Sampling and Analysis Plan
Soil and Groundwater Assessment

Moxee City Shop and STP
Moxee, Washington

for
Washington State Department of Ecology

January 31, 2012

GeoEngineers
Earth Science + Technology

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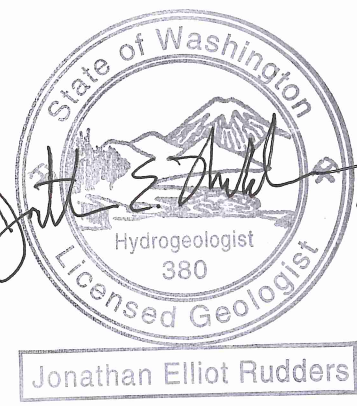
File No. 0504-078-00

January 31, 2012

Prepared for:

Washington Department of Ecology
Toxics Cleanup Program - Central Region Office
15 West Yakima Avenue, Suite 200
Yakima, Washington 98902-3452

Attention: Norman Hepner, PE



05/14/13

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1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) presents the proposed scope-of-work required to conduct a soil and groundwater assessment at the Moxee City Shop and STP site (herein designated site) located at 7520 Postma Road in Moxee, Washington (see Vicinity Map, Figure 1). The project scope includes drilling soil probes, collecting and analyzing soil and groundwater samples, installing two groundwater monitoring wells, and conducting one groundwater monitoring event.

This SAP has been prepared by GeoEngineers for the Washington State Department of Ecology (Ecology) under Contract Number C1100145. The project Quality Assurance Project Plan (QAPP) and the Health and Safety Plan (HASP) are presented as Appendices A and B of this SAP, respectively. Included in this SAP are general guidelines with the following sections:

- Background - Section 2.0
- Scope and Tasks - Section 3.0
- Assessment Procedures – Section 4.0
- Data Validation and Usability – Section 5.0

2.0 BACKGROUND

Our understanding of previous site assessment and remedial activities was primarily obtained through review of the following two reports:

- Report by Sage Earth Sciences, Inc. (Sage) summarizing results of 1996 underground storage tank (UST) removal activities performed at the site, (June 1996).
- Report by Maxim Technologies, Inc. (Maxim) summarizing results of a 1996 environmental investigation performed at the site, (December 1996).

Two, 1,000-gallon capacity, gasoline USTs were removed from the site during May 1996. These USTs were installed during approximately 1977 and used to fuel City vehicles. The USTs were located about 40 feet south of the former Sewage Treatment Plant (STP) Control Office, approximately as shown in 1996 UST Excavation and Test Pit Locations, Figure 2. Approximately 50 yards of petroleum-impacted soil encountered during excavation activities was excavated, treated on-site via bio-remediation and subsequently used to backfill the excavation. During UST removal activities, corrosion, pitting, and small holes were observed on the tanks. Groundwater was encountered between 4 and 5 feet below ground surface (bgs) in the UST excavation.

No confirmation soil samples collected from the UST excavation contained concentrations of petroleum hydrocarbons in excess of Model Toxics Control Act (MTCA) Method A cleanup levels. However, a groundwater sample collected from the excavation contained concentrations of the following analytes that were several orders of magnitude greater than MTCA Method A groundwater cleanup levels: gasoline-range petroleum hydrocarbons (GRPH); benzene, toluene, ethylbenzene, and totally xylenes (BTEX); and lead.

Additional soil assessment activities were conducted during August 1996 by Maxim. These activities consisted of an expansion (to the west) of the UST excavation to confirm that the original excavation had sufficiently removed petroleum-impacted soil in that direction. Maxim concluded that all petroleum-impacted soil associated with the UST excavation had been successfully removed and treated. However, no discussion of assessment associated with dispensers or underground piping is presented in either the Sage or Maxim reports.

Maxim also excavated four test pits to depths of about 8 feet bgs for the purpose of groundwater sample collection. Approximate test pit locations are presented in Figure 2. Encountered soil generally consisted of a surficial silty clay layer that extended about 6 feet bgs and was underlain by sand and gravel. Groundwater was encountered at depths between about 6 and 8 feet bgs. Maxim indicated that groundwater flow direction at the site likely is to the west/southwest, though site-specific groundwater elevation data were not collected. Groundwater samples were collected from each test pit and submitted to an analytical laboratory for GRPH and BTEX analyses. Results indicated GRPH, benzene, ethylbenzene, and xylenes were detected in the groundwater sample collected from test pit 3 (located about 10 feet southwest of the UST excavation) at concentrations greater than MTCA Method A cleanup criteria. Maxim recommended the installation of a groundwater monitoring well network at the site, although we understand this was not completed.

3.0 SCOPE AND TASKS

Proposed assessment activities under this SAP are summarized as follows:

- Advance six to eight direct-push borings to assess site conditions in and downgradient (likely west/southwest) of suspected contamination source areas; perform field screening and collect at least one soil sample per 4-foot acrylic sleeve.
- Advance two to four direct-push borings as step-out borings likely south and west of potential source areas to define the extent of contamination; perform field screening and collect at least one soil sample per 4-foot acrylic sleeve.
- Construct two monitoring wells near the soil borings exhibiting the greatest indications of petroleum contamination based on field-screening measurements.
- Perform one groundwater sampling event using the newly constructed wells.

Data quality objectives, special training/certification, and documentation will conform to the requirements of the QAPP (Appendix A). All field work will be performed consistent with HASP (Appendix B). Project tasks are divided into two work tasks as detailed below.

3.1. Soil and Groundwater Assessment

- Notify the Call-Before-You-Dig utility notification service before beginning drilling activities. The area within which underground utilities will be located is presented in Proposed Boring Locations, Figure 3.
- Subcontract a private utility locator to clear explorations located on private property before drilling.

- Contain soil cuttings and groundwater from assessment and/or well construction activities. Material will be drummed separately, labeled, and stored on-site pending results of analytical testing.
- Subcontract a licensed contractor to remove and dispose of drill cuttings from source assessment and/or well construction activities at a suitable disposal facility.
- Drill about 10 soil borings using direct-push drilling methods at the site. Two borings will be drilled within the 1996 UST excavation. Four to six borings will be located immediately down-gradient (south and west) of the 1996 UST excavation (one boring will be located as close as feasible to the location of former test pit #3). Two to four borings will be used as step-out borings to define the extent of contamination or to assess the presence of petroleum-impacted material in any additional potential source areas defined by City or Ecology personnel. Approximate proposed boring locations are presented in Figure 3.
- Soil samples will be collected in 4-foot acrylic sleeves continuously during drilling. Select sub-samples will be field-screened using visual observations, water sheen tests, and headspace vapor measurements with a photoionization detector (PID) to assess possible presence of petroleum-related contaminants. At least one sample from each 4-foot sleeve will be collected for potential chemical analysis.
- Construct two monitoring wells near the soil borings exhibiting the greatest indications of petroleum contamination based on field-screening measurements. The monitoring wells will be installed using direct-push drilling techniques and will consist of ¾-inch-diameter, Schedule 40 polyvinyl chloride (PVC) casing with a pre-pack well screen surrounded by an appropriate sand filter pack and bentonite slurry seal. The top of the well screens will be located approximately 3 feet bgs. The expected total depths of the monitoring wells are 12 feet, or about 5 feet below the expected depth to groundwater.

  The wells will be completed with flush-mount surface monuments. A lockable cap will be installed in the top of the PVC well casing. A concrete surface seal will be placed around the monuments at the ground surface to divert surface water away from the well location. The wells will be developed using surging and bailing.
- Submit soil samples (we anticipate submitting 1 sample from 10 borings or 2 samples from 5 borings) to a qualified analytical laboratory for chemical analysis. The sample collected from the vadose zone from each boring exhibiting the greatest indications of petroleum contamination, based on field-screening measurements, will be submitted for chemical analysis. Remaining samples will be held at the laboratory for potential analysis. We estimate a total of 10 soil samples will be analyzed for the following: GRPH by Northwest Method NWTPH-Gx; benzene, toluene, ethylbenzene, xylenes (BTEX), 1,2-dichloroethane (EDC), methyl tertiary-butyl ether (MTBE) and n-hexane by EPA Method 8260B; 1,2-dibromoethane (EDB) by Environmental Protection Agency (EPA) Method 8011; naphthalenes by EPA Method 8270; and lead using EPA Method 6010C. The two soil samples with the greatest indications of petroleum contamination will be analyzed for fractionalized petroleum hydrocarbons (aliphatics and aromatics) using Northwest VPH and EPH methods. Samples will be analyzed on standard turn-around-time.
- Collect groundwater samples from the two installed monitoring wells and submit to a qualified local analytical laboratory for analysis of GRPH using NWTPH-Gx methods, BTEX, EDB. EDC,

MTBE, and n-hexane using EPA Method 8260B, naphthalenes by EPA Method 8270, and lead using EPA Method 6010B. One duplicate sample also will be collected and analyzed for the above parameters.

- Enter data results information into Ecology's Environmental Information Management (EIM) database.

After the field work is complete, the results of previous investigations and this assessment will be reviewed to evaluate whether the site has been sufficiently characterized or if additional data gaps exist. We will provide to Ecology our preliminary conclusions regarding source assessment results and associated recommendations regarding additional investigative or remedial activities, if any, appropriate for the site.

4.0 ASSESSMENT PROCEDURES

This section contains standard procedures for field data collection that are anticipated during the assessment including the following:

- Collecting Soil Samples from Soil Borings;
- Monitoring Well Construction, Development, and Surveying;
- Depth to Groundwater Measurement;
- Groundwater Sample Collection;
- Decontamination Procedures;
- Handling of Investigation-Derived Waste (IDW); and
- Sample Location Control.

4.1. Collecting Soil Samples from Soil Borings

Eight to ten source area investigation soil borings will be advanced using direct-push drilling techniques. All drilling will be conducted by a State of Washington licensed driller and supervised by an appropriately trained GeoEngineers geologist or engineer.

Continuous soil samples will be collected during direct-push drilling using 4-foot-long, 1-inch-diameter acrylic sleeves.

Each boring will be continuously monitored by a GeoEngineers field representative to observe and classify the soil encountered, and prepare a detailed log of each boring. Soil encountered in the borings will be classified in the field in general accordance with ASTM International (ASTM) D 2488, the Standard Practice for Classification of Soils, Visual-Manual Procedure.

Soil samples from each 4-foot interval will be field-screened for the presence of petroleum-related compounds using the procedures described below to determine which portion to sample for chemical analysis. Based on field indicators, one soil sample from each boring (10 total) will be retained for laboratory analysis; remaining soil samples will be submitted to the laboratory and held for potential analysis (opportunity samples).

Soil selected for each sample will be removed from the sleeve using a decontaminated soil knife or new, clean nitrile gloves, and transferred into a laboratory-prepared container, labeled with a water proof pen, and placed on "blue ice" or double bagged wet ice in a clean plastic lined cooler. Each sample will be documented on a field sample data sheet (FSDS) including sample name, sample collection date and time, sample type, sample depth, requested analytical methods, and sampler name. Soil samples for volatile organic compound analyses (e.g. BTEX-N) will be collected consistent with EPA Method 5035A and preserved in accordance with Ecology Memo 5, document number 04-09-087 and EPA (1998).

Sampling equipment will be decontaminated between each sampling attempt as described in **Section 4.6.** The sample coolers will be delivered to the analytical laboratory under standard chain-of-custody procedures described in the QAPP.

4.2. Field Screening Methods

A GeoEngineers field representative will perform field screening tests on soil samples collected from approximately 5-foot intervals from all borings and record the observations on the field boring log and in the field notebook. Field screening results will be used to aid in the selection of soil samples for chemical analysis. The sample from each of the borings showing the highest likelihood of petroleum contamination based on field screening will be selected for laboratory analysis. The remaining samples may be submitted to the laboratory and held pending the results of the samples submitted for analysis.

