internal standard, and surrogate.	Daily, at the beginning of the analytical sequence, or when major instrument maintenance is performed.	VX thiol compounds are reported as Tentatively Identified Compounds (TICs). RT windows are based on average RT ± 3x standard deviation of 3 mid-point standards analyzed in a 72-hour period. All succeeding standards in an analysis sequence should fall within the daily RT window established by the first standard of the sequence.	1. Reanalyze standard 2. Recalculate RT windows 3. Verify that all target analytes fall within newly established RT windows
Other	Holding time is the length of time allowable between sampling and analysis.	Cool to 4°C ± 2ºC. Water: 14 days before extraction, 40 days to analysis. Soil: 14 days before extraction, 40 days to analysis.	Hold time may not be exceeded.	Recollect samples

*VX thiol compounds to be analyzed are diisopropylaminoethane thiol, bis-(diisopropylaminoethane) disulfide, bis-diisopropylaminosulfide and other isopropylaminoethane compounds.

Notes:
Information presented is based on EPA SW-846 modified Method 8270C, Southwest Research SOPs, and Southwest Research performance-based criteria.

APPENDIX C

Laboratory Performance-Based Quality Control Limits

Information presented in Appendix C was provided by the laboratories to demonstrate their ability to meet project-specific control limits on a routine basis. However, project-required reporting limits (Appendix A) and QC criteria (Appendix B) take precedence over the laboratories' in-house criteria (Appendix C).

Sound Analytical Services, Inc. - Method QC Limits

Volatile Organics by USEPA Method 5035/8260B

Analysis Method: 8260B
Matrix : **Soil**
Preparation Method : SW5035
Low -ITS 40- Level
Expires: 07/04/2001

Blank Spike Recovery

1,1-Dichloroethene	75 - 125%	=<27% RPD
1,2-Dichloroethane	75 - 125%	=<32% RPD
1,4-Dichlorobenzene	75 - 125%	=<30% RPD
2-Butanone	60 - 140%	=<39% RPD
Benzene	75 - 125%	=<26% RPD
Carbon Tetrachloride	75 - 125%	=<26% RPD
Chlorobenzene	75 - 125%	=<27% RPD
Chloroform	75 - 124%	=<29% RPD
Ethylbenzene	75 - 125%	=<24% RPD
m,p-Xylene	75 - 125%	=<26% RPD
o-Xylene	75 - 125%	=<28% RPD
Tetrachloroethene	75 - 125%	=<25% RPD
Toluene	75 - 125%	=<30% RPD
Trichloroethene	75 - 125%	=<27% RPD
Vinyl chloride	75 - 125%	=<28% RPD

Matrix Spike Recovery

1,1-Dichloroethene	75 - 125%	=<27% RPD
1,2-Dichloroethane	75 - 125%	=<32% RPD
1,4-Dichlorobenzene	75 - 125%	=<30% RPD
2-Butanone	60 - 140%	=<39% RPD
Benzene	75 - 125%	=<26% RPD
Carbon Tetrachloride	75 - 125%	=<26% RPD
Chlorobenzene	75 - 125%	=<27% RPD
Chloroform	75 - 124%	=<29% RPD
Ethylbenzene	75 - 125%	=<24% RPD
m,p-Xylene	75 - 125%	=<26% RPD
o-Xylene	75 - 125%	=<28% RPD
Tetrachloroethene	75 - 125%	=<25% RPD
Toluene	75 - 125%	=<30% RPD
Trichloroethene	75 - 125%	=<27% RPD
Vinyl chloride	75 - 125%	=<28% RPD

Surrogate Recovery

Bromofluorobenzene	80 - 113%
Dibromofluoromethane	75 - 115%
Ethylbenzene-d10	90 - 106%
Fluorobenzene	85 - 115%
Toluene-d8	91 - 109%

Sound Analytical Services, Inc. - Method QC Limits

Volatile Organics by USEPA Method 5030B/8260B

Analysis Method : 8260B
Matrix : **Water**
Preparation Method : SW5030B
Low -ITS-40- Level
Expires: 07/04/2001

Blank Spike Recovery

1,1-Dichloroethene	80 - 120%	=<11% RPD
1,2-Dichloroethane	80 - 120%	=<16% RPD
1,4-Dichlorobenzene	80 - 120%	=<20% RPD
2-Butanone	60 - 140%	=<36% RPD
Benzene	80 - 119%	=<12% RPD
Carbon Tetrachloride	80 - 120%	=<12% RPD
Chlorobenzene	80 - 120%	=<12% RPD
Chloroform	80 - 120%	=<12% RPD
Ethylbenzene	80 - 120%	=<13% RPD
m,p-Xylene	80 - 120%	=<14% RPD
o-Xylene	80 - 120%	=<13% RPD
Tetrachloroethene	80 - 120%	=<12% RPD
Toluene	80 - 120%	=<12% RPD
Trichloroethene	80 - 118%	=<12% RPD
Vinyl chloride	80 - 120%	=<15% RPD

Matrix Spike Recovery

1,1-Dichloroethene	80 - 120%	=<11% RPD
1,2-Dichloroethane	80 - 120%	=<16% RPD
1,4-Dichlorobenzene	80 - 120%	=<20% RPD
2-Butanone	60 - 140%	=<36% RPD
Benzene	80 - 119%	=<12% RPD
Carbon Tetrachloride	80 - 120%	=<12% RPD
Chlorobenzene	80 - 120%	=<12% RPD
Chloroform	80 - 120%	=<12% RPD
Ethylbenzene	80 - 120%	=<13% RPD
m,p-Xylene	80 - 120%	=<14% RPD
o-Xylene	80 - 120%	=<13% RPD
Tetrachloroethene	80 - 120%	=<12% RPD
Toluene	80 - 120%	=<12% RPD
Trichloroethene	80 - 118%	=<12% RPD
Vinyl chloride	80 - 120%	=<15% RPD

Surrogate Recovery

Bromofluorobenzene	86 - 110%
Dibromofluoromethane	83 - 114%
Ethylbenzene-d10	87 - 108%
Fluorobenzene	84 - 114%
Toluene-D8	91 - 107%

Sound Analytical Services, Inc. - Method QC Limits

Semivolatile Organics by USEPA Method 8270C

Analysis Method : 8270C
Matrix : **Water**
Preparation Method : 3510C
Expires: 06/08/2001

Blank Spike Recovery

1,2,4-Trichlorobenzene	42 - 114%	=<30% RPD
1,4-Dichlorobenzene	39 - 114%	=<35% RPD
2,4-Dinitrotoluene	50 - 132%	=<31% RPD
2-Chlorophenol	44 - 119%	=<33% RPD
4-Chloro-3-methylphenol	45 - 141%	=<33% RPD
4-Nitrophenol	17 - 83%	=<39% RPD
Acenaphthene	48 - 114%	=<32% RPD
N-nitroso-di-n-propylamine	30 - 130%	=<28% RPD
Pentachlorophenol	24 - 154%	=<38% RPD
Phenol	15 - 82%	=<38% RPD
Pyrene	46 - 127%	=<32% RPD

Matrix Spike Recovery

1,2,4-Trichlorobenzene	42 - 114%	=<30% RPD
1,4-Dichlorobenzene	39 - 114%	=<35% RPD
2,4-Dinitrotoluene	50 - 132%	=<31% RPD
2-Chlorophenol	44 - 119%	=<33% RPD
4-Chloro-3-methylphenol	45 - 141%	=<33% RPD
4-Nitrophenol	17 - 83%	=<39% RPD
Acenaphthene	48 - 114%	=<32% RPD
N-nitroso-di-n-propylamine	30 - 130%	=<28% RPD
Pentachlorophenol	24 - 154%	=<38% RPD
Phenol	15 - 82%	=<38% RPD
Pyrene	46 - 127%	=<32% RPD

Surrogate Recovery

2 - Fluorobiphenyl	56 - 127%
2 - Fluorophenol	34 - 109%
2,4,6 - Tribromophenol	55 - 156%
Nitrobenzene - d5	52 - 149%
p - Terphenyl - d14	43 - 145%
Phenol - d5	19 - 105%

Sound Analytical Services, Inc. - Method QC Limits

Semivolatile Organics by USEPA Method 8270C

Analysis Method : 8270C
Matrix : **Soil**
Preparation Method : 3550B
Expires: 06/08/2001

Blank Spike Recovery

1,2,4-Trichlorobenzene	48 - 140%	=<30% RPD
1,4-Dichlorobenzene	53 - 131%	=<33% RPD
2,4-Dinitrotoluene	51 - 140%	=<33% RPD
2-Chlorophenol	58 - 123%	=<32% RPD
4-Chloro-3-methylphenol	50 - 150%	=<32% RPD
4-Nitrophenol	36 - 130%	=<41% RPD
Acenaphthene	54 - 128%	=<32% RPD
N-nitroso-di-n-propylamine	43 - 130%	=<35% RPD
Pentachlorophenol	21 - 144%	=<41% RPD
Phenol	45 - 128%	=<36% RPD
Pyrene	45 - 145%	=<34% RPD

Matrix Spike Recovery

1,2,4-Trichlorobenzene	48 - 140%	=<30% RPD
1,4-Dichlorobenzene	53 - 131%	=<33% RPD
2,4-Dinitrotoluene	51 - 140%	=<33% RPD
2-Chlorophenol	58 - 123%	=<32% RPD
4-Chloro-3-methylphenol	50 - 150%	=<32% RPD
4-Nitrophenol	36 - 130%	=<41% RPD
Acenaphthene	54 - 128%	=<32% RPD
N-nitroso-di-n-propylamine	43 - 130%	=<35% RPD
Pentachlorophenol	21 - 144%	=<41% RPD
Phenol	45 - 128%	=<36% RPD
Pyrene	45 - 145%	=<34% RPD

Surrogate Recovery

2 - Fluorobiphenyl	55 - 137%
2 - Fluorophenol	57 - 146%
2,4,6 - Tribromophenol	35 - 146%
Nitrobenzene - d5	56 - 145%
p - Terphenyl - d14	45 - 134%
Phenol - d5	54 - 140%

Sound Analytical Services, Inc. - Method QC Limits

Organochlorine Pesticides by USEPA Method 8081A

Analysis Method : 8081A
Matrix : **Soil**
Preparation Method : 3550B
Expires: 11/17/2001

Blank Spike Recovery

4,4'-DDT	47 - 135%	=<26% RPD
Aldrin	50 - 124%	=<23% RPD
Dieldrin	55 - 138%	=<21% RPD
Endrin	45 - 145%	=<22% RPD
gamma-BHC (Lindane)	52 - 121%	=<18% RPD
Heptachlor	50 - 133%	=<21% RPD

Surrogate Recovery

Decachlorobiphenyl	26 - 157%
TCMX	34 - 143%

Organochlorine Pesticides by USEPA Method 8081A

Analysis Method : 8081A
Matrix : Water
Preparation Method : 3510C
Expires: 11/17/2001

Blank Spike Recovery

4,4'-DDT	68 - 128%	=<20% RPD
Aldrin	55 - 117%	=<21% RPD
Dieldrin	72 - 133%	=<17% RPD
Endrin	54 - 150%	=<22% RPD
gamma-BHC (Lindane)	51 - 122%	=<19% RPD
Heptachlor	64 - 127%	=<21% RPD

Surrogate Recovery

Decachlorobiphenyl	42 - 163%
TCMX	44 - 137%

Sound Analytical Services, Inc. - Method QC Limits

PCBs by USEPA Method 8082

Analysis Method : 8082
Matrix : **Soil**
Preparation Method : SW3550B
Expires: 11/17/2001

Blank Spike Recovery

Aroclor-1260	59 - 138%	=<16% RPD

Surrogate Recovery

Decachlorobiphenyl	53 - 126%
TCMX	52 - 131%

PCBs by USEPA Method 8082

Analysis Method : 8082
Matrix : **Water**
Preparation Method : SW3510C
Expires: 11/17/2001

Blank Spike Recovery

Aroclor 1260	62 - 129%	=<25% RPD

Surrogate Recovery

Decachlorobiphenyl	49 - 132%
TCMX	43 - 129%

Sound Analytical Services, Inc. - Method QC Limits

Total and Dissolved Metals by ICP - USEPA Method 6010B

Analysis Method : 6010B
Matrix : **Soil**
Preparation Method : 3051

Blank Spike Recovery

Aluminum	80 - 120%
Antimony	80 - 120%
Arsenic	80 - 120%
Barium	80 - 120%
Beryllium	80 - 120%
Boron	80 - 120%
Cadmium	80 - 120%
Calcium	80 - 120%
Chromium	80 - 120%
Cobalt	80 - 120%
Copper	80 - 120%
Iron	80 - 120%
Lead	80 - 120%
Magnesium	80 - 120%
Manganese	80 - 120%
Molybdenum	80 - 120%
Nickel	80 - 120%
Potassium	80 - 120%
Selenium	80 - 120%
Silica	80 - 120%
Silver	80 - 120%
Sodium	80 - 120%
Strontium	80 - 120%
Thallium	80 - 120%
Tin	80 - 120%
Titanium	80 - 120%
Vanadium	80 - 120%
Zinc	80 - 120%

Duplicate RPD

Aluminum	=<35% RPD
Antimony	=<35% RPD
Arsenic	=<35% RPD
Barium	=<35% RPD
Beryllium	=<35% RPD
Boron	=<35% RPD
Cadmium	=<35% RPD
Calcium	=<35% RPD
Chromium	=<35% RPD
Cobalt	=<35% RPD
Copper	=<35% RPD
Iron	=<35% RPD
Lead	=<35% RPD
Magnesium	=<35% RPD

Sound Analytical Services, Inc. - Method QC Limits

Manganese	=<35% RPD
Molybdenum	=<35% RPD
Nickel	=<35% RPD
Potassium	=<35% RPD
Selenium	=<35% RPD
Silica	=<35% RPD
Silver	=<35% RPD
Sodium	=<35% RPD
Strontium	=<35% RPD
Thallium	=<35% RPD
Tin	=<35% RPD
Titanium	=<35% RPD
Vanadium	=<35% RPD
Zinc	=<35% RPD

Matrix Spike Recovery

Aluminum	75 - 125%
Antimony	75 - 125%
Arsenic	75 - 125%
Barium	75 - 125%
Beryllium	75 - 125%
Boron	75 - 125%
Cadmium	75 - 125%
Calcium	75 - 125%
Chromium	75 - 125%
Cobalt	75 - 125%
Copper	75 - 125%
Iron	75 - 125%
Lead	75 - 125%
Magnesium	75 - 125%
Manganese	75 - 125%
Molybdenum	75 - 125%
Nickel	75 - 125%
Potassium	75 - 125%
Selenium	75 - 125%
Silica	75 - 125%
Silver	75 - 125%
Sodium	75 - 125%
Strontium	75 - 125%
Thallium	75 - 125%
Tin	75 - 125%
Titanium	75 - 125%
Vanadium	75 - 125%
Zinc	75 - 125%

Sound Analytical Services, Inc. - Method QC Limits

Total and Dissolved Metals by ICP - USEPA Method 6010B

Analysis Method : 6010B
Matrix : **Water**
Preparation Method : 3010A

Blank Spike Recovery

Aluminum	80 - 120%	=<20% RPD
Antimony	80 - 120%	=<20% RPD
Arsenic	80 - 120%	=<20% RPD
Barium	80 - 120%	=<20% RPD
Beryllium	80 - 120%	=<20% RPD
Boron	80 - 120%	=<20% RPD
Cadmium	80 - 120%	=<20% RPD
Calcium	80 - 120%	=<20% RPD
Chromium	80 - 120%	=<20% RPD
Cobalt	80 - 120%	=<20% RPD
Copper	80 - 120%	=<20% RPD
Iron	80 - 120%	=<20% RPD
Lead	80 - 120%	=<20% RPD
Magnesium	80 - 120%	=<20% RPD
Manganese	80 - 120%	=<20% RPD
Molybdenum	80 - 120%	=<20% RPD
Nickel	80 - 120%	=<20% RPD
Potassium	80 - 120%	=<20% RPD
Selenium	80 - 120%	=<20% RPD
Silica	80 - 120%	=<20% RPD
Silver	80 - 120%	=<20% RPD
Sodium	80 - 120%	=<20% RPD
Strontium	80 - 120%	=<20% RPD
Thallium	80 - 120%	=<20% RPD
Tin	80 - 120%	=<20% RPD
Titanium	80 - 120%	=<20% RPD
Uranium	80 - 120%	=<20% RPD
Vanadium	80 - 120%	=<20% RPD
Zinc	80 - 120%	=<20% RPD

Duplicate RPD

Aluminum	=<20% RPD
Antimony	=<20% RPD
Arsenic	=<20% RPD
Barium	=<20% RPD
Beryllium	=<20% RPD
Boron	=<20% RPD
Cadmium	=<20% RPD
Calcium	=<20% RPD
Chromium	=<20% RPD
Cobalt	=<20% RPD
Copper	=<20% RPD
Iron	=<20% RPD
Lead	=<20% RPD

Sound Analytical Services, Inc. - Method QC Limits

Magnesium		=<20% RPD
Manganese		=<20% RPD
Molybdenum		=<20% RPD
Nickel		=<20% RPD
Potassium		=<20% RPD
Selenium		=<20% RPD
Silica		=<20% RPD
Silver		=<20% RPD
Sodium		=<20% RPD
Strontium		=<20% RPD
Thallium		=<20% RPD
Tin		=<20% RPD
Titanium		=<20% RPD
Uranium		=<20% RPD
Vanadium		=<20% RPD
Zinc		=<20% RPD

Matrix Spike Recovery

Aluminum	75 - 125%	=<20% RPD
Antimony	75 - 125%	=<20% RPD
Arsenic	75 - 125%	=<20% RPD
Barium	75 - 125%	=<20% RPD
Beryllium	75 - 125%	=<20% RPD
Boron	75 - 125%	=<20% RPD
Cadmium	75 - 125%	=<20% RPD
Calcium	75 - 125%	=<20% RPD
Chromium	75 - 125%	=<20% RPD
Cobalt	75 - 125%	=<20% RPD
Copper	75 - 125%	=<20% RPD
Iron	75 - 125%	=<20% RPD
Lead	75 - 125%	=<20% RPD
Magnesium	75 - 125%	=<20% RPD
Manganese	75 - 125%	=<20% RPD
Molybdenum	75 - 125%	=<20% RPD
Nickel	75 - 125%	=<20% RPD
Potassium	75 - 125%	=<20% RPD
Selenium	75 - 125%	=<20% RPD
Silica	75 - 125%	=<20% RPD
Silver	75 - 125%	=<20% RPD
Sodium	75 - 125%	=<20% RPD
Strontium	75 - 125%	=<20% RPD
Thallium	75 - 125%	=<20% RPD
Tin	75 - 125%	=<20% RPD
Titanium	75 - 125%	=<20% RPD
Uranium	75 - 125%	=<20% RPD
Vanadium	75 - 125%	=<20% RPD
Zinc	75 - 125%	=<20% RPD

Sound Analytical Services, Inc. - Method QC Limits

Total and Dissolved Metals by ICP-MS - USEPA Method 6020

Analysis Method : 6020
Matrix : **Soil**
Preparation Method : 3051

Blank Spike Recovery

Antimony	80 - 120%
Arsenic	80 - 120%
Barium	80 - 120%
Beryllium	80 - 120%
Boron	80 - 120%
Cadmium	80 - 120%
Chromium	80 - 120%
Cobalt	80 - 120%
Copper	80 - 120%
Lead	80 - 120%
Manganese	80 - 120%
Molybdenum	80 - 120%
Nickel	80 - 120%
Selenium	80 - 120%
Silver	80 - 120%
Strontium	80 - 120%
Thallium	80 - 120%
Tin	80 - 120%
Titanium	80 - 120%
Uranium	80 – 120%
Vanadium	80 - 120%
Zinc	80 - 120%

Duplicate RPD

Antimony	=<35% RPD
Arsenic	=<35% RPD
Barium	=<35% RPD
Beryllium	=<35% RPD
Boron	=<35% RPD
Cadmium	=<35% RPD
Chromium	=<35% RPD
Cobalt	=<35% RPD
Copper	=<35% RPD
Lead	=<35% RPD
Manganese	=<35% RPD
Molybdenum	=<35% RPD
Nickel	=<35% RPD
Selenium	=<35% RPD
Silver	=<35% RPD
Strontium	=<35% RPD
Thallium	=<35% RPD
Tin	=<35% RPD
Titanium	=<35% RPD
Uranium	=<35% RPD

Sound Analytical Services, Inc. - Method QC Limits

Vanadium	=<35% RPD
Zinc	=<35% RPD

Matrix Spike Recovery

Antimony	75 - 125%
Arsenic	75 - 125%
Barium	75 - 125%
Beryllium	75 - 125%
Boron	75 - 125%
Cadmium	75 - 125%
Chromium	75 - 125%
Cobalt	75 - 125%
Copper	75 - 125%
Lead	75 - 125%
Manganese	75 - 125%
Molybdenum	75 - 125%
Nickel	75 - 125%
Selenium	75 - 125%
Silver	75 - 125%
Strontium	75 - 125%
Thallium	75 - 125%
Tin	75 - 125%
Titanium	75 - 125%
Uranium	75 - 125%
Vanadium	75 - 125%
Zinc	75 - 125%

Sound Analytical Services, Inc. - Method QC Limits

Total and Dissolved Metals by ICP-MS - USEPA Method 6020B

Analysis Method : 6020B
Matrix : **Water**
Preparation Method : 3010A

Blank Spike Recovery

Antimony	80 - 120%
Arsenic	80 - 120%
Barium	80 - 120%
Beryllium	80 - 120%
Boron	80 - 120%
Cadmium	80 - 120%
Chromium	80 - 120%
Cobalt	80 - 120%
Copper	80 - 120%
Lead	80 - 120%
Manganese	80 - 120%
Molybdenum	80 - 120%
Nickel	80 - 120%
Selenium	80 - 120%
Silver	80 - 120%
Strontium	80 - 120%
Thallium	80 - 120%
Tin	80 - 120%
Titanium	80 - 120%
Uranium	80 - 120%
Vanadium	80 - 120%
Zinc	80 - 120%