Screening methods will include (1) visual examination; (2) water sheen screening; and (3) headspace vapor screening using a PID. Visual screening consists of inspecting the soil for discoloration indicative of the presence of petroleum-impacted material in the sample.

Water sheen screening involves placing soil in water and observing the water surface for signs of sheen. Sheen classifications are as follows:

- **No Sheen (NS)** No visible sheen on the water surface;
- **Slight Sheen (SS)** Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly. Natural organic matter in the soil might produce a slight sheen;
- **Moderate Sheen (MS)** Light to heavy sheen; might have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on water surface; and
- **Heavy Sheen (HS)** Heavy sheen with color/iridescence; spread is rapid; entire water surface might be covered with sheen.

Headspace vapor screening involves inserting a soil sample into a sealed plastic bag and measuring the airspace VOC vapor concentrations in parts per million (ppm) with a PID. Once a soil sample is placed in a sealed plastic bag with air space, the bag is shaken to expose the soil to the air trapped in the bag. The probe of the PID, calibrated to isobutylene following the manufacturer's instructions, is inserted into a small opening in the bag seal and the measurement is collected. The PID typically is designed to quantify VOC vapor concentrations in the range between 1 ppm and 2,000 ppm with an accuracy of 10 percent of the reading and between 2,000 ppm and 10,000 ppm with an accuracy of 20 percent of the reading.

Field screening results are site specific. The results vary with temperature, soil type, type of contaminant, and soil moisture content. Water sheen testing equipment will be disposable or decontaminated before field screening each sample using a Liquinox® soap solution with a water rinse. Used testing equipment and/or decontamination water will be stored on-site in a labeled Washington State Department of Transportation (DOT)-approved drum pending disposal with IDW.

4.3. Monitoring Well Construction, Development, and Surveying

The monitoring wells will be constructed in accordance with Chapter 173-160, Section 400 of the Washington Administrative Code (WAC), titled *Washington State Resource Protection Well Construction Standards*. All monitoring well records will be submitted in accordance with Washington State monitoring well construction standards. Monitoring well installation will be observed and documented by a GeoEngineers field representative on a monitoring well construction record form.

The monitoring wells will be installed using direct-push drilling techniques and will consist of a ¾-inch-diameter, schedule 40 polyvinyl chloride (PVC), pre-pack well surrounded by an appropriately-sized sand filter pack and bentonite slurry seal. The top of the well screen will be located approximately 3 feet bgs. The expected total depth of the monitoring wells is 12 feet, or 5 feet below the expected depth to groundwater.

The wells will be completed with a flush-mount surface monument. A lockable compression cap will be installed in the top of the PVC well casing. A concrete surface seal will be placed around the monument at the ground surface to divert surface water away from the well location.

The monitoring wells will be developed to remove water introduced into the well during drilling (if any), stabilize the filter pack and formation materials surrounding the well screen, and restore the hydraulic connection between the well screen and the surrounding soil. The depth to water in the monitoring wells will be measured prior to development. The total depth of the wells will also be measured and recorded. The monitoring wells will be developed by pumping, surging, bailing, or a combination of these methods after construction. Development of the wells will continue until the water is as free of sediment as practicable with respect to the composition of the subsurface materials within the screened interval. The removal rate and amount of groundwater removed will be recorded during the well development procedures. Development purge water will be collected and stored on site.

The horizontal location of the new wells will be surveyed relative to existing site features and its top-of-casing elevation will be surveyed using a laser level and referenced to an on-site benchmark.

4.4. Depth to Groundwater

Depth to groundwater measurements from the new wells will be collected and recorded in the field notebook after the water level has stabilized after well development. Depth to groundwater relative to the notch in the monitoring well casing rims will be measured to the nearest 0.01 foot using an electronic water level indicator and recorded in the field notebook. Product thickness (if any) will be measured with an oil-water interface probe and recorded in the field notebook. Groundwater elevation will be calculated by subtracting the depth-to-water measurement from the surveyed casing rim elevation. The electronic water level indicator will be decontaminated with Liquinox® solution wash and a distilled water rinse prior to use in each well.

4.5. Groundwater Sampling

Following depth to groundwater measurements, groundwater samples will be collected from the installed monitoring wells consistent with the EPA's low-flow groundwater sampling procedure, as described in EPA (1996) and Puls and Barcelona (1996). Dedicated polyethylene tubing and a portable bladder pump will be used for groundwater purging and sampling. During purging activities, water quality parameters, including pH, temperature, conductivity, dissolved oxygen, and turbidity will be measured using a multi-parameter meter equipped with a flow-through cell. Groundwater samples will be collected after 1) water quality parameters stabilize; or 2) a maximum purge time of 60 minutes is achieved. During purging and sampling, drawdown will not be allowed to exceed 0.3 feet, if possible, and the purge rate will not be allowed to exceed 400 milliliters per minute. Water quality parameter stabilization criteria will include the following:

- Turbidity: ±10 percent for values greater than 5 nephelometric turbidity units (ntu);
- Conductivity: ±3 percent;
- pH: ±0.1 unit;
- Temperature: ±3 percent; and
- Dissolved oxygen: ± 10 percent.

Samples will not be collected from the wells if they contain any measureable free product. Field water quality measurements and depth-to-water measurements will be recorded on a Well Purging-Field Water Quality Measurement Form. The groundwater samples will be transferred in the field to laboratory-prepared sample containers and kept cool during transport to the testing laboratory. Chain-of-custody procedures will be observed from the time of sample collection to delivery to the testing laboratory consistent with the QAPP.

4.6. Decontamination Procedures

The objective of the decontamination procedures described herein is to minimize the potential for cross-contamination between sample locations.

A designated decontamination area will be established for decontamination of drilling equipment and reusable sampling equipment. Drilling equipment will be cleaned by water jetting using high-pressure/low-volume cleaning equipment.

Sampling equipment will be decontaminated in accordance with the following procedures before each sampling attempt or measurement.

1. Brush equipment with a nylon brush to remove large particulate matter.
2. Rinse with potable tap water.
3. Wash with non-phosphate detergent solution (Liquinox® and potable tap water).
4. Rinse with potable tap water.

5. Rinse with distilled water.

6. Replace the pump bladder and discharge tubing.

4.7. Handling of IDW

IDW, which consists of mainly drill cuttings and decontamination/purge water, typically will be placed in DOT-approved 55-gallon drums. Each drum will be labeled with the project name, exploration number, general contents, and date. The drummed IDW will be stored onsite pending analysis and disposal.

Disposable items, such as sample tubing, disposable bailers, bailer line, gloves and protective overalls, paper towels, etc., will be placed in plastic bags after use and deposited in trash receptacles for disposal.

4.8. Sample Location Control

Horizontal sample control will be maintained throughout the project. Horizontal control will be established using measuring tapes or a hand-held global positioning system (GPS) meter accurate to approximately 3 lateral feet. To achieve optimum accuracy, several epoch cycles will be used to obtain each coordinate.

4.9. Sampling And Analytical Methods

Groundwater and soil field sampling methods, including quality control (QC) and maintenance of field instrumentation, will generally adhere to the requirements of the QAPP. Analytical method requirements also will adhere to the QAPP. During laboratory procurement and coordination, analytical method reporting limits for each proposed analysis will be compared to the reporting limits listed in the QAPP to ensure that data generated will be sufficient for assessment purposes.

4.10. Sample Handling And Custody Requirements

Samples will be handled in accordance with the QAPP. A complete discussion of the sample identification and custody procedures is provided in the QAPP.

4.11. Field Measurements And Observations Documentation

Field measurements and observations will be recorded in a project field notebook. Daily logs will be dated, and pages will be consecutively numbered. Entries will be recorded directly and legibly in the daily log and signed and dated by the person conducting the work. If changes are made, the changes will not obscure the previous entry, and the changes will be signed and dated. At a minimum, the following data will be recorded in the log book:

- Purpose of activity
- Location of activity
- Description of sampling reference point(s)
- Date and time of activity
- Sample number identification
- Soil sample top and bottom depth (bgs)

- Sample number and volume
- Sample transporting procedures
- Field measurements and screening observations
- Calibration records for field instruments
- Visitors to site
- Relevant comments regarding field activities
- Signatures of responsible personnel

Sufficient information will be recorded in the log book so that field activities can be reconstructed without reliance on personnel memory.

4.12. Data Management And Documentation

Data logs and data report packages will be located in the project file system in GeoEngineers' Spokane, Washington office. Data reports will be available in both hard copy and electronic formats. Laboratory data reports will include internal laboratory quality control checks and sample results. Data logs and packages that are anticipated to be generated during the investigation include laboratory data report packages, boring logs, field sampling data sheets, and chain-of-custody forms.

Analytical data will be supplied to GeoEngineers in both electronic data deliverable (EDD) format and hard copy format. The hard copy will serve as the official record of laboratory results. The EDDs will contain only data reported in the hard copy reports (e.g. only reportable results).

Upon receipt of the analytical data, the EDD will be uploaded to a project database and reduced into summary tables for each group of analytes and media. Upon completion of the summary tables, the accuracy of the data reduction will be verified using the hard copy of the data received from the laboratory. Any exceptions will be noted and corrections will be made. The EDD data will be submitted to Ecology's EIM system.

5.0 DATA VALIDATION AND USABILITY

Upon receipt of the sample data from the laboratory, the data will be validated and evaluated for usability in accordance with the QAPP.

6.0 REFERENCES

Puls, R.W. and Barcelona, M.J., Low-flow (minimal drawdown) ground-water sampling procedures: EPA Ground Water Issue, April 1996, p.1-9.

U.S. Environmental Protection Agency (EPA), Region 1, Low stress (low-flow) purging and sampling procedure for the collection of ground water samples from monitoring wells. EPA SOP No. GW 0001, Revision No. 2, July 30, 1996.

U.S. Environmental Protection Agency (EPA), "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846),", Revision 5, April 1998.

Washington State Department of Ecology, "Collecting and Preparing Soil Samples for VOC Analysis.", 2004.