Duplicate RPD

Antimony	=<20% RPD
Arsenic	=<20% RPD
Barium	=<20% RPD
Beryllium	=<20% RPD
Boron	=<20% RPD
Cadmium	=<20% RPD
Chromium	=<20% RPD
Cobalt	=<20% RPD
Copper	=<20% RPD
Lead	=<20% RPD
Manganese	=<20% RPD
Molybdenum	=<20% RPD
Nickel	=<20% RPD
Selenium	=<20% RPD
Silver	=<20% RPD
Strontium	=<20% RPD
Thallium	=<20% RPD
Tin	=<20% RPD
Titanium	=<20% RPD
Uranium	=<20% RPD

Sound Analytical Services, Inc. - Method QC Limits

Vanadium		=<20% RPD
Zinc		=<20% RPD

Matrix Spike Recovery

Antimony	75 - 125%
Arsenic	75 - 125%
Barium	75 - 125%
Beryllium	75 - 125%
Boron	75 - 125%
Cadmium	75 - 125%
Chromium	75 - 125%
Cobalt	75 - 125%
Copper	75 - 125%
Lead	75 - 125%
Manganese	75 - 125%
Molybdenum	75 - 125%
Nickel	75 - 125%
Selenium	75 - 125%
Silver	75 - 125%
Strontium	75 - 125%
Thallium	75 - 125%
Tin	75 - 125%
Titanium	75 - 125%
Uranium	75 - 125%
Vanadium	75 - 125%
Zinc	75 - 125%

Mercury by CVAA - USEPA Method 7470A

Analysis Method : 7470A
Matrix : **Water**

Blank Spike Recovery

Mercury	75 - 125%

Duplicate RPD

Mercury	=<20% RPD

Matrix Spike Recovery

Mercury	75 - 125%

Sound Analytical Services, Inc. - Method QC Limits

Mercury by CVAA - USEPA Method 7471A

Analysis Method : 7471A
Matrix : **Soil**

Blank Spike Recovery

Mercury	75 - 125%	=<25% RPD

Duplicate RPD

Mercury		=<35% RPD

Matrix Spike Recovery

Mercury	75 - 125%

Sound Analytical Services, Inc. - Method QC Limits

Total Cyanide by USEPA Method 9012A

Analysis Method : 9012A
Matrix : Soil
Preparation Method: 9013
Expires: 09/30/2001

Blank Spike Recovery

Cyanide	80 - 120%	=<22% RPD

Matrix Spike Recovery

Cyanide	80 - 120%	=<22% RPD

Total Cyanide by USEPA Method 9012A

Analysis Method : 9012A
Matrix : **Water**
Preparation Method 9012A
Expires: 09/30/2001

Blank Spike Recovery

Cyanide	80 - 120%	=<20% RPD

Matrix Spike Recovery

Cyanide	80 - 120%	=<20% RPD

Sound Analytical Services, Inc. - Method QC Limits

Diesel and Motor Oil by NWTPH-Dx Modified

Analysis Method : NWTPH-Dx
Matrix : **Soil**
Expires: 08/05/2001

Blank Spike Recovery

#2 Diesel	67 - 139%	=<22% RPD
Motor Oil	62 - 120%	=<25% RPD

Duplicate RPD

#2 Diesel		=<35% RPD

Matrix Spike Recovery

#2 Diesel	50 - 150%	=<35% RPD
Motor Oil	50 - 150%	=<35% RPD

Surrogate Recovery

o-terphenyl	50 - 150%

Sound Analytical Services, Inc. - Method QC Limits

Nitroamine & Nitroaromatic Compounds by USEPA Method 8330

Analysis Method : 8330
Matrix : **Soil**
Preparation Method : Solid-Phase Extraction
Expires: 11/17/2001

Blank Spike Recovery

1,3,5-Trinitrobenzene	67 - 112%	=<11% RPD
1,3-Dinitrobenzene	77 - 106%	=<7% RPD
2,4,6-Trinitrotoluene	69 - 110%	=<16% RPD
2,4-Dinitrotoluene	78 - 105%	=<13% RPD
2,6-Dinitrotoluene	68 - 119%	=<10% RPD
2-Nitrotoluene	74 - 106%	=<7% RPD
3-Nitrotoluene	76 - 101%	=<8% RPD
4-Nitrotoluene	73 - 108%	=<12% RPD
HMX	73 - 110%	=<9% RPD
Nitrobenzene	73 - 116%	=<8% RPD
RDX	68 - 111%	=<10% RPD
Tetryl	47 - 130%	=<14% RPD

Surrogate Recovery

3,4-Dinitrotoluene	48 - 143%

SOUTHWEST RESEARCH INSTITUTE

Thiodiglycol in Soil

Analysis Method : SWRI SOP for the Analysis of Thiodiglycol by HPLC
Matrix : **Soil**

Blank Spike Recovery

Thiodiglycol	60 - 120%	

Matrix Spike Recovery

Thiodiglycol	50 - 140%	=<50% RPD

Surrogate Recovery Not Applicable

SOUTHWEST RESEARCH INSTITUTE

Dithiane and Oxathiane in Soil

Analysis Method : SWRI SOP for the Analysis of Dithiane and Oxathiane by GC/FPD
Matrix : **Soil**

Blank Spike Recovery		
Dithiane/oxathiane	50 - 150%	
Matrix Spike Recovery		
Dithiane/oxathiane	50 - 150%	=<50% RPD
Surrogate Recovery	Not Applicable	

SOUTHWEST RESEARCH INSTITUTE

VX Thiols in Soil

Analysis Method : SWRI SOP for the Analysis of VX Thiols by GC/MS
Matrix : **Soil**

Blank Spike Recovery		
Dithiane/oxathiane	30 - 160%	
Matrix Spike Recovery		
Dithiane/oxathiane	30 - 160%	=<60% RPD
Surrogate Recovery	Not Applicable	

SOUTHWEST RESEARCH INSTITUTE

Methylphosphonic Acid in Soil

Analysis Method : SWRI SOP for the Analysis of Methylphosphonic Acid by IC
Matrix : **Soil**

Blank Spike Recovery

Methylphosphonic Acid	50 - 150%	

Matrix Spike Recovery

Methylphosphonic Acid	50 - 150%	=<35% RPD

Surrogate Recovery Not Applicable

on/off

Home

Volatile Organics Reporting Limits - Soils Preserved

EPA Method: SW 5035 / 8260B / 8260B BTEX
Matrix: soil
Container: 5035 Sampling Kit
Preservative: Methanol / Na2S2O3
Holding Time: 14 Days to Extract

Analyte	PQL	Units	CAS No.	Reporting Level	Instrument
1,1,1,2-Tetrachloroethane	0.4	ug/kg	630-20-6	Low Level	GCMS - Ion Trap
1,1,1-Trichloroethane	0.4	ug/kg	71-55-6	Low Level	GCMS - Ion Trap
1,1,2,2-Tetrachloroethane	0.4	ug/kg	79-34-5	Low Level	GCMS - Ion Trap
1,1,2-Trichloroethane	0.4	ug/kg	79-00-5	Low Level	GCMS - Ion Trap
1,1-Dichloroethane	0.4	ug/kg	75-34-3	Low Level	GCMS - Ion Trap
1,1-Dichloroethene	0.4	ug/kg	75-35-4	Low Level	GCMS - Ion Trap
1,1-Dichloropropene	0.4	ug/kg	563-58-6	Low Level	GCMS - Ion Trap
1,2,3-Trichlorobenzene	0.4	ug/kg	120-82-1	Low Level	GCMS - Ion Trap
1,2,3-Trichloropropane	0.4	ug/kg	96-18-4	Low Level	GCMS - Ion Trap
1,2,4-Trichlorobenzene	0.4	ug/kg	120-82-1	Low Level	GCMS - Ion Trap
1,2,4-Trimethylbenzene	0.4	ug/kg	95-63-6	Low Level	GCMS - Ion Trap
1,2-Dibromo-3-chloropropane	0.4	ug/kg	96-12-8	Low Level	GCMS - Ion Trap
1,2-Dibromoethane	0.4	ug/kg	106-93-4	Low Level	GCMS - Ion Trap
1,2-Dichlorobenzene	0.4	ug/kg	95-50-1	Low Level	GCMS - Ion Trap
1,2-Dichloroethane	0.4	ug/kg	107-06-2	Low Level	GCMS - Ion Trap
1,2-Dichloropropane	0.4	ug/kg	78-87-5	Low Level	GCMS - Ion Trap
1,3,5-Trimethylbenzene	0.4	ug/kg	108-67-8	Low Level	GCMS - Ion Trap
1,3-Dichlorobenzene	0.4	ug/kg	541-73-1	Low Level	GCMS - Ion Trap
1,3-Dichloropropane	0.4	ug/kg	142-28-9	Low Level	GCMS - Ion Trap
1,4-Dichlorobenzene	0.4	ug/kg	106-46-7	Low Level	GCMS - Ion Trap
2,2-Dichloropropane	0.4	ug/kg	594-20-7	Low Level	GCMS - Ion Trap

2-Chlorotoluene	0.4	ug/kg	95-49-8	Low Level	GCMS - Ion Trap
4-Chlorotoluene	0.4	ug/kg	106-43-4	Low Level	GCMS - Ion Trap
4-Isopropyltoluene	0.4	ug/kg	99-87-6	Low Level	GCMS - Ion Trap
Benzene	0.4	ug/kg	71-43-2	Low Level	GCMS - Ion Trap
Bromobenzene	0.4	ug/kg	108-86-1	Low Level	GCMS - Ion Trap
Bromochloromethane	0.4	ug/kg	74-97-5	Low Level	GCMS - Ion Trap
Bromodichloromethane	0.4	ug/kg	75-27-4	Low Level	GCMS - Ion Trap
Bromoform	0.4	ug/kg	75-25-2	Low Level	GCMS - Ion Trap
Bromomethane	0.4	ug/kg	74-83-9	Low Level	GCMS - Ion Trap
Carbon Tetrachloride	0.4	ug/kg	56-23-5	Low Level	GCMS - Ion Trap
Chlorobenzene	0.4	ug/kg	108-90-7	Low Level	GCMS - Ion Trap
Chloroethane	0.4	ug/kg	75-00-3	Low Level	GCMS - Ion Trap
Chloroform	0.4	ug/kg	67-66-3	Low Level	GCMS - Ion Trap
Chloromethane	0.4	ug/kg	74-87-3	Low Level	GCMS - Ion Trap
cis-1,2-Dichloroethene	0.4	ug/kg	156-60-5	Low Level	GCMS - Ion Trap
cis-1,3-Dichloropropene	0.4	ug/kg	10061-01-5	Low Level	GCMS - Ion Trap
Dibromochloromethane	0.4	ug/kg	124-48-1	Low Level	GCMS - Ion Trap
Dibromomethane	0.4	ug/kg	74-95-3	Low Level	GCMS - Ion Trap
Dichlorodifluoromethane	0.4	ug/kg	75-71-8	Low Level	GCMS - Ion Trap
Ethylbenzene	0.4	ug/kg	100-41-4	Low Level	GCMS - Ion Trap
Hexachlorobutadiene	0.4	ug/kg	87-68-3	Low Level	GCMS - Ion Trap
Isopropylbenzene	0.4	ug/kg	98-82-8	Low Level	GCMS - Ion Trap
m,p-Xylenes	0.8	ug/kg	08-38-3 & 106-42-3	Low Level	GCMS - Ion Trap
Methyl acetate	2	ug/kg	79-20-9	Low Level	GCMS - Ion Trap
Methylcyclohexane	0.4	ug/kg	108-87-2	Low Level	GCMS - Ion Trap
Methylene chloride	0.4	ug/kg	75-09-2	Low Level	GCMS - Ion Trap
Naphthalene	0.4	ug/kg	91-20-3	Low Level	GCMS - Ion Trap
n-Butylbenzene	0.4	ug/kg	104-51-8	Low Level	GCMS - Ion Trap
n-Propylbenzene	0.4	ug/kg	103-65-1	Low Level	GCMS - Ion Trap
o-Xylene	0.4	ug/kg	95-47-6	Low Level	GCMS - Ion Trap
sec-Butylbenzene	0.4	ug/kg	135-98-8	Low Level	GCMS - Ion Trap
Styrene	0.4	ug/kg	100-42-5	Low Level	GCMS - Ion Trap
t-Butylbenzene	0.4	ug/kg	98-06-6	Low Level	GCMS - Ion Trap
Tetrachloroethene	0.4	ug/kg	127-18-4	Low Level	GCMS - Ion Trap
Toluene	0.4	ug/kg	108-88-3	Low Level	GCMS - Ion Trap
trans-1,2-Dichloroethene	0.4	ug/kg	156-60-5	Low Level	GCMS - Ion Trap

trans-1,3-Dichloropropene	0.4	ug/kg	10061-02-6	Low Level	GCMS - Ion Trap
Trichloroethene	0.4	ug/kg	79-01-6	Low Level	GCMS - Ion Trap
Trichlorofluoromethane	0.4	ug/kg	75-69-4	Low Level	GCMS - Ion Trap
Vinyl chloride	0.4	ug/kg	75-01-4	Low Level	GCMS - Ion Trap

on/off

Home

Volatile Organics Reporting Limits - Waters

EPA Method: SW 8260B/5030B (prep)
Matrix: Water
Container: 3 - 40 ml VOA Vials
Preservative: HCl - pH<2
Holding Time: 14 Days

Analyte	PQL	Units	CAS No.	Reporting Level	Instrument
1,1,1,2-Tetrachloroethane	0.4	ug/L	630-20-6	Low Level	GCMS - Ion Trap
1,1,1-Trichloroethane	0.4	ug/L	71-55-6	Low Level	GCMS - Ion Trap
1,1,2,2-Tetrachloroethane	0.4	ug/L	79-34-5	Low Level	GCMS - Ion Trap
1,1,2-Trichloroethane	0.4	ug/L	79-00-5	Low Level	GCMS - Ion Trap
1,1-Dichloroethane	0.4	ug/L	75-34-3	Low Level	GCMS - Ion Trap
1,1-Dichloroethene	0.4	ug/L	75-35-4	Low Level	GCMS - Ion Trap
1,1-Dichloropropene	0.4	ug/L	563-58-6	Low Level	GCMS - Ion Trap
1,2,3-Trichlorobenzene	0.4	ug/L		Low Level	GCMS - Ion Trap
1,2,3-Trichloropropane	0.4	ug/L	96-18-4	Low Level	GCMS - Ion Trap
1,2,4-Trichlorobenzene	0.4	ug/L	120-82-1	Low Level	GCMS - Ion Trap
1,2,4-Trimethylbenzene	0.4	ug/L	95-63-6	Low Level	GCMS - Ion Trap
1,2-Dibromo-3-chloropropane	0.4	ug/L	96-12-8	Low Level	GCMS - Ion Trap
1,2-Dibromoethane	0.4	ug/L	106-93-4	Low Level	GCMS - Ion Trap
1,2-Dichlorobenzene	0.4	ug/L	95-50-1	Low Level	GCMS - Ion Trap
1,2-Dichloroethane	0.4	ug/L	107-06-2	Low Level	GCMS - Ion Trap
1,2-Dichloropropane	0.4	ug/L	78-87-5	Low Level	GCMS - Ion Trap
1,3,5-Trimethylbenzene	0.4	ug/L	108-67-8	Low Level	GCMS - Ion Trap
1,3-Dichlorobenzene	0.4	ug/L	541-73-1	Low Level	GCMS - Ion Trap
1,3-Dichloropropane	0.4	ug/L	142-28-9	Low Level	GCMS - Ion Trap
1,4-Dichlorobenzene	0.4	ug/L	106-46-7	Low Level	GCMS - Ion Trap
2,2-Dichloropropane	0.4	ug/L	594-20-7	Low Level	GCMS - Ion Trap

2-Butanone	2	ug/L	78-93-3	Low Level	GCMS - Ion Trap
2-Chlorotoluene	0.4	ug/L	95-49-8	Low Level	GCMS - Ion Trap
2-Hexanone	2	ug/L	591-78-6	Low Level	GCMS - Ion Trap
4-Chlorotoluene	0.4	ug/L	106-43-4	Low Level	GCMS - Ion Trap
4-Isopropyltoluene	0.4	ug/L	99-87-6	Low Level	GCMS - Ion Trap
4-Methyl-2-pentanone	2	ug/L	108-10-1	Low Level	GCMS - Ion Trap
Acetone	2	ug/L	67-64-1	Low Level	GCMS - Ion Trap
Benzene	0.4	ug/L	71-43-2	Low Level	GCMS - Ion Trap
Bromobenzene	0.4	ug/L	108-86-1	Low Level	GCMS - Ion Trap
Bromochloromethane	0.4	ug/L	74-97-5	Low Level	GCMS - Ion Trap
Bromodichloromethane	0.4	ug/L	75-27-4	Low Level	GCMS - Ion Trap
Bromoform	0.4	ug/L	75-25-2	Low Level	GCMS - Ion Trap
Bromomethane	0.4	ug/L	74-83-9	Low Level	GCMS - Ion Trap
Carbon disulfide	0.4	ug/L	75-15-0	Low Level	GCMS - Ion Trap
Carbon Tetrachloride	0.4	ug/L	56-23-5	Low Level	GCMS - Ion Trap
Chlorobenzene	0.4	ug/L	108-90-7	Low Level	GCMS - Ion Trap
Chloroethane	0.4	ug/L	75-00-3	Low Level	GCMS - Ion Trap
Chloroform	0.4	ug/L	67-66-3	Low Level	GCMS - Ion Trap
Chloromethane	0.4	ug/L	74-87-3	Low Level	GCMS - Ion Trap
cis-1,2-Dichloroethene	0.4	ug/L	156-60-5	Low Level	GCMS - Ion Trap
cis-1,3-Dichloropropene	0.4	ug/L	10061-01-5	Low Level	GCMS - Ion Trap
Dibromochloromethane	0.4	ug/L	124-48-1	Low Level	GCMS - Ion Trap
Dibromomethane	0.4	ug/L	74-95-3	Low Level	GCMS - Ion Trap
Dichlorodifluoromethane	0.4	ug/L	75-71-8	Low Level	GCMS - Ion Trap
Ethylbenzene	0.4	ug/L	100-41-4	Low Level	GCMS - Ion Trap
Hexachlorobutadiene	0.4	ug/L	87-68-3	Low Level	GCMS - Ion Trap
Isopropylbenzene	0.4	ug/L	98-82-8	Low Level	GCMS - Ion Trap
m,p-Xylenes	0.8	ug/L	136777-61-2	Low Level	GCMS - Ion Trap
Methylene chloride	0.4	ug/L	75-09-2	Low Level	GCMS - Ion Trap
Methyl Acetate	2	ug/L	79-20-9	Low Level	GCMS - Ion Trap
Methylcyclohexane	0.4	ug/L	108-87-2	Low Level	GCMS - Ion Trap
Naphthalene	0.4	ug/L	91-20-3	Low Level	GCMS - Ion Trap
n-Butylbenzene	0.4	ug/L	104-51-8	Low Level	GCMS - Ion Trap
n-Propylbenzene	0.4	ug/L	103-65-1	Low Level	GCMS - Ion Trap
o-Xylene	0.4	ug/L	95-47-6	Low Level	GCMS - Ion Trap
sec-Butylbenzene	0.4	ug/L	135-98-8	Low Level	GCMS - Ion Trap

Styrene	0.4	ug/L	100-42-5	Low Level	GCMS - Ion Trap
t-Butylbenzene	0.4	ug/L	98-06-6	Low Level	GCMS - Ion Trap
Tetrachloroethene	0.4	ug/L	127-18-4	Low Level	GCMS - Ion Trap
Toluene	0.4	ug/L	108-88-3	Low Level	GCMS - Ion Trap
trans-1,2-Dichloroethene	0.4	ug/L	156-60-5	Low Level	GCMS - Ion Trap
trans-1,3-Dichloropropene	0.4	ug/L	10061-02-6	Low Level	GCMS - Ion Trap
Trichloroethene	0.4	ug/L	79-01-6	Low Level	GCMS - Ion Trap
Trichlorofluoromethane	0.4	ug/L	75-69-4	Low Level	GCMS - Ion Trap
Vinyl chloride	0.4	ug/L	75-01-4	Low Level	GCMS - Ion Trap

on/off

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Semivolatile Organic Compounds Reporting Limits - Soils

EPA Method: SW 8270C/3050B (prep)
Matrix: soil
Container: 4 oz. Soil Jar
Preservative: Cool 4° C
Holding Time: 14 Days to Extract

Analyte	PQL	Units	CAS No.	Reporting Level	Instrument
1,2,4-Trichlorobenzene	50	ug/kg	120-82-1	Low Level	GCMS - Ion Trap
1,2-Dichlorobenzene	50	ug/kg	95-50-1	Low Level	GCMS - Ion Trap
1,2-Diphenylhydrazine	50	ug/kg	122-66-7	Low Level	GCMS - Ion Trap
1,3-Dichlorobenzene	50	ug/kg	541-73-1	Low Level	GCMS - Ion Trap
1,4-Dichlorobenzene	50	ug/kg	106-46-7	Low Level	GCMS - Ion Trap
2,4,5-Trichlorophenol	50	ug/kg	95-95-4	Low Level	GCMS - Ion Trap
2,4,6-Trichlorophenol	50	ug/kg	88-06-2	Low Level	GCMS - Ion Trap
2,4-Dichlorophenol	50	ug/kg	120-83-2	Low Level	GCMS - Ion Trap
2,4-Dimethylphenol	50	ug/kg	105-67-9	Low Level	GCMS - Ion Trap
2,4-Dinitrophenol	50	ug/kg	51-28-5	Low Level	GCMS - Ion Trap
2,4-Dinitrotoluene	50	ug/kg	121-14-2	Low Level	GCMS - Ion Trap
2,6-Dinitrotoluene	50	ug/kg	606-20-2	Low Level	GCMS - Ion Trap
2-Chloronaphthalene	10	ug/kg	91-58-7	Low Level	GCMS - Ion Trap
2-Chlorophenol	50	ug/kg	95-57-8	Low Level	GCMS - Ion Trap
2-Ethoxyethanol	50	ug/kg		Low Level	GCMS - Ion Trap
2-Methylnaphthalene	10	ug/kg	91-57-6	Low Level	GCMS - Ion Trap
2-Methylphenol	50	ug/kg	95-48-7	Low Level	GCMS - Ion Trap
2-Nitroaniline	50	ug/kg	88-74-4	Low Level	GCMS - Ion Trap
2-Nitrophenol	50	ug/kg	88-75-5	Low Level	GCMS - Ion Trap
2-Nitropropane	50	ug/kg		Low Level	GCMS - Ion Trap