7.0 ACRONYMS

ASTM –American Society for Testing and Materials

bgs - below ground surface

BTEX - benzene, toluene, ethylbenzene, and xylenes

DOT – Washington State Department of Transportation

GRPH – gasoline-range petroleum hydrocarbons

EDD - electronic data deliverable

EIM - Environmental Information Management

EPA -United States Environmental Protection Agency

FSDS - field sample data sheet

GPS – global positioning system

HASP - Health and Safety Plan

IDW - investigation derived waste

MTCA – Model Toxics Control Act

ntu – nephelometric turbidity units

PID -photoionization detector

PVC - polyvinyl chloride

SAP - Sampling and Analysis Plan

STP – sewage treatment plant

QAPP – Quality Assurance Project Plan

QC - quality control

UST - underground storage tank

WAC -Washington Administrative Code

VOC -volatile organic compounds

FIGURES

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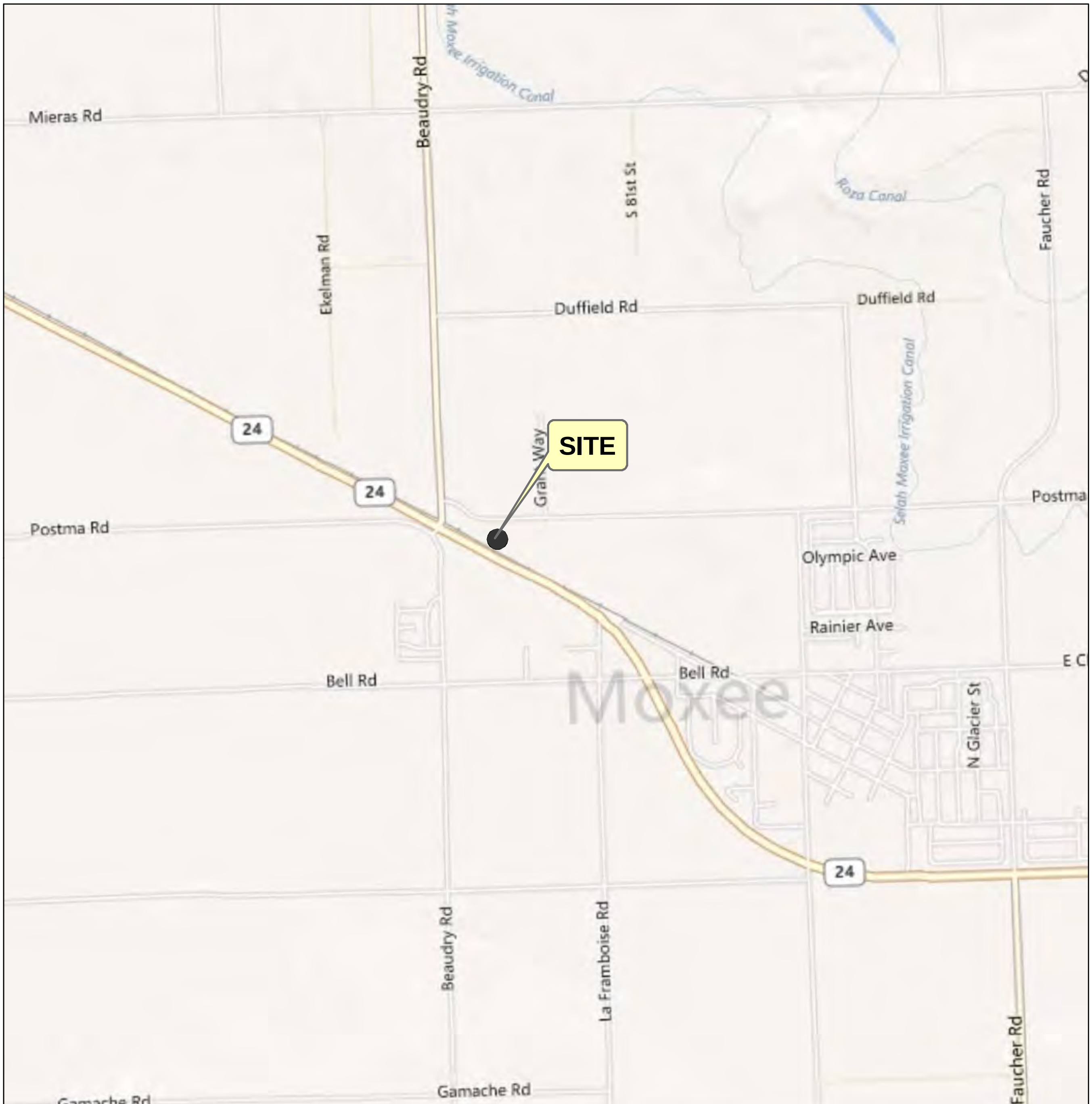

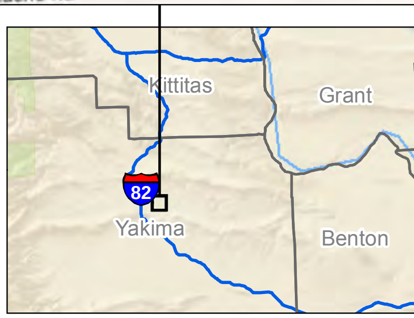

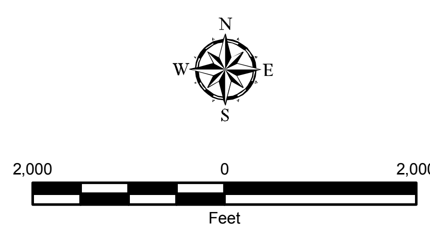

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
Data Sources: ESRI Data & Maps, Street Maps 2008.
Bing Maps Road from ESRI Data Online.
Projection: NAD 1983, UTM Zone 10 North.

Vicinity Map

Moxee City Shop & STP
Moxee, Washington

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Figure 1

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Approximate Location of 1996

Test Pits/Groundwater Samples

- Groundwater Concentrations Exceeded MTCA Method A Cleanup Levels
- Groundwater Concentrations Did Not Exceed MTCA Method A Cleanup Levels
- Approximate Location of 1996 UST Excavation

60 0 60

Feet

Notes:
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Data Sources: Bing Maps Aerial from ESRI Data Online.
Projection: NAD 1983, UTM Zone 10 North.

1996 UST Excavation and Test Pit Locations

Moxee City Shop & STP
Moxee, Washington

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Figure 2

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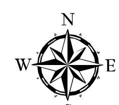
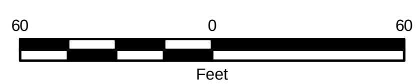


Proposed Boring Locations

Proposed Utility Locate Area

Approximate Location of 1996 UST Excavation



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Proposed Boring Locations

Moxee City Shop & STP
Moxee, Washington

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Figure 3

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APPENDICES

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Appendix A
Quality Assurance Project Plan

APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) was developed for soil and groundwater assessment activities at the Moxee City Shop and STP site, located at 7520 Postma Road in Moxee, Washington. Sampling procedures are outlined in the Sampling and Analysis Plan (SAP), of which this is Appendix A. The QAPP serves as the primary guide for the integration of quality assurance (QA) and quality control (QC) functions into assessment activities. The QAPP presents the objectives, procedures, organization, functional activities, and specific QA and QC activities designed to achieve data quality goals established for the project. This QAPP is based on guidelines specified in Chapter 173-340-820 of the Washington Administrative Code (WAC) and the Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans (EPA, 2004b).

Throughout the project, environmental measurements will be conducted to produce data that are scientifically valid, of known and acceptable quality, and meet established objectives. QA/QC procedures will be implemented so that precision, accuracy, representativeness, completeness, and comparability (PARCC) of data generated meet the specified data quality objectives.

1.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Descriptions of the responsibilities, lines of authority and communication for the key positions to QA/QC are provided below. This organization facilitates the efficient production of project work, allows for an independent quality review, and permits resolution of QA issues before submittal.

1.1. Project Leadership and Management

The Project Manager's (PM) duties consist of providing concise technical work statements for project tasks, selecting project team members, determining subcontractor participation, establishing budgets and schedules, adhering to budgets and schedules, providing technical oversight, and providing overall production and review of project deliverables. Jonathan Rudders, Licensed Hydrogeologist (LHG) is the PM for activities at the sites. The Principal-in-Charge is responsible to Ecology for fulfilling contractual and administrative control of the project. Bruce Williams is the Principal-in Charge.

1.2. Field Coordinator

The Field Coordinator is responsible for the daily management of activities in the field. Specific responsibilities include the following:

- Provides technical direction to the field staff.
- Develops schedules and allocates resources for field tasks.
- Coordinates data collection activities to be consistent with information requirements.
- Supervises the compilation of field data and laboratory analytical results.
- Assures that data are correctly and completely reported.

- Implements and oversees field sampling in accordance with project plans.
- Supervises field personnel.
- Coordinates work with on-site subcontractors.
- Schedules sample shipment with the analytical laboratory.
- Monitors that appropriate sampling, testing, and measurement procedures are followed.
- Coordinates the transfer of field data, sample tracking forms, and log books to the PM for data reduction and validation.
- Participates in QA corrective actions as required.

The Field Coordinators for RI exploration activities at the site are Katie Hall, Brent Randall, Kevin Randall, Robert Miyahira, and/or Scott Lathen.

1.3. QA Leader

The GeoEngineers project QA Leader is under the direction of Jonathan Rudders and Bruce Williams, who are responsible for the project's overall QA. The Project QA Leader is responsible for coordinating QA/QC activities as they relate to the acquisition of field data. Mark Lybeer is the QA Leader. The QA Leader has the following responsibilities:

- Serves as the official contact for laboratory data QA concerns.
- Responds to laboratory data, QA needs, resolves issues, and answers requests for guidance and assistance.
- Reviews the implementation of the QAPP and the adequacy of the data generated from a quality perspective.
- Maintains the authority to implement corrective actions as necessary.
- Reviews and approves the laboratory QA Plan.
- Evaluates the laboratory's final QA report for any condition that adversely impacts data generation.
- Ensures that appropriate sampling, testing, and analysis procedures are followed and that correct QC checks are implemented.
- Monitors subcontractor compliance with data quality requirements.

1.4. Laboratory Management

The subcontracted laboratories conducting sample analyses for this project are required to obtain approval from the QA Leader before the initiation of sample analysis to assure that the laboratory QA plan complies with the project QA objectives. The Laboratory's QA Coordinator administers the Laboratory QA Plan and is responsible for QC. Specific responsibilities of this position include:

- Ensure implementation of the QA Plan.
- Serve as the laboratory point of contact.
- Activate corrective action for out-of-control events.

- Issue the final QA/QC report.
- Administer QA sample analysis.
- Comply with the specifications established in the project plans as related to laboratory services.
- Participate in QA audits and compliance inspections.

The chemical analytical laboratory QA Coordinator will be determined after an Ecology-accredited laboratory is chosen.

1.5. Health and Safety

A site-specific Health and Safety Plan (HASP) will be used for site characterization field activities and is presented as Appendix B of the SAP. The Field Coordinator will be responsible for implementing the HASP during sampling activities. The PM will discuss health and safety issues with the Field Coordinator on a routine basis during the completion of field activities.

The Field Coordinator will conduct a tailgate safety meeting each morning before beginning daily field activities. The Field Coordinator will terminate any work activities that do not comply with the HASP. Companies providing services for this project on a subcontracted basis will be responsible for developing and implementing their own HASP. GeoEngineers will review subcontractor HASPs before commencement of their work at the site.

2.0 DATA QUALITY OBJECTIVES

The QA objective for technical data is to collect environmental monitoring data of known, acceptable, and documentable quality. The QA objectives established for the project are:

- Implement the procedures outlined herein for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting that will facilitate consistency and thoroughness of data generated.
- Achieve the acceptable level of confidence and quality required so that data generated are scientifically valid and of known and documented quality. This will be performed by establishing criteria for precision, accuracy, representativeness, completeness, and comparability, and by testing data against these criteria.

The sampling design, field procedures, laboratory procedures, and QC procedures are set up to provide high-quality data for use in this project. Specific data quality factors that may affect data usability include quantitative factors (precision, bias, accuracy, completeness, and reporting limits) and qualitative factors (representativeness and comparability). The measurement quality objectives (MQO) associated with these data quality factors are summarized in Table A-1 and are discussed below.

2.1. Analytes and Matrices of Concern

Samples of soil, groundwater, and/or soil vapor will be collected during the assessment. Tables A-2 and A-3 summarize the analyses to be performed at the site for soil and groundwater, respectively.

2.2. Detection Limits

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Individual instruments often can detect but not accurately quantify compounds at concentrations lower than the MDL, referred to as the instrument detection limit (IDL). Although results reported near the MDL or IDL provide insight to site conditions, QA dictates that analytical methods achieve a consistently reliable level of detection known as the practical quantitation limit (PQL). The contract laboratory will provide numerical results for all analytes and report them as detected above the PQL or undetected at the PQL.