3- & 4-Methylphenol	50	ug/kg		Low Level	GCMS - Ion Trap
3,3'-Dichlorobenzidine	50	ug/kg	91-94-1	Low Level	GCMS - Ion Trap
3-Nitroaniline	50	ug/kg	99-09-2	Low Level	GCMS - Ion Trap
4,6-Dinitro-2-methylphenol	50	ug/kg	534-52-1	Low Level	GCMS - Ion Trap
4-Bromophenylphenylether	50	ug/kg	101-55-3	Low Level	GCMS - Ion Trap
4-Chloro-3-methylphenol	50	ug/kg	59-50-7	Low Level	GCMS - Ion Trap
4-Chloroaniline	50	ug/kg	106-47-8	Low Level	GCMS - Ion Trap
4-Chlorophenylphenylether	50	ug/kg	7005-72-3	Low Level	GCMS - Ion Trap
4-Nitroaniline	50	ug/kg	100-01-6	Low Level	GCMS - Ion Trap
4-Nitrophenol	50	ug/kg	100-02-7	Low Level	GCMS - Ion Trap
Acenaphthene	10	ug/kg	83-32-9	Low Level	GCMS - Ion Trap
Acenaphthylene	10	ug/kg	208-96-8	Low Level	GCMS - Ion Trap
Acetophenone	100	ug/kg	98-86-2	Low Level	GCMS - Ion Trap
Aniline	500	ug/kg	62-53-3	Low Level	GCMS - Ion Trap
Anthracene	10	ug/kg	120-12-7	Low Level	GCMS - Ion Trap
Atrazine	50	ug/kg	1912-24-9	Low Level	GCMS - Ion Trap
Benzaldehyde	100	ug/kg	100-52-7	Low Level	GCMS - Ion Trap
Benzidine	100	ug/kg	92-87-5	Low Level	GCMS - Ion Trap
Benzo(a)anthracene	10	ug/kg	56-55-3	Low Level	GCMS - Ion Trap
Benzo(a)pyrene	10	ug/kg	50-32-8	Low Level	GCMS - Ion Trap
Benzo(b)fluoranthene	10	ug/kg	205-99-2	Low Level	GCMS - Ion Trap
Benzo(g,h,i)perylene	10	ug/kg	191-24-2	Low Level	GCMS - Ion Trap
Benzo(k)fluoranthene	10	ug/kg	207-08-9	Low Level	GCMS - Ion Trap
Benzoic Acid	50	ug/kg	65-85-0	Low Level	GCMS - Ion Trap
Benzyl Alcohol	50	ug/kg	100-51-6	Low Level	GCMS - Ion Trap
1,1'-Biphenyl	50	ug/kg	92-52-4	Low Level	GCMS - Ion Trap
bis(2-Chloroethoxy)methane	50	ug/kg	111-91-1	Low Level	GCMS - Ion Trap
bis(2-Chloroethyl)ether	50	ug/kg	111-44-4	Low Level	GCMS - Ion Trap
bis(2-Chloroisopropyl)ether	50	ug/kg	108-60-1	Low Level	GCMS - Ion Trap
bis(2-Ethylhexyl)phthalate	50	ug/kg	117-81-7	Low Level	GCMS - Ion Trap
Butylbenzylphthalate	50	ug/kg	85-68-7	Low Level	GCMS - Ion Trap
Caprolactam	100	ug/kg	105-60-2	Low Level	GCMS - Ion Trap
Carbazole	50	ug/kg	86-74-8	Low Level	GCMS - Ion Trap
Chrysene	10	ug/kg	218-01-9	Low Level	GCMS - Ion Trap
Cyclohexanone	100	ug/kg	108-94-1	Low Level	GCMS - Ion Trap
Dibenz(a,h)anthracene	10	ug/kg	53-70-3	Low Level	GCMS - Ion Trap

Dibenzofuran	50	ug/kg	132-64-9	Low Level	GCMS - Ion Trap
Diethylphthalate	50	ug/kg	84-66-2	Low Level	GCMS - Ion Trap
Dimethylphthalate	50	ug/kg	131-11-3	Low Level	GCMS - Ion Trap
Di-n-butylphthalate	50	ug/kg	87-74-2	Low Level	GCMS - Ion Trap
Di-n-octylphthalate	50	ug/kg	117-84-0	Low Level	GCMS - Ion Trap
Fluoranthene	10	ug/kg	206-44-0	Low Level	GCMS - Ion Trap
Fluorene	10	ug/kg	86-73-7	Low Level	GCMS - Ion Trap
Hexachlorobenzene	50	ug/kg	118-74-1	Low Level	GCMS - Ion Trap
Hexachlorobutadiene	50	ug/kg	87-68-3	Low Level	GCMS - Ion Trap
Hexachlorocyclopentadiene	50	ug/kg	77-47-4	Low Level	GCMS - Ion Trap
Hexachloroethane	50	ug/kg	67-72-1	Low Level	GCMS - Ion Trap
Indeno(1,2,3-cd)pyrene	10	ug/kg	193-39-5	Low Level	GCMS - Ion Trap
Isophorone	50	ug/kg	78-59-1	Low Level	GCMS - Ion Trap
Naphthalene	10	ug/kg	91-20-3	Low Level	GCMS - Ion Trap
Nitrobenzene	50	ug/kg	98-95-3	Low Level	GCMS - Ion Trap
N-nitrosodimethylamine	50	ug/kg	62-75-9	Low Level	GCMS - Ion Trap
N-nitroso-di-n-propylamine	50	ug/kg	621-64-7	Low Level	GCMS - Ion Trap
N-Nitrosodiphenylamine	50	ug/kg	86-30-6	Low Level	GCMS - Ion Trap
Pentachlorophenol	50	ug/kg	87-86-5	Low Level	GCMS - Ion Trap
Phenanthrene	10	ug/kg	85-01-8	Low Level	GCMS - Ion Trap
Phenol	50	ug/kg	108-95-2	Low Level	GCMS - Ion Trap
Pyrene	10	ug/kg	129-00-0	Low Level	GCMS - Ion Trap
Pyridine	50	ug/kg	110-86-1	Low Level	GCMS - Ion Trap
Tetrachlorophenols	50	ug/kg		Low Level	GCMS - Ion Trap

on/off

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Semivolatile Organic Compounds Reporting Limits - Waters

EPA Method: SW 8270C/3510C (prep)
Matrix: Water
Container: 125 ml Amber B.R. (low volume)
Container: 1 Liter Amber B.R.
Preservative: Cool 4° C
Holding Time: 7 Days to Extract

Analyte	PQL	Units	CAS No.	Reporting Level	Instrument
1,2,4-Trichlorobenzene	0.5	ug/L	120-82-1	Low Volume	GCMS - Ion Trap
1,2-Dichlorobenzene	0.5	ug/L	95-50-1	Low Volume	GCMS - Ion Trap
1,2-Diphenylhydrazine	0.5	ug/L	122-66-7	Low Volume	GCMS - Ion Trap
1,3-Dichlorobenzene	0.5	ug/L	541-73-1	Low Volume	GCMS - Ion Trap
1,4-Dichlorobenzene	0.5	ug/L	106-46-7	Low Volume	GCMS - Ion Trap
2,4,5-Trichlorophenol	0.5	ug/L	95-95-4	Low Volume	GCMS - Ion Trap
2,4,6-Trichlorophenol	0.5	ug/L	88-06-2	Low Volume	GCMS - Ion Trap
2,4-Dichlorophenol	0.5	ug/L	120-83-2	Low Volume	GCMS - Ion Trap
2,4-Dimethylphenol	0.5	ug/L	105-67-9	Low Volume	GCMS - Ion Trap
2,4-Dinitrophenol	0.5	ug/L	51-28-5	Low Volume	GCMS - Ion Trap
2,4-Dinitrotoluene	0.5	ug/L	121-14-2	Low Volume	GCMS - Ion Trap
2,6-Dinitrotoluene	0.5	ug/L	606-20-2	Low Volume	GCMS - Ion Trap
2-Chloronaphthalene	0.1	ug/L	91-58-7	Low Volume	GCMS - Ion Trap
2-Chlorophenol	0.5	ug/L	95-57-8	Low Volume	GCMS - Ion Trap
2-Ethoxyethanol	2	ug/L		Low Volume	GCMS - Ion Trap
2-Methylnaphthalene	0.1	ug/L	91-57-6	Low Volume	GCMS - Ion Trap
2-Methylphenol	0.5	ug/L	95-48-7	Low Volume	GCMS - Ion Trap
2-Nitroaniline	0.5	ug/L	88-74-4	Low Volume	GCMS - Ion Trap
2-Nitrophenol	0.5	ug/L	88-75-5	Low Volume	GCMS - Ion Trap
2-Nitropropane	2	ug/L		Low Volume	GCMS - Ion Trap

Dibenzofuran	0.5	ug/L	132-64-9	Low Volume	GCMS - Ion Trap
Diethylphthalate	0.5	ug/L	84-66-2	Low Volume	GCMS - Ion Trap
Dimethylphthalate	0.5	ug/L	131-11-3	Low Volume	GCMS - Ion Trap
Di-n-butylphthalate	0.5	ug/L	87-74-2	Low Volume	GCMS - Ion Trap
Di-n-octylphthalate	0.5	ug/L	117-84-0	Low Volume	GCMS - Ion Trap
Fluoranthene	0.1	ug/L	206-44-0	Low Volume	GCMS - Ion Trap
Fluorene	0.1	ug/L	86-73-7	Low Volume	GCMS - Ion Trap
Hexachlorobenzene	0.5	ug/L	118-74-1	Low Volume	GCMS - Ion Trap
Hexachlorobutadiene	0.5	ug/L	87-68-3	Low Volume	GCMS - Ion Trap
Hexachlorocyclopentadiene	0.5	ug/L	77-47-4	Low Volume	GCMS - Ion Trap
Hexachloroethane	0.5	ug/L	67-72-1	Low Volume	GCMS - Ion Trap
Indeno(1,2,3-cd)pyrene	0.1	ug/L	193-39-5	Low Volume	GCMS - Ion Trap
Isophorone	0.5	ug/L	78-59-1	Low Volume	GCMS - Ion Trap
Naphthalene	0.1	ug/L	91-20-3	Low Volume	GCMS - Ion Trap
Nitrobenzene	0.5	ug/L	98-95-3	Low Volume	GCMS - Ion Trap
N-nitrosodimethylamine	0.5	ug/L	62-75-9	Low Volume	GCMS - Ion Trap
N-nitroso-di-n-propylamine	0.5	ug/L	621-64-7	Low Volume	GCMS - Ion Trap
N-Nitrosodiphenylamine	0.1	ug/L	86-30-6	Low Volume	GCMS - Ion Trap
Pentachlorophenol	0.5	ug/L	87-86-5	Low Volume	GCMS - Ion Trap
Phenanthrene	0.1	ug/L	85-01-8	Low Volume	GCMS - Ion Trap
Phenol	0.5	ug/L	108-95-2	Low Volume	GCMS - Ion Trap
Pyrene	0.1	ug/L	129-00-0	Low Volume	GCMS - Ion Trap
Pyridine	0.5	ug/L	110-86-1	Low Volume	GCMS - Ion Trap
Tetrachlorophenols	0.5	ug/L		Low Volume	GCMS - Ion Trap
1,2,4-Trichlorobenzene	0.05	ug/L	120-82-1	Low Level	GCMS - Ion Trap
1,2-Dichlorobenzene	0.05	ug/L	95-50-1	Low Level	GCMS - Ion Trap
1,2-Diphenylhydrazine	0.05	ug/L	122-66-7	Low Level	GCMS - Ion Trap
1,3-Dichlorobenzene	0.05	ug/L	541-73-1	Low Level	GCMS - Ion Trap
1,4-Dichlorobenzene	0.05	ug/L	106-46-7	Low Level	GCMS - Ion Trap
2,4,5-Trichlorophenol	0.05	ug/L	95-95-4	Low Level	GCMS - Ion Trap
2,4,6-Trichlorophenol	0.05	ug/L	88-06-2	Low Level	GCMS - Ion Trap
2,4-Dichlorophenol	0.05	ug/L	120-83-2	Low Level	GCMS - Ion Trap
2,4-Dimethylphenol	0.05	ug/L	105-67-9	Low Level	GCMS - Ion Trap
2,4-Dinitrophenol	0.05	ug/L	51-28-5	Low Level	GCMS - Ion Trap
2,4-Dinitrotoluene	0.05	ug/L	121-14-2	Low Level	GCMS - Ion Trap
2,6-Dinitrotoluene	0.05	ug/L	606-20-2	Low Level	GCMS - Ion Trap