Achieving a stated detection limit for a given analyte is helpful in providing statistically useful data. Intended data uses, such as comparison to numerical criteria or risk assessments, typically dictate specific project target reporting limits (TRLs) necessary to fulfill stated objectives. The PQL for site COPCs are presented in Tables A-2 and A-3 for soil and groundwater, respectively. These reporting limits were obtained from an Ecology-certified laboratory (TestAmerica, Spokane, Washington). Other criteria include State of Washington (WAC 173-201) and federal Ambient Water Quality Criteria (AWQC). The analytical methods and processes selected will provide PQLs less than the TRLs under ideal conditions. However, the reporting limits in Tables A-2 through A-3 are considered targets because several factors may influence final detection limits. First, moisture and other physical conditions of soil affect detection limits. Second, analytical procedures may require sample dilutions or other practices to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes could be reported as undetected but at a value much higher than a specified TRL. Data users must be aware that high non-detect values, although correctly reported, can bias statistical summaries and careful interpretation is required to correctly characterize site conditions.

2.3. Precision

Precision is the measure of mutual agreement among replicate or duplicate measurements of an analyte from the same sample and applies to field duplicate or split samples, replicate analyses, and duplicate spiked environmental samples (matrix spike duplicates). The closer the measured values are to each other, the more precise the measurement process. Precision error may affect data usefulness. Good precision is indicative of relative consistency and comparability between different samples. Precision will be expressed as the relative percent difference (RPD) for spike sample comparisons of various matrices and field duplicate comparisons for water samples. This value is calculated by:

$$RPD(\%) = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} X\ 100,$$

Where

D_1	=	Concentration of analyte in sample.
D_2	=	Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision can also be expressed as the percent difference (%D) between replicate analyses. Persons performing the evaluation must review one or more pertinent documents (EPA October 1999; EPA October 2004a) that address criteria exceedances and courses of action. Relative percent difference goals for this effort are 30 percent in groundwater and 40 percent in soil for all analyses, unless the duplicate sample values are within 5 times the reporting limit.

2.4. Accuracy

Accuracy is a measure of bias in the analytic process. The closer the measurement value is to the true value, the greater the accuracy. This measure is defined as the difference between the reported value versus the actual value and is often measured with the addition of a known compound to a sample. The amount of known compound reported in the sample, or percent recovery, assists in determining the performance of the analytical system in correctly quantifying the compounds of interest. Since most environmental data collected represent one point spatially and temporally rather than an average of values, accuracy plays a greater role than precision in assessing the results. In general, if the percent recovery is low, non-detect results may indicate that compounds of interest are not present when in fact these compounds are present. Detected compounds may be biased low or reported at a value less than actual environmental conditions. The reverse is true when recoveries are high. Non-detect values are considered accurate while detected results may be higher than the true value.

Accuracy will be expressed as the percent recovery of a surrogate compound (also known as “system monitoring compound”), a matrix spike (MS) result, or from a standard reference material where:

$$Recovery\,(\%) = \frac{Sample\ Result}{Spike\ Amount}\ X\ 100$$

Persons performing the evaluation must review one or more pertinent documents (EPA October 1999; EPA October 2004a) that address criteria exceedances and courses of action. Accuracy criteria for surrogate spikes, matrix spikes (MS), and laboratory control spikes (LCS) are found in Table A-1 of this QAPP.

2.5. Representativeness, Completeness and Comparability

Representativeness expresses the degree to which data accurately and precisely represent the actual site conditions. The determination of the representativeness of the data will be performed by completing the following:

- Comparing actual sampling procedures to those delineated within the SAP and this QAPP.
- Comparing analytical results of field duplicates to determine the variations in the analytical results.
- Invalidating non-representative data or identifying data to be classified as questionable or qualitative. Only representative data will be used in subsequent data reduction, validation, and reporting activities.

Completeness establishes whether a sufficient amount of valid measurements were obtained to meet project objectives. The number of samples and results expected establishes the comparative basis for completeness. Completeness goals are 90 percent useable data for samples/analyses planned. If the completeness goal is not achieved an evaluation will be made to determine if the data are adequate to meet study objectives.

Comparability expresses the confidence with which one set of data can be compared to another. Although numeric goals do not exist for comparability, a statement on comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy.

2.6. Holding Times

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Some analytical methods specify a holding time for analysis only. For many methods, holding times may be extended by sample preservation techniques in the field. If a sample exceeds a holding time, then the results may be biased low. For example, if the extraction holding time for volatile analysis of soil sample is exceeded, then the possibility exists that some of the organic constituents have volatilized from the sample or degraded. Results for that analysis will be qualified as estimated to indicate that the reported results may be lower than actual site conditions. Holding times are presented in Table A-4.

2.7. Blanks

According to the *National Functional Guidelines for Organic Data Review* (EPA 1999), "The purpose of laboratory (or field) blank analysis is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks)." Trip blanks are placed with samples during shipment; method blanks are created during sample preparation and follow samples throughout the analysis process.

Analytical results for blanks will be interpreted in general accordance with *National Functional Guidelines for Organic Data Review* and professional judgment.

3.0 SAMPLE COLLECTION, HANDLING AND CUSTODY

3.1. Sampling Equipment Decontamination

Sampling equipment decontamination procedures are described in **Section 4.6** of the SAP.

3.2. Sample Containers and Labeling

The Field Coordinator will establish field protocol to manage field sample collection, handling, and documentation. Soil and groundwater samples obtained during this study will be placed in appropriate laboratory-prepared containers. Sample containers and preservatives are listed in Table A-4.

Sample containers will be labeled with the following information at the time of collection:

- project name and number,
- sample name, which will include a reference to depth if appropriate, and
- date and time of collection.

The sample collection activities will be noted in the field log books. The Field Coordinator will monitor consistency between the SAP, sample containers/labels, field log books, and the COC.

3.3. Sample Storage

Samples will be placed in a cooler with "blue ice" or double-bagged "wet ice" immediately after they are collected. The objective of the cold storage will be to attain a sample temperature of 4 degrees Celsius. Holding times will be observed during sample storage. Holding times for the project analyses are summarized in Table A-4.

3.4. Sample Shipment

The samples will be transported and delivered to the analytical laboratory in the coolers. Field personnel will transport and hand-deliver samples that are being submitted to a local laboratory for analysis. Samples that are being submitted to an out-of-town laboratory for analysis will be transported by a commercial express mailing service on an overnight basis. The Field Coordinator will monitor that the shipping container (cooler) has been properly secured using clear plastic tape and custody seals.

Measures will be implemented to minimize the potential for sample breakage, which includes packaging materials and placing sample bottles in the cooler in a manner intended to minimize damage. Sample bottles will be appropriately wrapped with bubble wrap or other protective material before being place in coolers. Trip blanks will be included in coolers with groundwater samples.

3.5. COC Records

Field personnel are responsible for the security of samples from the time the samples are taken until the samples have been received by the shipper or laboratory. A COC form will be completed at the end of each field day for samples being shipped to the laboratory. Information to be included on the COC form includes:

- Project name and number.
- Sample identification number.
- Date and time of sampling.
- Sample matrix (soil, water, etc.) and number of containers from each sampling point, including preservatives used.
- Depth of subsurface soil sample.
- Analyses to be performed.
- Names of sampling personnel and transfer of custody acknowledgment spaces.
- Shipping information including shipping container number.

The original COC record will be signed by a member of the field team and bear a unique tracking number. Field personnel shall retain carbon copies and place the original and remaining copies in a plastic bag, placed within the cooler or taped to the inside lid of the cooler before sealing the container for shipment. This record will accompany the samples during transit by carrier to the laboratory.

3.6. Laboratory Custody Procedures

The laboratory will follow their standard operating procedures (SOPs) to document sample handling from time of receipt (sample log-in) to reporting. Documentation will include at a minimum, the analysts name or initial, time, and date.

3.7. Field Documentation

Field documentation provides important information about potential problems or special circumstances surrounding sample collection. Field personnel will maintain daily field logs while on-site. The field logs will be prepared on field report forms or in a bound logbook. Entries in the field logs and associated sample documentation forms will be made in waterproof ink, and corrections will consist of line-out deletions that are initialed and dated. Individual logbooks will become part of the project files at the conclusion of the site characterization field explorations.

At a minimum, the following information will be recorded during the collection of each sample:

- Sample location and description.
- Site or sampling area sketch showing sample location and measured distances.
- Sampler's name(s).
- Date and time of sample collection.
- Designation of sample as composite or discrete.
- Type of sample (soil or water).
- Type of sampling equipment used.
- Field instrument readings.
- Field observations and details that are pertinent to the integrity/condition of the samples (e.g., weather conditions, performance of the sampling equipment, sample depth control, sample disturbance, etc.).
- Preliminary sample descriptions (e.g., lithologies, noticeable odors, colors, field-screening results).
- Sample preservation.
- Shipping arrangements (overnight air bill number).
- Name of recipient laboratory.

In addition to the sampling information, the following specific information also will be recorded in the field log for each day of sampling:

- Team members and their responsibilities.
- Time of arrival/entry on Site and time of Site departure.
- Other personnel present at the site.
- Summary of pertinent meetings or discussions with regulatory agency or contractor personnel.
- Deviations from sampling plans, Site safety plans, and QAPP procedures.
- Changes in personnel and responsibilities with reasons for the changes.
- Levels of safety protection.
- Calibration readings for any equipment used and equipment model and serial number.

The handling, use, and maintenance of field log books are the field coordinator's responsibilities.

4.0 CALIBRATION PROCEDURES

4.1. Field Instrumentation

Equipment and instrumentation calibration facilitates accurate and reliable field measurements. Field and laboratory equipment used on the project will be calibrated and adjusted in general accordance with the manufacturer's recommendations. Methods and intervals of calibration and maintenance will be based on the type of equipment, stability characteristics, required accuracy, intended use, and environmental conditions. The basic calibration frequencies are described below.

The photoionization detector (PID) or flame-ionization detector (FID) used for vapor measurements will be calibrated daily, if required (based on the model used), for site safety monitoring purposes in general accordance with the manufacturer's specifications. If daily calibration is not required for a specific PID or FID model, calibration of the PID will be checked to make sure it is up to date. The calibration results will be recorded in the field logbook.

The water quality measuring system will be calibrated prior to each monitoring event in general accordance with the manufacturer's specifications. The calibration results will be recorded in the field report.

4.2. Laboratory Instrumentation

For analytical chemistry, calibration procedures will be performed in general accordance with the methods cited and laboratory standard operating procedures. Calibration documentation will be retained at the laboratory and readily available for a period of six months.

5.0 DATA REPORTING AND LABORATORY DELIVERABLES

Laboratories will report data in formatted hardcopy and digital form. Analytical laboratory measurements will be recorded in standard formats that display, at a minimum, the field sample identification, the laboratory identification, reporting units, qualifiers, analytical method, analyte tested, analytical result, extraction and analysis dates, and detection limit (PQL only). Each sample delivery group will be accompanied by sample receipt forms and a case narrative identifying data quality issues. Laboratory EDD will be established by GeoEngineers, Inc., with the contract laboratory. Final results will be sent to the PM.

Chromatograms will be provided for samples analyzed by Northwest Methods NWTPH-Gx. The laboratory will assure that the full heights of all peaks appear on the chromatograms and that the same horizontal time scale is used to allow for comparisons to other chromatograms.

6.0 INTERNAL QC

Table A-5 summarizes the types and frequency of QC samples to be collected during the site characterization, including both field QC and Laboratory QC samples.

6.1. Field QC

Field QC samples serve as a control and check mechanism to monitor the consistency of sampling methods and the influence of off-site factors on environmental samples. Off-site factors include airborne volatile organic compounds and potable water used in drilling activities.

6.1.1. Field Duplicates

In addition to replicate analyses performed in the laboratory, field duplicates also serve as measures for precision. Under ideal field conditions, field duplicates (referred to as splits), are created when a volume of the sample matrix is thoroughly mixed, placed in separate containers, and identified as different samples. This tests both the precision and consistency of laboratory analytical procedures and methods, and the consistency of the sampling techniques used by field personnel.

One field duplicate will be collected during groundwater sampling. The duplicate sample will be analyzed for the COPCs specified for the given sample location or well.