2-Chloronaphthalene	0.01	ug/L	91-58-7	Low Level	GCMS - Ion Trap
2-Chlorophenol	0.05	ug/L	95-57-8	Low Level	GCMS - Ion Trap
2-Ethoxyethanol	0.2	ug/L		Low Level	GCMS - Ion Trap
2-Methylnaphthalene	0.01	ug/L	91-57-6	Low Level	GCMS - Ion Trap
2-Methylphenol	0.05	ug/L	95-48-7	Low Level	GCMS - Ion Trap
2-Nitroaniline	0.05	ug/L	88-74-4	Low Level	GCMS - Ion Trap
2-Nitrophenol	0.05	ug/L	88-75-5	Low Level	GCMS - Ion Trap
2-Nitropropane	0.2	ug/L		Low Level	GCMS - Ion Trap
3- & 4-Methylphenol	0.05	ug/L		Low Level	GCMS - Ion Trap
3,3'-Dichlorobenzidine	0.5	ug/L	91-94-1	Low Level	GCMS - Ion Trap
3-Nitroaniline	0.05	ug/L	99-09-2	Low Level	GCMS - Ion Trap
4,6-Dinitro-2-methylphenol	0.05	ug/L	534-52-1	Low Level	GCMS - Ion Trap
4-Bromophenylphenylether	0.05	ug/L	101-55-3	Low Level	GCMS - Ion Trap
4-Chloro-3-methylphenol	0.05	ug/L	59-50-7	Low Level	GCMS - Ion Trap
4-Chloroaniline	0.05	ug/L	106-47-8	Low Level	GCMS - Ion Trap
4-Chlorophenylphenylether	0.05	ug/L	7005-72-3	Low Level	GCMS - Ion Trap
4-Nitroaniline	0.05	ug/L	100-01-6	Low Level	GCMS - Ion Trap
4-Nitrophenol	0.05	ug/L	100-02-7	Low Level	GCMS - Ion Trap
Acenaphthene	0.01	ug/L	83-32-9	Low Level	GCMS - Ion Trap
Acenaphthylene	0.01	ug/L	208-96-8	Low Level	GCMS - Ion Trap
Aniline	0.2	ug/L	62-53-3	Low Level	GCMS - Ion Trap
Anthracene	0.01	ug/L	120-12-7	Low Level	GCMS - Ion Trap
Benzidine	0.1	ug/L	92-87-5	Low Level	GCMS - Ion Trap
Benzo(a)anthracene	0.01	ug/L	56-55-3	Low Level	GCMS - Ion Trap
Benzo(a)pyrene	0.01	ug/L	50-32-8	Low Level	GCMS - Ion Trap
Benzo(b)fluoranthene	0.01	ug/L	205-99-2	Low Level	GCMS - Ion Trap
Benzo(g,h,i)perylene	0.01	ug/L	191-24-2	Low Level	GCMS - Ion Trap
Benzo(k)fluoranthene	0.01	ug/L	207-08-9	Low Level	GCMS - Ion Trap
Benzoic Acid	0.05	ug/L	65-85-0	Low Level	GCMS - Ion Trap
Benzyl Alcohol	0.05	ug/L	100-51-6	Low Level	GCMS - Ion Trap
bis(2-Chloroethoxy)methane	0.05	ug/L	111-91-1	Low Level	GCMS - Ion Trap
bis(2-Chloroethyl)ether	0.05	ug/L	111-44-4	Low Level	GCMS - Ion Trap
bis(2-Chloroisopropyl)ether	0.05	ug/L	108-60-1	Low Level	GCMS - Ion Trap
bis(2-Ethylhexyl)phthalate	1	ug/L	117-81-7	Low Level	GCMS - Ion Trap
Butylbenzylphthalate	1	ug/L	85-68-7	Low Level	GCMS - Ion Trap
Carbazole	0.05	ug/L	86-74-8	Low Level	GCMS - Ion Trap

Chrysene	0.01	ug/L	218-01-9	Low Level	GCMS - Ion Trap
Cyclohexanone	0.2	ug/L	108-94-1	Low Level	GCMS - Ion Trap
Dibenz(a,h)anthracene	0.01	ug/L	53-70-3	Low Level	GCMS - Ion Trap
Dibenzofuran	0.05	ug/L	132-64-9	Low Level	GCMS - Ion Trap
Diethylphthalate	0.05	ug/L	84-66-2	Low Level	GCMS - Ion Trap
Dimethylphthalate	0.05	ug/L	131-11-3	Low Level	GCMS - Ion Trap
Di-n-butylphthalate	0.05	ug/L	87-74-2	Low Level	GCMS - Ion Trap
Di-n-octylphthalate	0.05	ug/L	117-84-0	Low Level	GCMS - Ion Trap
Fluoranthene	0.01	ug/L	206-44-0	Low Level	GCMS - Ion Trap
Fluorene	0.01	ug/L	86-73-7	Low Level	GCMS - Ion Trap
Hexachlorobenzene	0.05	ug/L	118-74-1	Low Level	GCMS - Ion Trap
Hexachlorobutadiene	0.05	ug/L	87-68-3	Low Level	GCMS - Ion Trap
Hexachlorocyclopentadiene	0.05	ug/L	77-47-4	Low Level	GCMS - Ion Trap
Hexachloroethane	0.05	ug/L	67-72-1	Low Level	GCMS - Ion Trap
Indeno(1,2,3-cd)pyrene	0.01	ug/L	193-39-5	Low Level	GCMS - Ion Trap
Isophorone	0.05	ug/L	78-59-1	Low Level	GCMS - Ion Trap
Naphthalene	0.01	ug/L	91-20-3	Low Level	GCMS - Ion Trap
Nitrobenzene	0.05	ug/L	98-95-3	Low Level	GCMS - Ion Trap
N-nitrosodimethylamine	0.05	ug/L	62-75-9	Low Level	GCMS - Ion Trap
N-nitroso-di-n-propylamine	0.05	ug/L	621-64-7	Low Level	GCMS - Ion Trap
N-Nitrosodiphenylamine	0.01	ug/L	86-30-6	Low Level	GCMS - Ion Trap
Pentachlorophenol	0.05	ug/L	87-86-5	Low Level	GCMS - Ion Trap
Phenanthrene	0.01	ug/L	85-01-8	Low Level	GCMS - Ion Trap
Phenol	0.05	ug/L	108-95-2	Low Level	GCMS - Ion Trap
Pyrene	0.01	ug/L	129-00-0	Low Level	GCMS - Ion Trap
Pyridine	0.05	ug/L	110-86-1	Low Level	GCMS - Ion Trap
Tetrachlorophenols	0.05	ug/L		Low Level	GCMS - Ion Trap

on/off

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Pesticides / PCBs Reporting Limits - Soils

EPA Method:	SW 8081A, 8082
Matrix:	Soil
Prep Method:	3550B
Container:	4 oz. Soil Jar
Preservative:	Cool 4 degrees C
Holding Time:	14 Days to Extract

Analyte	EPA Method	PQL	Units	CAS No.	Reporting Level	Instrument
4,4'-DDD	SW8081A	2	ug/kg	72-54-8	Standard	GC/ECD
4,4'-DDE	SW8081A	2	ug/kg	72-55-9	Standard	GC/ECD
4,4'-DDT	SW8081A	2	ug/kg	50-29-3	Standard	GC/ECD
Aldrin	SW8081A	1	ug/kg	309-00-2	Standard	GC/ECD
alpha-BHC	SW8081A	1	ug/kg	319-84-6	Standard	GC/ECD
beta-BHC	SW8081A	1	ug/kg	319-84-6	Standard	GC/ECD
Chlordane (technical)	SW8081A	10	ug/kg	57-74-9	Standard	GC/ECD
delta-BHC	SW8081A	1	ug/kg	319-86-8	Standard	GC/ECD
Dieldrin	SW8081A	2	ug/kg	60-57-1	Standard	GC/ECD
Endosulfan I	SW8081A	1	ug/kg	959-98-8	Standard	GC/ECD
Endosulfan II	SW8081A	2	ug/kg	33213-65-9	Standard	GC/ECD
Endosulfan sulfate	SW8081A	2	ug/kg	1031-07-8	Standard	GC/ECD
Endrin	SW8081A	2	ug/kg	72-20-8	Standard	GC/ECD
Endrin aldehyde	SW8081A	2	ug/kg	7421-93-4	Standard	GC/ECD
Endrin ketone	SW8081A	2	ug/kg	53494-70-5	Standard	GC/ECD
gamma-BHC (Lindane)	SW8081A	1	ug/kg	58-89-9	Standard	GC/ECD
Heptachlor	SW8081A	1	ug/kg	76-74-8	Standard	GC/ECD
Heptachlor epoxide	SW8081A	1	ug/kg	76-44-8	Standard	GC/ECD
Methoxychlor	SW8081A	10	ug/kg	72-43-5	Standard	GC/ECD
Toxaphene	SW8081A	100	ug/kg	8001-35-2	Standard	GC/ECD

Aroclor 1016	SW8082	10	ug/kg	12674-11-2	Standard	GC/ECD
Aroclor 1221	SW8082	20	ug/kg	11104-28-2	Standard	GC/ECD
Aroclor 1232	SW8082	10	ug/kg	11141-16-5	Standard	GC/ECD
Aroclor 1242	SW8082	10	ug/kg	53469-21-9	Standard	GC/ECD
Aroclor 1248	SW8082	10	ug/kg	12672-29-6	Standard	GC/ECD
Aroclor 1254	SW8082	10	ug/kg	11097-69-1	Standard	GC/ECD
Aroclor 1260	SW8082	10	ug/kg	11096-82-5	Standard	GC/ECD

on/off

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Pesticides / PCBs Reporting Limits - Waters