6.1.2. Trip Blanks

Trip blanks accompany groundwater sample containers used for VOC analyses during shipment and sampling periods. Trip blanks will be analyzed on a one per cooler basis.

6.2. Laboratory QC

Laboratory QC procedures will be evaluated through a formal data validation process. The analytical laboratory will follow standard method procedures that include specified QC monitoring requirements. These requirements will vary by method but generally include:

- method blanks
- internal standards
- calibrations
- MS/matrix spike duplicates MSD)
- LCS/laboratory control spike duplicates (LCSD)

- laboratory replicates or duplicates
- surrogate spikes

6.2.1. Laboratory Blanks

Laboratory procedures employ the use of several types of blanks but the most commonly used blank for QA/QC assessments are method blanks. Method blanks are laboratory QC samples that consist of either a soil like material having undergone a contaminant destruction process or high performance liquid chromatography (HPLC) water. Method blanks are extracted and analyzed with each batch of environmental samples undergoing analysis. Method blanks are particularly useful during volatiles analysis since VOCs can be transported in the laboratory through the vapor phase. If a substance is found in the method blank then one (or more) of the following occurred:

- Measurement apparatus or containers were not properly cleaned and contained contaminants.
- Reagents used in the process were contaminated with a substance(s) of interest.
- Contaminated analytical equipment was not properly cleaned.
- Volatile substances in the air with high solubility or affinities toward the sample matrix contaminated the samples during preparation or analysis.

It is difficult to determine which of the above scenarios took place if blank contamination occurs. However, it is assumed that the conditions that affected the blanks also likely affected the project samples. Given method blank results, validation rules assist in determining which substances in samples are considered "real," and which ones are attributable to the analytical process. Furthermore, the guidelines state, ". . . there may be instances where little or no contamination was present in the associated blank, but qualification of the sample is deemed necessary. Contamination introduced through dilution water is one example."

6.2.2. Calibrations

Several types of calibrations are used, depending on the method, to determine whether the methodology is 'in control' by verifying the linearity of the calibration curve and to assure that the sample results reflect accurate and precise measurements. The main calibrations used are initial calibrations, daily calibrations, and continuing calibration verification.

6.2.3. MS/MSD

MS/MSD samples are used to assess influences or interferences caused by the physical or chemical properties of the sample itself. For example, extreme pH affects the results of semivolatile organic compounds (SVOCs). Or, the presence of a particular compound may interfere with accurate quantitation of another analyte. MS/MSD data is reviewed in combination with other QC monitoring data to determine matrix effects. In some cases, matrix affects cannot be determined due to dilution and/or high levels of related substances in the sample. A MS is evaluated by spiking a known amount of one or more of the target analytes ideally at a concentration of 5 to 10 times higher than the sample result. A percent recovery is calculated by subtracting the sample result from the spike result, dividing by the spiked amount, and multiplying by 100.

The samples for the MS and MSD analyses should be collected from a boring or sampling location that is believed to exhibit low-level contamination. A sample from an area of low-level contamination is needed because the objective of MS/MSD analyses is to determine the presence of matrix interferences, which can best be achieved with low levels of contaminants. Additional sample volume will be collected for these analyses. This MS/MSD sample will be a composite to achieve a level of representativeness and reproducibility in the data.

6.2.4. LCS/LCSD

Also known as blanks spikes, LCSs are similar to MSs in that a known amount of one or more of the target analytes are spiked into a prepared media and a percent recovery of the spiked substances are calculated. The primary difference between a MS and LCS is that the LCS media is considered “clean” or contaminant free. For example, HPLC water is typically used for LCS water analyses. The purpose of an LCS is to help assess the overall accuracy and precision of the analytical process including sample preparation, instrument performance, and analyst performance. LCS data must be reviewed in context with other controls to determine if out-of-control events occur.

6.2.5. Laboratory Replicates/Duplicates

Laboratories often utilize MS/MSDs, LCS/LCSDs, and/or replicates to assess precision. Replicates are a second analysis of a field collected environmental sample. Replicates can be split at varying stages of the sample preparation and analysis process, but most commonly occur as a second analysis on the extracted media.

6.2.6. Surrogate Spikes

The purposes of using a surrogate are to verify the accuracy of the instrument being used and extraction procedures. Surrogates are substances similar to, but not one of, the target analytes. A known concentration of surrogate is added to the sample and passed through the instrument, noting the surrogate recovery. Each surrogate used has an acceptable range of percent recovery. If a surrogate recovery is low, sample results may be biased low and depending on the recovery value, a possibility of false negatives may exist. Conversely, when recoveries are above the specified range of acceptance a possibility of false positives exist, although non-detected results are considered accurate.

7.0 DATA REDUCTION AND ASSESSMENT PROCEDURES

7.1. Data Reduction

Data reduction involves the conversion or transcription of field and analytical data to a useable format. The laboratory personnel will reduce the analytical data for review by the QA Leader and PM.

7.2. Field Measurement Evaluation

Field data will be reviewed at the end of each day by following the QC checks outlined below and procedures in the SAP. Field data documentation will be checked against the applicable criteria as follows:

- Sample collection information.
- Field instrumentation and calibration.
- Sample collection protocol.
- Sample containers, preservation and volume.
- Field QC samples collected at the frequency specified.
- Sample documentation and COC protocols.
- Sample shipment.

Cooler receipt forms and sample condition forms provided by the laboratory will be reviewed for out-of-control incidents. The final report will contain what effects, if any, an incident has on data quality. Sample collection information will be reviewed for correctness before inclusion in a final report.

7.3. Field QC Evaluation

A field QC evaluation will be conducted by reviewing field log books and daily reports, discussing field activities with staff, and reviewing field QC samples (trip blanks and field duplicates). Trip blanks will be evaluated using the same criteria as method blanks.

Precision for field duplicate soil samples will not be evaluated because even a well mixed sample is not entirely homogenous due to sampling procedures, soil conditions, and contaminant transport mechanisms.

7.4. Laboratory Data QC Evaluation

The laboratory data assessment will consist of a formal review of the following QC parameters:

- Holding times
- Method blanks
- MS/MSD
- LCS/LCSD
- Surrogate spikes
- Replicates

In addition to these QC mechanisms, other documentation such as cooler receipt forms and case narratives will be reviewed to fully evaluate laboratory QA/QC.

8.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 1998. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). Revision 5. April.

U.S. Environmental Protection Agency (EPA). 1999. Contract Laboratory Program National Functional Guidelines for Organic Data Review. 540/R-99/008.

U.S. Environmental Protection Agency (EPA). 2004a. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. 540/R-04/004.

U.S. Environmental Protection Agency (EPA). 2004b. EPA Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. EPA 04-03-030.

Washington State Department of Ecology (Ecology), 1997. Analytical Methods for Petroleum Hydrocarbons. Publication No. ECY 97-602. June.

Table A-1

Measurement Quality Objectives

Moxee City Shop & STP

Moxee, Washington

		Check Standard (LCS) %R Limits[2,3]			Matrix Spike (MS) %R Limits[3]			Surrogate Standards (SS) %R Limits [1,2,3]		MSD Samples or Lab Duplicate (Dup) RPD Limits[4]			Field Duplicate Samples RPD Limits[4]
Laboratory Analysis	**Reference Method**	**Soil**	**Water**	**Soil Vapor**	**Soil**	**Water**	**Soil Vapor**	**Soil/Water**	**Soil Vapor**	**Soil**	**Water**	**Soil Vapor**	**Water**
Gasoline-range Petroleum Hydrocarbons	Ecology NWTPH-Gx EPA TO3 (soil vapor)	74.4%-124%	80%-120%	80%-125%	50%-133%	55.6%-126%	NA	50%-150% (soil) 37.9%-162% (water)	NA	≤20% (MSD) ≤32.3% (Dup)	≤20% (MSD) ≤35% (Dup)	NA	≤20%
Volatile Organic Compounds (VOC)	EPA 8260B EPA TO3 (soil vapor)	50%-150%	47.1%-150%	65%-125%	50%-150%	44.3%-150%	NA	66.5%-145% (water) 57.7%-149% (soil)	NA	≤29.8% (MSD) ≤20% (Dup)	≤15.7% (MSD) ≤20% (Dup)	NA	≤20%
Napththalenes	EPA 8270	40%-120%	40%-130%	NA	30%-120%	35%-125%	NA	30%-150%	NA	≤20%	≤20%	NA	≤20%
Ethylene Dibromide (EDB)	EPA 8011	60%-140	60%-140%	NA	60%-140%	60%-140%	NA	NA	NA	≤20%	≤20%	NA	≤20%
Lead	EPA 6010C	80%-120%	80%-120%	NA	75%-125%	75%-125%	NA	NA	NA	≤20%	≤20%	NA	≤20%
Volatile Petroleum Hydrocarbons (VPH)	NWTPH-VPH	70%-130%	70%-130%	NA	70%-130%	70%-130%	NA	60%-140%	NA	≤25%	≤25%	NA	≤20%
Extractable Petroleum Hydrocarbons (EPH)	NWTPH-EPH	50%-150%	50%-150%	NA	50%-150%	50%-150%	NA	60%-140%	NA	≤25%	≤25%	NA	≤20%

Notes:

[1] Individual surrogate recoveries are compound specific.

[2] Recovery Ranges are estimates. Actual ranges will be provided by the laboratory when contracted.

[3] Percent Recovery Limits are expressed as ranges based on laboratory control limits. Limits will vary for individual analytes.

[4] RPD control limits are only applicable if the concentration are greater than 5 times the method reporting limit (MRL). For results less than 5 times the MRL, the difference between the sample and duplicate must be less than 2X the MRL for soils and 1X the MRL for waters.

Method numbers refer to EPA SW-846 Analytical Methods or Washington State Department of Ecology (Ecology) recommended analytical methods.

VOCs = Volatile Organic Compounds: %R = percent recovery; LCS = Laboratory Control Sample; MS/MSD = Matrix Spike/Matrix Spike Duplicate; RPD = Relative Percent Difference; NA = Not Applicable

https://projects.geoengineers.com/sites/0050407800/Final/Report/SAP/[City Shop Table A-1.xlsx]Table A-1

Table A-2

Methods of Analysis and Practical Quantitation Limits (Soil)

Moxee City Shop & STP

Moxee, Washington

Analyte	Analytical Method	Practical Quantitation Limit (mg/kg)	MTCA Method A Cleanup Level (mg/kg)
Total Petroleum Hydrocarbons			
TPH-Gasoline Range	NWTPH-Gx	5	100/30[1]
EPH	NWTPH-EPH	Varies	Varies
VPH	NWTPH-VPH	Varies	Varies
Volatile Organic Compounds			
Benzene	EPA 8260B	0.015	0.03
Toluene	EPA 8260B	0.100	7
Ethylbenzene	EPA 8260B	0.100	6
M+P Xylene	EPA 8260B	0.400	9[2]
O-Xylene	EPA 8260B	0.200	9[2]
Methyl T-Butyl Ether (MTBE)	EPA 8260B	0.030	0.1
n-hexane	EPA 8260B	0.040	NE
Naphthalenes	EPA 8260B or 8270 SIM	0.200	5 [3]
1 & 2 Methyl Naphthalene	EPA 8270 SIM	0.010	5 [3]
EDC	EPA 8260B	0.100	NE
EDB	EPA 8011	0.001	0.005
Metals			
Lead	EPA 6010C	1.50	250

Notes:

[1] MTCA Method A cleanup level for gasoline-range hydrocarbons is 100 mg/kg if benzene is not detected and the total concentration of ethylenzene, toluene and xylenes are less than 1 percent of the gasoline mixture; otherwise the cleanup level is 30 mg/kg.

[2] Cleanup level for total xylenes.

[3] Cleanup level refers to the sum of naphthalenes.

Practical quantitation limits (PQLs) based on information provided by TestAmericaLaboratories.

mg/kg = milligrams per kilogram; NE = Not established

https://projects.geoengineers.com/sites/0050407800/Final/Report/SAP/[City Shop Table A-2.xlsx]Table A-2

Table A-3

Methods of Analysis and Target Reporting Limits (Groundwater)

Moxee City Shop & STP
Moxee, Washington

Analyte	Analytical Method	Practical Quantitation Limit (µg/l)	MTCA Method A Cleanup Levels (µg/l)
Total Petroleum Hydrocarbons			
TPH-Gasoline Range	NWTPH-Gx	100	1,000/800[1]
Volatile Organic Compounds			
Benzene	EPA 8260B	0.2	5
Toluene	EPA 8260B	0.5	1,000
Ethylbenzene	EPA 8260B	0.5	700
M+P Xylene	EPA 8260B	0.5	1,000[2]
O-Xylene	EPA 8260B	0.5	1,000[2]
Methyl T-Butyl Ether (MTBE)	EPA 8260B	0.5	20
n-hexane	EPA 8260B	1.0	NE
Napthalene	EPA 8260B/8270SIM	2.0	160 [3]
1 & 2 Methyl Naphthalene	EPA 8270 SIM	0.1	160 [3]
EDC	EPA 8260B	0.5	5
EDB	EPA 8011	0.01	0.01
Metals			
Lead	EPA 6010C	15	15

Notes:

[1]MTCA Method A cleanup level for gasoline-range petroleum hydrocarbons is 1,000 µg/l if benzene is not detected and the total concentrations of ethylbenzene, toluene and xylenes are less than 1 percent of the gasoline mixture; otherwise the cleanup level is 800 µg/l.

[2]Cleanup level for total xylenes

[3]Cleanup level refers to the sum of naphthalenes

Practical quantitation limist (PQLs) based on information provided by TestAmericaLaboratories.

µg/l = micrograms per liter; NE = not established

https://projects.geoengineers.com/sites/0050407800/Final/Report/SAP/[City Shop Table A-3.xlsx]Table A-3

Table A-4

Test Methods, Sample Containers, Preservation and Holding Time[1]

Moxee City Shop & STP

Moxee, Washington

Analysis	Method	Soil				Groundwater			
		Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times	Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times
Gasoline-Range Hydrocarbons [2]	NWTPH-Gx	30 g	2 pre-weighed 40 ml voa vials preserved with MeOH; 4 oz jar (for dry-weight correction)	MeOH; Cool 4°C	14 days from collection to analysis	80 mL	2 - 40 mL VOA Vials	Cool 4 C, HCl to pH < 2	14 days preserved 7 days unpreserved
VOCs [2, 3]	EPA 8260B	30 g	2 pre-weighed 40 ml voa vials preserved with MeOH; 4 oz jar (for dry-weight correction)	MeOH; Cool 4°C	14 days from collection to analysis	80 mL	2 - 40 mL VOA Vials	Cool 4 C, HCl to pH < 2	14 days preserved 7 days unpreserved
1 & 2 Methyl Naphthalene	EPA 8270 SIM	30g	4 or 8 oz glass wide-mouth with Teflon-lined lid	Cool 4°C	14 days	1000 mL	1L Amber	Cool 4°C	7 days
Lead	EPA 6010C	10g	4 or 8 oz glass wide-mouth with Teflon-lined lid	NA	180 days	50ml	1 - 500 or 250ml poly	HNO3 to pH <2	180 days
EDB	EPA 8011	40g	4 or 8 oz glass wide-mouth with Teflon-lined lid	Cool 4°C	14 days	80 ml	2- - voa vials (a minimum of 2 voa vials but 4 is preferred)	Cool 4°C	7 days
VPH	NWTPH-VPH	20g	2 pre-weighed 40 ml voa vials preserved with MeOH; 4 oz jar (for dry-weight correction)	MeOH; Cool 4°C	14 days	NA	NA	NA	NA
EPH	NWTPH-EPH	40g	4 or 8 oz glass wide-mouth with Teflon-lined lid	Cool 4°C	14 days	NA	NA	NA	NA

Notes:

[1] Holding Times are based on elapsed time from date of collection

[2] For both soil and water the gasoline range hydrocarbons and VOCs can be combined and do not require separate containers

[3] VOCs = Volatile organic compounds (to include naphthalene, ethylene dibromide (EDB), 1,2-dichloroethane (EDC), n-hexane, and methyl tert butyl ether (MTBE).

HCl = Hydrochloric Acid; HNO_s = Nitric Acid; VOA = volatile organic analyte; oz. = ounce; mL = millilieter; L = liter; g = gram; NA = not applicable

https://projects.geoengineers.com/sites/0050407800/Final/Report/SAP/[City Shop Table A-4.xlsx]Table A-4

Table A-5

Quality Control Samples Type and Frequency

Moxee City Shop & STP
Moxee, Washington

Parameter	Field QC		Laboratory QC			
	Field Duplicates	Trip Blanks	Method Blanks	LCS	MS / MSD	Lab Duplicates
Gasoline Range Hydrocarbons	1/20 groundwater samples	NA	1/batch	1/batch	1/batch	1/batch
BTEX	1/20 groundwater samples	1/cooler	1/batch	1/batch	1 set/batch	1/batch
VOCs	1/20 groundwater samples	1/cooler	1/batch	1/batch	1 set/batch	NA
EDB	1/20 groundwater samples	1/cooler	1/batch	1/batch	1/batch	NA
Napthalenes	1/20 groundwater samples	NA	1/batch	1/batch	1/batch	NA
Lead	1/20 groundwater samples	NA	1/batch	1/batch	1/batch	1/batch
EPH	NA	NA	1/batch	1/batch	1/batch	NA
VPH	NA	NA	1/batch	1/batch	1/batch	NA

Note:

An analytical lot or batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS, and MS/ MSD (or MS and lab duplicate). No more than 20 field samples can be contained in one batch.

LCS = Laboratory control sample; MS = Matrix spike sample; MSD = Matrix spike dupblicate sample; VOCs = volatile organic compounds;

BTEX = benzene, toluene, ethylbenzene, xylenes

NA = Not applicable

https://projects.geoengineers.com/sites/0050407800/Final/Report/SAP/[City Shop Table A-5.xlsx]Table A-5

APPENDIX B
Health and Safety Plan

APPENDIX B
HEALTH AND SAFETY PLAN

This Health and Safety Plan (HASP) is to be used in conjunction with the GeoEngineers Safety Program Manual. Together, the written safety programs and this HASP constitute the site safety plan for this site. This plan is to be used by GeoEngineers personnel on this site and must be available on site. If the work entails potential exposures to other substances or unusual situations, additional safety and health information will be included and the plan will be approved by the GeoEngineers Health and Safety Manager. All plans are to be used in conjunction with current standards and policies outlined in the GeoEngineers Health and Safety Program Manual.

TABLE 1. GENERAL PROJECT INFORMATION

Project Name:	**Moxee City Shop and STP**
Project Number:	00504-078-00
Type of Project:	Soil and Groundwater Assessment
Project Address:	7520 Postma Road, Moxee, WA
Start/Completion:	January 2012; June 30, 2012
Subcontractors:	Environmental West

Liability Clause - This Site Safety Plan is intended for use by GeoEngineers Employees only. It does not extend to the other contractors or subcontractors working on this site. If requested by subcontractors, this site safety plan may be used as a minimum guideline for those entities to develop safety plans or procedures for their own staff to work under. In this case, Form 3 shall be signed by the subcontractor.

All personnel participating in this project must receive initial health and safety orientation (Form 1). Thereafter, brief tailgate safety meetings will be held as deemed necessary by the Site Safety and Health Supervisor.

The orientation and the tailgate safety meetings shall include a discussion of emergency response, site communications and site hazards.

TABLE 2. ORGANIZATION CHART

Chain of Command	Title	Name	Telephone Numbers
1	Project Manager	Jonathan Rudders	O: (509)363-3125 C: (509) 993-4053
2	Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) Supervisor	Bruce Williams	O: (509)363-3125 C: (509) 954-6614

Chain of Command	Title	Name	Telephone Numbers
3	Field Engineer/Geologist	Scott Lathen Kevin Randall Katie Hall	O: 509.363.3125 C: 509.251.5239 O: 509.363.3125 C: 435.764.7169 O: 509.363.3125 C: 509.768.3579
4	Site Safety and Health Supervisor (Site Safety Officer; [SSO])	Scott Lathen	See above
5	Client Assigned Site Supervisor	Bruce Williams	509.363.3125
6	Health and Safety Program Manager (HSM)	Wayne Adams	O: 425.861.6000 C: 253.350.4387
N/A	Subcontractor(s)	Environmental West	O: 509.534.2740
	Current Owner		

SITE SAFETY AND HEALTH SUPERVISOR

The individual present at a hazardous waste site responsible to the employer and who has the authority and knowledge necessary to establish the site-specific health and safety plan and verify compliance with applicable safety and health requirements.

GeoEngineers employees often do not have stop work authority on projects controlled by other contractors; however, any GeoEngineers employee, regardless of job title, working in the field will be responsible for contacting the Project Manager if they observe practices on the job site that are serious safety violations that are not under their control. They will document the unsafe practices and will contact the site supervisor as identified by the client. If no one is on site, the Project Manager, once notified, will contact the client. This action establishes GeoEngineers commitment to site health and safety on all job sites as our duty of care to the public, contractors, and clients.

TABLE 3. PERSONNEL TRAINING RECORDS

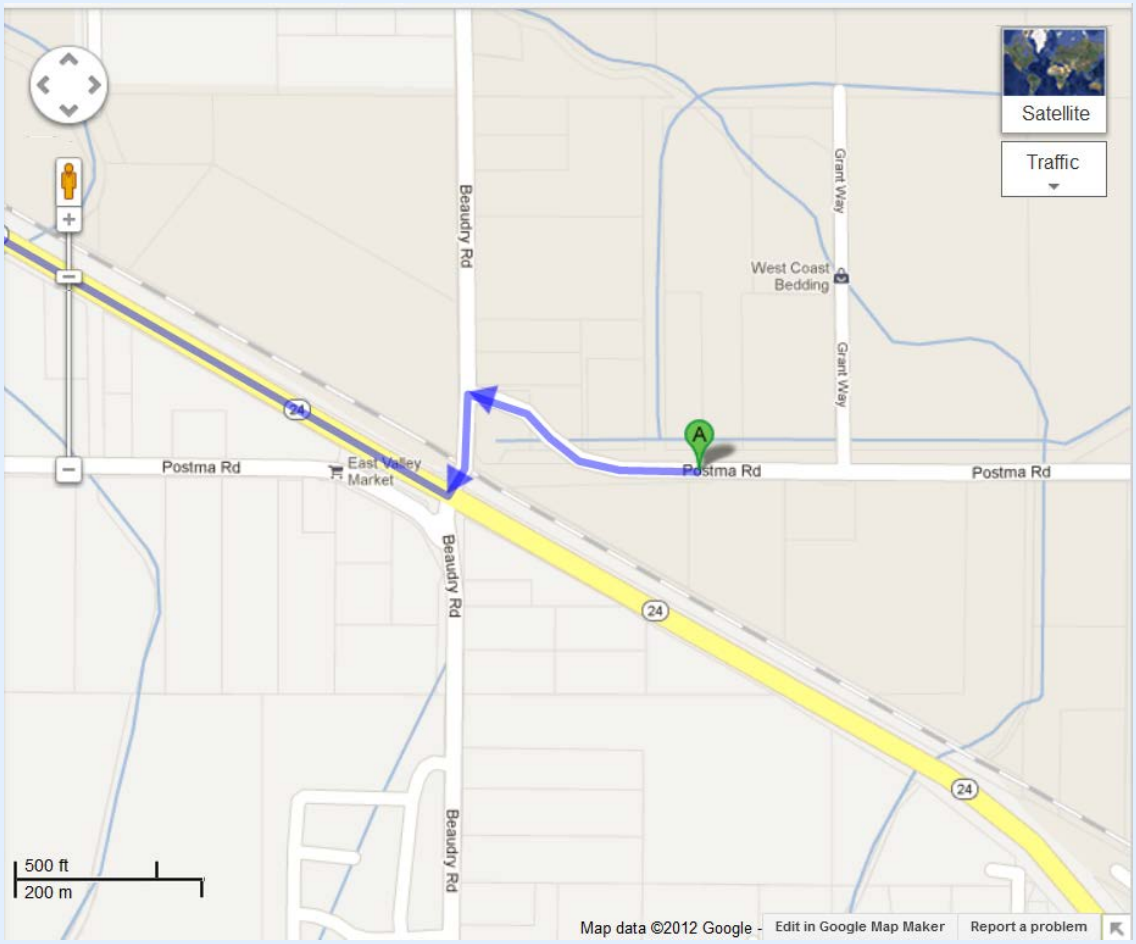
Name of Employee On Site	Level of HAZWOPER Training (24-/40-hr)	Date of 8-Hr Refresher Training	Date of HAZWOPER Supervisor Training	First Aid/ Cardiopulmonary Resuscitation (CPR)	Date of Other Trainings	Date of Respirator Fit Test
Scott Lathen	40-hr	02/11		Current		Current
Kevin Randall	40-hr	02/11		Current		Current
Katie Hall	40-hr			Current		NA