EPA Method: SW 8081A , 8082
Matrix: Water
Container: 125 ml Amber B.R. (low volume)
Container: 1 Liter Amber B.R.
Preservative: Cool 4° C
Holding Time: 7 Days to Extract
Prep Method: 3510C

Analyte	EPA Method	PQL	Units	CAS No.	Reporting Level	Instrument
4,4'-DDD	SW8081A	0.02	ug/L	72-54-8	Standard	GC/ECD
4,4'-DDE	SW8081A	0.02	ug/L	72-55-9	Standard	GC/ECD
4,4'-DDT	SW8081A	0.02	ug/L	50-29-3	Standard	GC/ECD
Aldrin	SW8081A	0.01	ug/L	309-00-2	Standard	GC/ECD
alpha-BHC	SW8081A	0.01	ug/L	319-84-6	Standard	GC/ECD
beta-BHC	SW8081A	0.01	ug/L	319-84-6	Standard	GC/ECD
Chlordane (technical)	SW8081A	0.1	ug/L	57-74-9	Standard	GC/ECD
delta-BHC	SW8081A	0.01	ug/L	319-86-8	Standard	GC/ECD
Dieldrin	SW8081A	0.02	ug/L	60-57-1	Standard	GC/ECD
Endosulfan I	SW8081A	0.01	ug/L	959-98-8	Standard	GC/ECD
Endosulfan II	SW8081A	0.02	ug/L	33213-65-9	Standard	GC/ECD
Endosulfan sulfate	SW8081A	0.02	ug/L	1031-07-8	Standard	GC/ECD
Endrin	SW8081A	0.02	ug/L	72-20-8	Standard	GC/ECD
Endrin aldehyde	SW8081A	0.02	ug/L	7421-93-4	Standard	GC/ECD
Endrin ketone	SW8081A	0.02	ug/L	53494-70-5	Standard	GC/ECD
gamma-BHC (Lindane)	SW8081A	0.01	ug/L	58-89-9	Standard	GC/ECD
Heptachlor	SW8081A	0.01	ug/L	76-74-8	Standard	GC/ECD
Heptachlor epoxide	SW8081A	0.01	ug/L	76-44-8	Standard	GC/ECD
Methoxychlor	SW8081A	0.1	ug/L	72-43-5	Standard	GC/ECD
Toxaphene	SW8081A	1	ug/L	8001-35-2	Standard	GC/ECD

Aroclor 1016	SW8082	0.1	ug/L	12674-11-2	Standard	GC/ECD
Aroclor 1221	SW8082	0.2	ug/L	11104-28-2	Standard	GC/ECD
Aroclor 1232	SW8082	0.1	ug/L	11141-16-5	Standard	GC/ECD
Aroclor 1242	SW8082	0.1	ug/L	53469-21-9	Standard	GC/ECD
Aroclor 1248	SW8082	0.1	ug/L	12672-29-6	Standard	GC/ECD
Aroclor 1254	SW8082	0.1	ug/L	11097-69-1	Standard	GC/ECD
Aroclor 1260	SW8082	0.1	ug/L	11096-82-5	Standard	GC/ECD

on/off

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Metals Reporting Limits - Soil

EPA Method: Various, 3051 (preparation)
Matrix: Soil
Container: 4 oz. Soil Jar
Preservative: Cool 4o C
Holding Time: 6 Months
Holding Time: Mercury 28 Days

Analyte	EPA Method	PQL	Units	CAS No.	Reporting Level	Instrument
Aluminum	SW6010B	40	mg/kg	742-99-05	Standard	ICP - Leeman
Antimony	SW6010B	100	mg/kg	7440-36-0	Standard	ICP - Leeman
Arsenic	SW6010B	40	mg/kg	7440-38-2	Standard	ICP - Leeman
Barium	SW6010B	1	mg/kg	7440-39-3	Standard	ICP - Leeman
Beryllium	SW6010B	0.4	mg/kg	7440-41-7	Standard	ICP - Leeman
Boron	SW6010B	100	mg/kg	7440-42-8	Standard	ICP - Leeman
Cadmium	SW6010B	4	mg/kg	7440-43-9	Standard	ICP - Leeman
Calcium	SW6010B	100	mg/kg	7440-70-2	Standard	ICP - Leeman
Chromium	SW6010B	2	mg/kg	7440-47-3	Standard	ICP - Leeman
Cobalt	SW6010B	2	mg/kg	7440-48-4	Standard	ICP - Leeman
Copper	SW6010B	4	mg/kg	7440-50-8	Standard	ICP - Leeman
Iron	SW6010B	20	mg/kg	7439-89-6	Standard	ICP - Leeman
Lead	SW6010B	20	mg/kg	7439-92-1	Standard	ICP - Leeman
Magnesium	SW6010B	100	mg/kg	7439-95-4	Standard	ICP - Leeman
Manganese	SW6010B	3	mg/kg	7439-96-5	Standard	ICP - Leeman
Molybdenum	SW6010B	10	mg/kg	7439-98-7	Standard	ICP - Leeman
Nickel	SW6010B	8	mg/kg	7440-02-0	Standard	ICP - Leeman
Phosphorus	SW6010B	1000	mg/kg	7723-14-0	Standard	ICP - Leeman
Potassium	SW6010B	200	mg/kg	7440-09-7	Standard	ICP - Leeman
Selenium	SW6010B	80	mg/kg	7782-49-2	Standard	ICP - Leeman
Silicon	SW6010B	10	mg/kg	7440-21-3	Standard	ICP - Leeman

Silver	SW6010B	10	mg/kg	7440-22-4	Standard	ICP - Leeman
Sodium	SW6010B	200	mg/kg	7440-23-5	Standard	ICP - Leeman
Strontium	SW6010B	10	mg/kg	7440-24-6	Standard	ICP - Leeman
Thallium	SW6010B	100	mg/kg	7440-30-4	Standard	ICP - Leeman
Tin	SW6010B	100	mg/kg	7440-31-5	Standard	ICP - Leeman
Titanium	SW6010B	10	mg/kg	7440-32-6	Standard	ICP - Leeman
Vanadium	SW6010B	10	mg/kg	7440-62-2	Standard	ICP - Leeman
Zinc	SW6010B	4	mg/kg	7440-66-6	Standard	ICP - Leeman
Aluminum	SW6020	5	mg/kg	742-99-05	Low Level	ICPMS - PE ELAN 6100
Antimony	SW6020	3	mg/kg	7440-36-0	Low Level	ICPMS - PE ELAN 6100
Arsenic	SW6020	1	mg/kg	7440-38-2	Low Level	ICPMS - PE ELAN 6100
Barium	SW6020	1	mg/kg	7440-39-3	Low Level	ICPMS - PE ELAN 6100
Beryllium	SW6020	0.5	mg/kg	7440-41-7	Low Level	ICPMS - PE ELAN 6100
Boron	SW6020	5	mg/kg	7440-42-8	Low Level	ICPMS - PE ELAN 6100
Cadmium	SW6020	0.5	mg/kg	7440-43-9	Low Level	ICPMS - PE ELAN 6100
Chromium	SW6020	1	mg/kg	7440-47-3	Low Level	ICPMS - PE ELAN 6100
Cobalt	SW6020	0.5	mg/kg	7440-48-4	Low Level	ICPMS - PE ELAN 6100
Copper	SW6020	1	mg/kg	7440-50-8	Low Level	ICPMS - PE ELAN 6100
Lead	SW6020	0.5	mg/kg	7439-92-1	Low Level	ICPMS - PE ELAN 6100
Manganese	SW6020	0.5	mg/kg	7439-96-5	Low Level	ICPMS - PE ELAN 6100
Molybdenum	SW6020	1	mg/kg	7439-98-7	Low Level	ICPMS - PE ELAN 6100
Nickel	SW6020	1	mg/kg	7440-02-0	Low Level	ICPMS - PE ELAN 6100
Selenium	SW6020	3	mg/kg	7782-49-2	Low Level	ICPMS - PE ELAN 6100
Silver	SW6020	0.5	mg/kg	7440-22-4	Low Level	ICPMS - PE ELAN 6100
Strontium	SW6020	0.5	mg/kg	7440-24-6	Low Level	ICPMS - PE ELAN 6100
Thallium	SW6020	0.5	mg/kg	7440-30-4	Low Level	ICPMS - PE ELAN 6100
Tin	SW6020	2	mg/kg	7440-31-5	Low Level	ICPMS - PE ELAN 6100
Titanium	SW6020	1	mg/kg	7440-32-6	Low Level	ICPMS - PE ELAN 6100
Uranium	SW6020	0.1	mg/kg	7440-32-6	Low Level	ICPMS - PE ELAN 6100
Vanadium	SW6020	1	mg/kg	7440-62-2	Low Level	ICPMS - PE ELAN 6100
Zinc	SW6020	4	mg/kg	7440-66-6	Low Level	ICPMS - PE ELAN 6100
Mercury	SW7471	0.1	mg/kg	7439-97-6	Standard	CVAA - Leeman PS200

on/off

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Metals Reporting Limits - Waters

EPA Method: Various, 3010A (Prep)
Matrix: Water
Container: 250 ml HDPE
Preservative: HNO3 - pH<2
Holding Time: 6 Months
Holding Time: Mercury, 28 Days

Analyte	EPA Method	PQL	Units	CAS No.	Reporting Level	Instrument
Aluminum	SW6010B	0.20	mg/L	742-99-05	Standard	ICP - Leeman
Antimony	SW6010B	0.50	mg/L	7440-36-0	Standard	ICP - Leeman
Arsenic	SW6010B	0.20	mg/L	7440-38-2	Standard	ICP - Leeman
Barium	SW6010B	0.005	mg/L	7440-39-3	Standard	ICP - Leeman
Beryllium	SW6010B	0.002	mg/L	7440-41-7	Standard	ICP - Leeman
Boron	SW6010B	0.50	mg/L	7440-42-8	Standard	ICP - Leeman
Cadmium	SW6010B	0.02	mg/L	7440-43-9	Standard	ICP - Leeman
Calcium	SW6010B	0.50	mg/L	7440-70-2	Standard	ICP - Leeman
Chromium	SW6010B	0.01	mg/L	7440-47-3	Standard	ICP - Leeman
Cobalt	SW6010B	0.01	mg/L	7440-48-4	Standard	ICP - Leeman
Copper	SW6010B	0.02	mg/L	7440-50-8	Standard	ICP - Leeman
Iron	SW6010B	0.1	mg/L	7439-89-6	Standard	ICP - Leeman
Lead	SW6010B	0.10	mg/L	7439-92-1	Standard	ICP - Leeman
Magnesium	SW6010B	0.50	mg/L	7439-95-4	Standard	ICP - Leeman
Manganese	SW6010B	0.015	mg/L	7439-96-5	Standard	ICP - Leeman
Molybdenum	SW6010B	0.05	mg/L	7439-98-7	Standard	ICP - Leeman
Nickel	SW6010B	0.04	mg/L	7440-02-0	Standard	ICP - Leeman
Phosphorus	SW6010B	5.0	mg/L	7723-14-0	Standard	ICP - Leeman
Potassium	SW6010B	1.0	mg/L	7440-09-7	Standard	ICP - Leeman
Selenium	SW6010B	0.40	mg/L	7782-49-2	Standard	ICP - Leeman
Silicon	SW6010B	0.05	mg/L	7440-21-3	Standard	ICP - Leeman