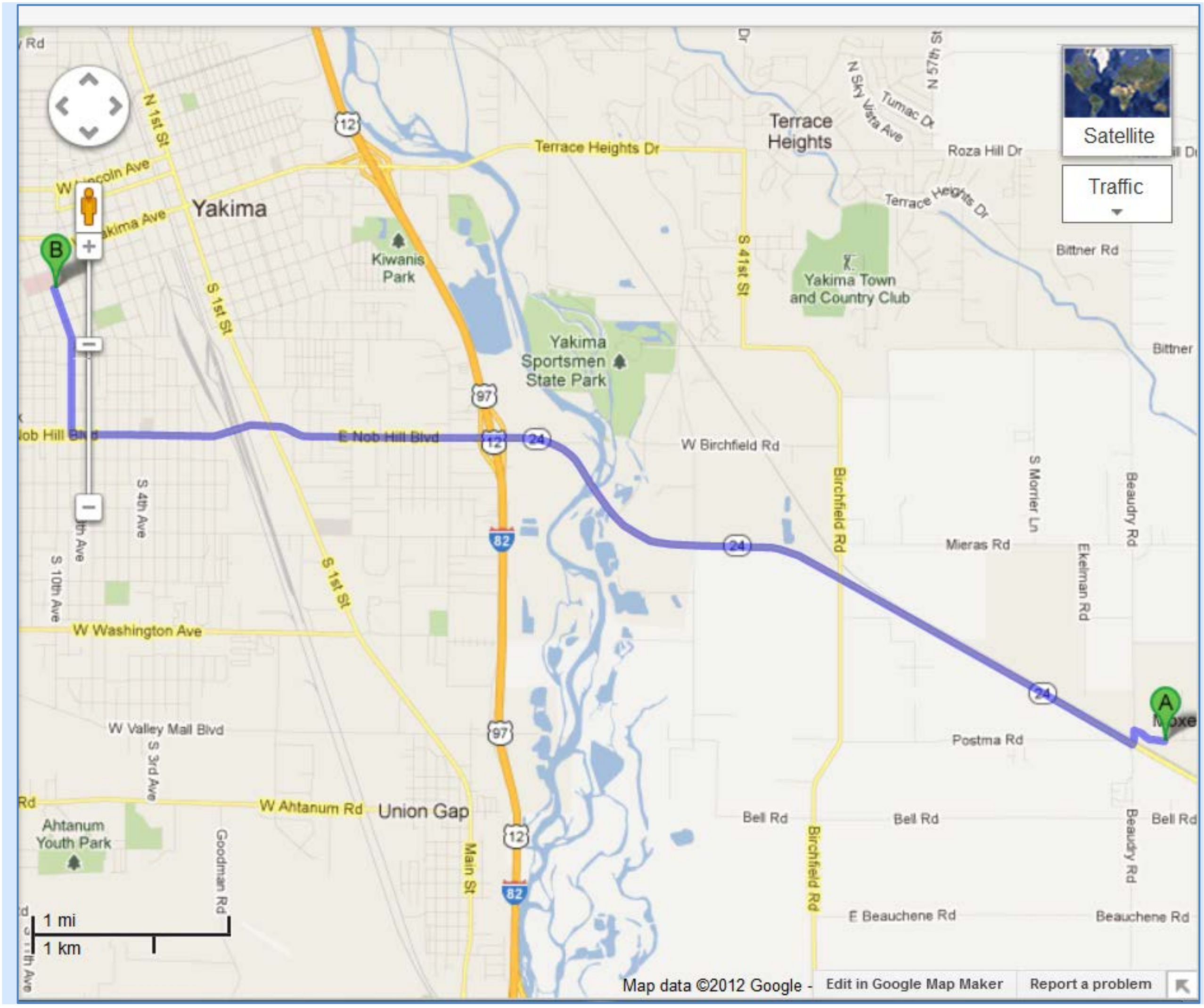
TABLE 4. EMERGENCY INFORMATION

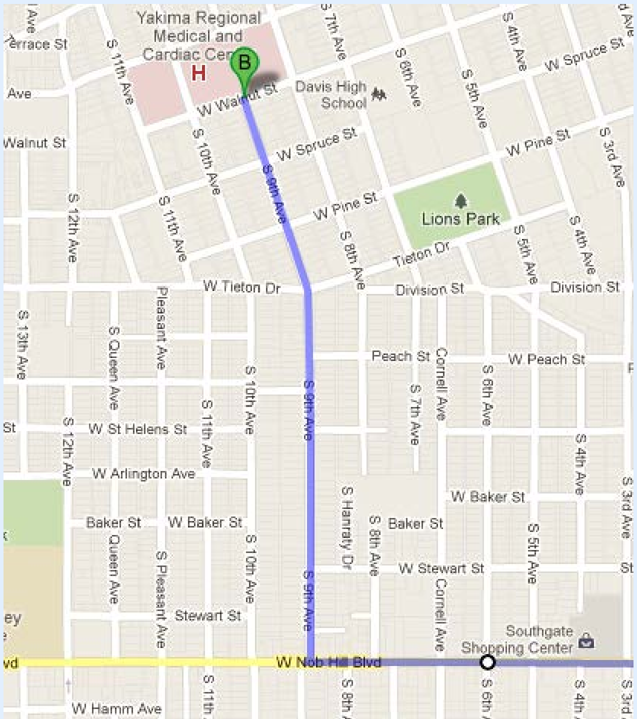
Hospital Name and Address:	Yakima Regional Medical & Cardiac Center 110 South 9th Avenue Yakima, WA 98902-3315
Phone Numbers (Hospital ER):	(509) 663-8711
Distance:	8.4 miles

Route to Hospital:

7. Head west on Postma Rd toward Beaudry Rd
8. Turn left onto Beaudry Rd.
9. Take the 1st right onto WA-24 W
10. Continue onto E Nob Hill Blvd.
11. Turn right onto S 9th Ave. Hospital will be on the right.




Yakima
Terrace Heights
Terrace Heights Dr
Kiwanis Park
Yakima Sportsmen State Park
Yakima Town and Country Club
E Nob Hill Blvd
W Birchfield Rd
Birchfield Rd
Mieras Rd
W Washington Ave
W Valley Mall Blvd
W Ahtanum Rd
Union Gap
Ahtanum Youth Park
Postma Rd
Bell Rd
E Beauchene Rd
Beauchene Rd
Satellite
Traffic
1 mi
1 km
Map data ©2012 Google



Ambulance:	9.1.1
Poison Control:	800.732.6985
Police:	9.1.1
Fire:	9.1.1
Location of Nearest Telephone:	Cell phones are carried by field personnel.
Nearest Fire Extinguisher:	Located in the GeoEngineers' vehicle on site.
Nearest First-Aid Kit:	Located in the GeoEngineers' vehicle on site.

STANDARD EMERGENCY PROCEDURES

1. Get help
    a. send another worker to phone 911 (if necessary)
    b. as soon as feasible, notify GeoEngineers' project manager
2. Reduce risk to injured person
    a. turn off equipment
    b. move person from injury location (if possible)
    c. keep person warm
    d. perform CPR (if necessary)

3. Transport injured person to medical treatment facility (if necessary)
    a. by ambulance (if necessary) or GeoEngineers vehicle
    b. stay with person at medical facility
    c. keep GeoEngineers manager apprised of situation and notify human resources manager of situation

COMPREHENSIVE WORK PLAN

- Contact the one-call utility locate service
- Collect soil samples from direct-push borings.
- Collect soil vapor samples if readings from the photoionization detector (PID) indicates the soil-vapor pathway poses a threat to human health.
- Construct two groundwater monitoring wells.
- Collect water level measurements at site monitoring wells.
- Sample the monitoring wells using low-flow methods.
- Soil and/or groundwater samples will be submitted for laboratory analysis of one or more of the following: gasoline-range-petroleum hydrocarbons (GRPH); benzene toluene, ethylbenzene, xylenes (BTEX), 1,2-dibromoethane (EDB), 1,2-dichloroethane (EDC), methyl tertiary-butyl ether (MTBE) and n-hexane; naphthalenes; and lead. Two soil samples will be analyzed for fractionalized petroleum hydrocarbons (aliphatics and aromatics).

TABLE 5. LIST OF FIELD ACTIVITIES

Check the Activities to be Completed during the Project	
X	Site reconnaissance
X	Exploratory borings
	Construction monitoring
X	Surveying
	Test pit exploration
X	Monitor well installation
X	Monitor well development
X	Soil sample collection
X	Field screening of soil samples
	Soil Vapor measurements
	Soil Vapor sampling
X	Groundwater sampling
X	Groundwater depth
X	Product sample measurement (if any)

Check the Activities to be Completed during the Project	
	Soil stockpile testing
	Remedial excavation
	UST removal monitoring
	Remediation system monitoring
	Recovery of free product

HAZARD ANALYSIS

Note: A hazard assessment will be completed at every site prior to beginning field activities. Updates will be included in the daily log. This list is a summary of hazards listed on the form.

TABLE 6. PHYSICAL HAZARDS

X	Drill rigs
X	Overhead hazards/power lines
X	Tripping/puncture hazards
X	Snow, rain, ice, freezing temperatures
X	Heat/ Cold, Humidity
X	Utilities/ utility locate
X	Contaminated soil
X	Contaminated groundwater
X	Loud noise
	Backhoe
	Trackhoe
	Crane
	Front End Loader
	Excavations/trenching (1:1 slopes for Type B soil)
	Shored/braced excavation if greater than 4 feet of depth

- Utility check list completed—there may be site specific procedures for preventing drilling or digging into utilities. Add these procedures to the standard GeoEngineers utility check list.
- Lifting hazards: use proper techniques, mechanical devices where appropriate.
- Terrain obstacles: Terrain could be soft and activities will be conducted to minimize lawn damage and the potential for vehicles to get stuck.
- Personnel will wear high-visibility vests for increased visibility by vehicle and equipment operators.
- Field personnel will be aware constantly of the location and motion of heavy equipment. A safe distance will be maintained between personnel and the equipment. Personnel will be visible to

the operator at all times and will remain out of the swing and/or direction of the equipment apparatus. Personnel will approach operating heavy equipment only when they are certain the operator has indicated it is safe to do so.