Silver	SW6010B	0.05	mg/L	7440-22-4	Standard	ICP - Leeman
Sodium	SW6010B	1.0	mg/L	7440-23-5	Standard	ICP - Leeman
Strontium	SW6010B	0.05	mg/L	7440-24-6	Standard	ICP - Leeman
Thallium	SW6010B	0.50	mg/L	7440-30-4	Standard	ICP - Leeman
Tin	SW6010B	0.50	mg/L	7440-31-5	Standard	ICP - Leeman
Titanium	SW6010B	0.05	mg/L	7440-32-6	Standard	ICP - Leeman
Vanadium	SW6010B	0.05	mg/L	7440-62-2	Standard	ICP - Leeman
Zinc	SW6010B	0.02	mg/L	7440-66-6	Standard	ICP - Leeman
Aluminum	SW6020	0.005	mg/L	742-99-05	Low Level	ICPMS - PE ELAN 6100
Antimony	SW6020	0.003	mg/L	7440-36-0	Low Level	ICPMS - PE ELAN 6100
Arsenic	SW6020	0.001	mg/L	7440-38-2	Low Level	ICPMS - PE ELAN 6100
Barium	SW6020	0.001	mg/L	7440-39-3	Low Level	ICPMS - PE ELAN 6100
Beryllium	SW6020	0.0005	mg/L	7440-41-7	Low Level	ICPMS - PE ELAN 6100
Boron	SW6020	0.005	mg/L	7440-42-8	Low Level	ICPMS - PE ELAN 6100
Cadmium	SW6020	0.0005	mg/L	7440-43-9	Low Level	ICPMS - PE ELAN 6100
Chromium	SW6020	0.001	mg/L	7440-47-3	Low Level	ICPMS - PE ELAN 6100
Cobalt	SW6020	0.0005	mg/L	7440-48-4	Low Level	ICPMS - PE ELAN 6100
Copper	SW6020	0.001	mg/L	7440-50-8	Low Level	ICPMS - PE ELAN 6100
Lead	SW6020	0.0005	mg/L	7439-92-1	Low Level	ICPMS - PE ELAN 6100
Manganese	SW6020	0.0005	mg/L	7439-96-5	Low Level	ICPMS - PE ELAN 6100
Molybdenum	SW6020	0.001	mg/L	7439-98-7	Low Level	ICPMS - PE ELAN 6100
Nickel	SW6020	0.001	mg/L	7440-02-0	Low Level	ICPMS - PE ELAN 6100
Selenium	SW6020	0.003	mg/L	7782-49-2	Low Level	ICPMS - PE ELAN 6100
Silver	SW6020	0.0005	mg/L	7440-22-4	Low Level	ICPMS - PE ELAN 6100
Strontium	SW6020	0.0005	mg/L	7440-24-6	Low Level	ICPMS - PE ELAN 6100
Thallium	SW6020	0.0005	mg/L	7440-30-4	Low Level	ICPMS - PE ELAN 6100
Tin	SW6020	0.002	mg/L	7440-31-5	Low Level	ICPMS - PE ELAN 6100
Titanium	SW6020	0.001	mg/L	7440-32-6	Low Level	ICPMS - PE ELAN 6100
Uranium	SW6020	0.1	mg/L	7440-32-6	Low Level	ICPMS - PE ELAN 6100
Vanadium	SW6020	0.001	mg/L	7440-62-2	Low Level	ICPMS - PE ELAN 6100
Zinc	SW6020	0.004	mg/L	7440-66-6	Low Level	ICPMS - PE ELAN 6100
Mercury	SW7470	0.0002	mg/L	7439-97-6	Standard	CVAA - Leeman PS200

on/off

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Explosives Reporting Limits - Soils

EPA Method: SW 8330
Matrix: soil
MDL Update: 9/10/99
Container: 4 oz. Soil Jar
Preservative: Cool 4° C
Holding Time: 14 Days to Extract

Analyte	PQL	Units	CAS No.	Reporting Level	Instrument
1,3,5-Trinitrobenzene	0.05	mg/kg	99-35-4	Standard	HPLC
1,3-Dinitrobenzene	0.05	mg/kg	99-65-0	Standard	HPLC
2,4,6-Trinitrotoluene	0.05	mg/kg	118-96-7	Standard	HPLC
2,4-Dinitrotoluene	0.05	mg/kg	121-14-2	Standard	HPLC
2,6-Dinitrotoluene	0.05	mg/kg	606-20-2	Standard	HPLC
2-Aminodinitrotoluene	0.05	mg/kg	355-72-78-2	Standard	HPLC
2-Nitrotoluene	0.1	mg/kg	88-72-2	Standard	HPLC
3-Nitrotoluene	0.1	mg/kg	99-08-1	Standard	HPLC
4-Aminodinitrotoluene	0.05	mg/kg	1946-51-0	Standard	HPLC
4-Nitrotoluene	0.1	mg/kg	99-99-0	Standard	HPLC
HMX	0.05	mg/kg	2691-41-0	Standard	HPLC
Nitrobenzene	0.05	mg/kg	98-95-3	Standard	HPLC
RDX	0.05	mg/kg	122-82-2	Standard	HPLC
Tetryl	0.05	mg/kg	479-45-8	Standard	HPLC

Reporting Limits Table

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General Chemistry Parameters

on/off

Analyte	Method #	Matrix	PQL	Units	Container	Preservative	Holding Time	CAS No.
Cyanide, total	SW9012A	water	0.01	mg/L	1 liter HDPE	Cool 4° C	14 Days	57-12-5
Cyanide, total	SW9012A/9013 (prep)	soil	1	mg/kg	4 oz. Soil Jar	Cool 4° C	14 Days	57-12-5

on/off

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Fuels Reporting Limits - Soils

EPA Method: Various
Matrix: Soil
Container: 4 oz. Soil Jar
Preservative: Cool 4° C (AK101 / 8260B BTEX - Methanol)
Holding Time: 14 Days

Analyte	EPA Method	PQL	Units	CAS No.	Reporting Level	Instrument
Diesel (>nC12-nC24)	NWTPH-Dx	25	mg/kg	68334-30-5	Standard	GC/FID
Motor Oil (C24-C36)	NWTPH-Dx	50	mg/kg		Standard	GC/FID

APPENDIX D

USACE Certification of Sound Analytical Services

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
HTRW CENTER OF EXPERTISE
12565 WEST CENTER ROAD
OMAHA, NEBRASKA 68144-3869

REPLY TO
ATTENTION OF

December 1, 1999

Hazardous, Toxic and Radioactive Waste
Center of Expertise

Sound Analytical Services, Inc.
4813 Pacific Highway East
Tacoma, WA 98424

Gentlemen:

This correspondence addresses the recent evaluation of Sound Analytical Services, Inc. of Tacoma, WA by the U.S. Army Corps of Engineers (USACE) for chemical analysis in support of the USACE Hazardous, Toxic and Radioactive Waste Program.

Your laboratory is now validated for the parameters listed below:

METHOD	PARAMETERS	MATRIX[1]
300 series	Anions[4]	Water[2]
8021B	Aromatic Volatile Organics	Water[2]
8021B	Aromatic Volatile Organics	Solids
9010B/9012A	Cyanide	Water[2]
9013	Cyanide	Solids
8330	Explosives	Water[2]
8330	Explosives	Solids[2]
8151A	Herbicides	Water[2]
8151A	Herbicides	Solids
8081A	Organochlorine Pesticides	Water[2]
8081A	Organochlorine Pesticides	Solids
8082	Polychlorinated Biphenyls	Water[2]
8082	Polychlorinated Biphenyls	Solids[2]
8310	Polynuclear Aromatic Hydrocarbons	Water[2]
8310	Polynuclear Aromatic Hydrocarbons	Solids
8270C	Semivolatile Organics	Water[2]
8270C	Semivolatile Organics	Solids[2]
6020	TAL Metals[6]	Water[2]
6020	TAL Metals[6]	Solids[2]
SW-846	TAL Metals[3]	Water[2]
SW-846	TAL Metals[3]	Solids[2]
9060	Total Organic Carbon	Water[2]
Mod 8015	TPH - GRO/DRO/RRO[5]	Water
Mod 8015	TPH - GRO/DRO/RRO[5]	Solids
8021B	Volatile Organics	Water[2]
8021B	Volatile Organics	Solids
8260B	Volatile Organics	Water[2]
8260B	Volatile Organics	Solids

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Remarks:

1) 'Solids' includes soils, sediments, and solid waste.

2) The laboratory has successfully analyzed a performance evaluation sample for this method/matrix.

3) TAL Metals: Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

4) Anions: Chloride, fluoride, sulfate, nitrate, nitrite, ortho-phosphate.

5) Approval for this parameter is based on review of SOPs only.

6) TAL metals less mercury.

Enclosed for your information is a copy of the Laboratory Inspection and Evaluation Report. Your laboratory has responded to the deficiencies as noted in the report. No further responses are necessary.

Based on the successful analysis of the performance evaluation samples and the results of the laboratory inspection, your laboratory will be validated for sample analysis by the methods listed above. The period of validation is 24 months and expires on September 10, 2001.

The USACE reserves the right to conduct additional laboratory inspections or to suspend validation status for any or all of the listed parameters if deemed necessary. It should be noted that your laboratory may not subcontract USACE analytical work to any other laboratory location without the approval of this office. This laboratory validation does not guarantee the delivery of any analytical samples from a USACE Contracting Officer Representative.

Any questions or comments can be directed to Richard Kissinger at (402) 697-2569. General questions regarding laboratory validation may be directed to the Laboratory Validation Coordinator at (402) 697-2574.

Sincerely,

for Marcia C. Davies, Ph.D.
Director, USACE Hazardous,
Toxic and Radioactive Waste
Center of Expertise

Enclosure

APPENDIX E

Electronic Data Deliverables

Electronic Data Deliverables

The left column contains the column headings. The spreadsheet column headings should look just like the left column. The right column contains a brief description of the type of information that should go into the columns. The laboratory electronic file should be a text file (comma or tab delimited).

Site	Site name or project name
Location	Site location
LabName	Lab name
SDG	SDG
SampleID	Client sample ID
QAQCType	QAQC type like MS, duplicate, or blank
Matrix	Sample matrix
LabSampleID	Laboratory sample ID
RunNumber	Run number
ExtractMethod	Extraction method
AnalysisMethod	Analysis method number (i.e., EPA number)
Filter	This field is yes or no and only for water samples
DateSampled	Date Sampled
DateReceived	Date laboratory received the samples
DateExtracted	Date extracted
DateAnalyzed	Date analyzed
PercentSolids	Percent solids
PercentMoisture	Percent moisture (can fill out either the solids or the moisture column)
CAS	CAS number
Analyte	Analyte name
Result	Result (no text)
LabQual	Laboratory qualifier
ReportLimit	Reporting Limit
Units	Units
Dilution	Dilution
Surrogate	yes or no
Basis	dry or wet
SpikeAmount	Spike concentration for MS, LCS or surrogates
Recovery	spike percent recovery for MS, LCS, or surrogates
RPD	Relative percent difference for dups or MS/MSDs
LowerLimit	Lower control limit for MS, LCS, or surrogates
UpperLimit	Upper control limit for MS, LCS, or surrogates
RPDlimit	RPD control limits for dups or MS/MSDs
MethodDesc	Name of the analytical method