- Heavy equipment and/or vehicles used on this site will not work within 20 feet of overhead utility lines without first ensuring that the lines are not energized. This distance may be reduced to 10 feet depending on the client and the use of a safety watch.
- Overhead Power Line Clearance Safety-Working equipment around overhead power lines requires distance and a spotter. Before a job begins, call the utility company and find out voltage in lines. Have the equipment de-energized if possible. Ensure that the equipment remains de-energized by using some type of lockout and tag procedure, and ensure that the electrician uses grounding lines when they are required.
- Keep a safe distance from energized parts which is a minimum of 10 feet for 50 kilovolt (kV) and under. The minimum distance will be more for higher voltages (above 50kV). The only exception is for trained and qualified electrical workers using insulated tools designed for high voltage lines.
- Don't operate equipment around overhead power lines unless you are authorized and trained to do so. If an object (scaffolds, crane, etc.) must be moved in the area of overhead power lines, appoint a competent worker whose sole responsibility is to observe the clearance between the power lines and the object. Warn others if the minimum distance is not maintained.
- Never touch an overhead line if it has been brought down by machinery or has fallen. Never assume lines are dead. When a machine is in contact with an overhead line, DO NOT allow anyone to come near or touch the machine. Stay away from the machine and summon outside assistance. Never touch a person who is in contact with a live power line.
- If you are in a vehicle that is in contact with an overhead power line, DON'T LEAVE THE VEHICLE. As long as you stay inside and avoid touching metal on the vehicle, you may avoid an electrical hazard. If you need to get out to summon help or because of fire, jump out without touching any wires or the machine, keep your feet together, and hop to safety.
- When mechanical equipment is being operated near overhead power lines, employees standing on the ground may not contact the equipment unless it is located so that the required clearance cannot be violated even at the maximum reach of the equipment.
- When working near overhead power lines, the use of nonconductive wooden or fiberglass ladders is recommended. Aluminum ladders and metal scaffolds or frames are efficient conductors of electricity.
- Avoid storing materials under or near overhead power lines.
- Personnel will avoid tripping hazards, steep slopes, pit and other hazardous encumbrances. If it becomes necessary to work within 6 feet of the edge of a pit, slope, pier or other potentially hazardous area, appropriate fall protection measures will be implemented by the Site Safety and Health Supervisor in accordance with Occupational Safety and Health Administration (OSHA)/Division of Occupational Safety and Health (DOSH) regulations and the GeoEngineers Safety Program manual.

- Heat stress control measures must be implemented according to the GeoEngineers, Inc. program with water provided on site. See Additional Programs at end of this HASP.
- Excessive levels of noise (exceeding 85 decibels [dBA]) are anticipated. Personnel potentially exposed will wear ear plugs or muffs with a noise reduction rating (NRR) of at least 25 dBA whenever it becomes difficult to carry on a conversation 6 feet away from a co-worker or whenever noise levels become bothersome. (Increasing the distance from the source will decrease the noise level noticeably.)
- Work may be conducted in rain, freezing rain, snow, or icy conditions. Care will be taken to wear warm water proof clothing that limits exposure to cold.

TABLE 7. ENGINEERING CONTROLS

	Trench shoring (1:1 slope for Type B Soils)
	Locate work spaces upwind/wind direction monitoring
	Other soil covers (as needed)
	Other (specify _______________

TABLE 8. CHEMICAL HAZARDS (POTENTIALLY PRESENT AT SITE)

Metals	
Yes	RCRA Metals
No	Manganese
Petroleum Products	
Suspected	EDB, EDC, MTBE, n-hexane
Suspected	Aromatic hydrocarbons (benzene, ethylbenzene, toluene, xylenes [BTEX])
Suspected	Gasoline
Suspected	Fractionalized petroleum hydrocarbons
Organic Compounds	
Suspected?	Pesticides
Other	
None	

TABLE 9. SUMMARY OF CHEMICAL HAZARDS

Compound/ Description	Exposure Limits/Immediately Dangerous to Life or Health (IDLH)	Exposure Routes	Toxic Characteristics
Gasoline Clear yellow brown combustible liquid; floats on water; distinct petroleum hydrocarbon odor	PEL (none) TLV 300 ppm STEL 500 ppm	Ingestion, inhalation, skin absorption, skin and eye contact	Irritation of eyes, skin, respiratory tract, dizziness, headache, nausea, pulmonary edema (from aspiration of liquid); dry, red skin; irritant contact dermatitis; eye redness, pain; fatigue, memory loss, slurred speech, loss of coordination, confusion, seizures, vomiting, damage to kidneys; potential lung damage ; Suspected carcinogen.
Benzene	PEL 5 ppm IDLH 500 ppm	Inhalation, ingestion, skin absorption, and/or direct contact	Irritation of eyes, skin, nose, respiratory system, dizziness, headache, nausea, staggered gait, anorexia, exhaustion, dermatitis, bone marrow depression (leukemia).
Toluene	PEL 100 ppm IDLH 500 ppm	Inhalation, absorption, ingestion, direct contact	Irritation to eyes, nose, exhaustion, confusion, dizziness, headaches, dilated pupils, euphoria, anxiety, teary eyes, muscle fatigue, insomnia, paresthesia, dermatitis, liver and kidney damage.
Ethyl benzene	PEL 100 ppm IDLH 800 ppm	Inhalation, ingestion, direct contact	Irritation to eyes, skin, respiratory system, burning of skin, dermatitis.
Xylenes	PEL 100 ppm IDLH 900 ppm	Inhalation, skin absorption, ingestion, direct contact	Irritation to eyes, skin, nose, throat, dizziness, excitement, drowsiness, incoordination, staggering gait, corneal vacuolization, anorexia, nausea, vomiting, abdominal pain, dermatitis.
1, 2-dibromoethane	PEL 20 ppm TLV Not Established IDLH 100 ppm (NIOSH)	Ingestion, inhalation, skin absorption, skin and eye contact	Irritation to eyes, skin, nose, throat, loss of consciousness, nausea, vomiting, pulmonary edema, cardiac arrhythmia, depression, bronchitis, damage to liver and kidneys, suspected carcinogen, possibly damage reproductive system.
1, 2-dichloroethane	PEL 50 ppm TLV 10 ppm IDLH 50 ppm (NIOSH)	Ingestion, inhalation, skin absorption, skin and eye contact	Irritation to eyes, skin, nose, throat, abdominal pain, cough, dizziness, drowsiness, headache, nausea, sore throat, unconsciousness, vomiting, blurred vision, diarrhea, dermatitis, damage to liver, kidneys, and nervous system, suspected carcinogen.
Methyl tertiary-butyl ether	PEL (none) TLV 50ppm	Ingestion, inhalation, skin absorption, skin and eye contact	Irritation of respiratory tract, loss of consciousness, suspected carcinogen,

Compound/ Description	Exposure Limits/Immediately Dangerous to Life or Health (IDLH)	Exposure Routes	Toxic Characteristics
n-hexane	PEL 500 ppm TLV 50 ppm IDLH 1100 ppm (NIOSH)	Ingestion, inhalation, skin absorption, skin and eye contact	Irritation of eyes, skin, respiratory tract, dizziness, drowsiness, headache, nausea, unconsciousness, weakness, abdominal pain, dermatitis, damage to peripheral and central nervous system, chemical pneumonitis (from aspiration of liquid).

Groundwater Sampling: Splash hazard associated with groundwater extraction and sample collection. Possible corrosion hazard associated with sample preservatives. Wear protective clothing and eye protection and chemical-resistant gloves are required when handling samples.

Sample handling, packaging, and processing: skin contact with contaminated media and preservative acids. Wear modified Level D personal protection equipment (PPE).

Decontamination of equipment: inhalation or eye contact or skin contact with airborne mists or vapors, or contaminated liquids. Wear safety glasses; decontaminate clothing and skin prior to eating, drinking or other hand to mouth contact.

TABLE 10. BIOLOGICAL HAZARDS AND PROCEDURES

Y/N	Hazard	Procedures
N	Poison Ivy or other vegetation	
N	Insects or snakes	
	Others	

Site personnel shall avoid contact with or exposures to potential biological hazards encountered.

Additional Hazards (Update in Daily Log)

Include evaluation of:

- Physical Hazards (equipment, traffic, tripping, heat stress, cold stress and others)
- Chemical Hazards (odors, spills, free product, airborne particulates and others present)
- Biological Hazards (snakes, spiders, other animals, poison ivy and others present)

Air Monitoring Plan

Work upwind if at all possible.

Check Instrumentation to be Used

_______ TLV Monitor (flammability only, for methane and petroleum vapors)

___X___ PID (Photoionization Detector)

_______ Other (i.e., detector tubes): ____

Check Monitoring Frequency/Locations: and Type (Specify: Work Space, Borehole, Breathing Zone)

___X___ 15 minutes—Continuous during soil disturbance activities or handling samples

_______ 15 minutes

_______ 30 minutes

_______ Hourly (in breathing zone during excavations, drilling, sampling)

SITE CONTROL PLAN

An up-to-date site control plan will be developed before field activities begin to minimize employee exposure to hazardous substances and including the following: a site map is included with the Sampling and Analysis Plan. The hospital route map is included with this HASP.

Traffic or Vehicle Access Control Plans

Survey tape and traffic cones will be used to cordon off any areas on site where borings will be conducted in order to restrict public vehicular and pedestrian access.

Site Work Zones

Exclusion zones will be established within approximately 10 feet around each boring or well during drilling/sampling. Only persons with the appropriate training will enter this perimeter while work is being conducted there.

Method of Delineation / Excluding Non-Site Personnel	
	Fence
X	Survey Tape
X	Traffic Cones
	Other Road Work Signs

Buddy System

Personnel on-site should use the buddy system (pairs), particularly whenever communication is restricted. If only one GeoEngineers employee is on-site, a buddy system can be arranged with subcontractor/contractor personnel.

Site Communication Plan

Positive communications (within sight and hearing distance or via radio) should be maintained between pairs on-site, with the pair remaining in proximity to assist each other in case of emergencies. The team should prearrange hand signals or other emergency signals for communication when voice communication becomes impaired (including cases of lack of radios or radio breakdown). In these instances, consider suspending work until communication can be restored; if not, the following are some examples for communication:

1. Hand gripping throat: Out of air, can't breathe.

2. Gripping partner's wrist or placing both hands around waist: Leave area immediately, no debate.
3. Hands on top of head: Need assistance.
4. Thumbs up: Okay, I'm all right. or I understand.
5. Thumbs down: No, negative.
6. Extended fist: Stop.

Decontamination Procedures

All non-dedicated sampling equipment will be decontaminated with Alconox™ soap and rinsed with distilled water prior to collecting any samples for analysis.

Personal decontamination consists of removing outer protective Tyvek clothing (if used), washing soiled boots, removing respirator (if used); hands and face will be washed in either a portable wash station or a bathroom facility in the support zone. Employees will perform decontamination procedures and wash prior to eating, drinking or leaving the site. All disposable personal protective clothing (i.e., nitrile gloves) will be bagged with other miscellaneous waste and discarded in the appropriate refuse receptacle in the contamination reduction zone.

PERSONAL PROTECTIVE EQUIPMENT

PPE will consist of standard Level D equipment. Disposable PPE (gloves) will be placed into plastic trash bags and disposed as solid waste. Minimum level of protective equipment for these sites is Level D. After the initial and/or daily hazard assessment has been completed, select the appropriate protective gear (PPE) to preserve worker safety. Task-specific levels of PPE shall be reviewed with field personnel during the pre-work briefing conducted prior to the start of site operations.

Check Applicable Personal Protection Equipment to be Used	
X	Hardhat
X	Steel-toed boots
X	Safety glasses
X	Hearing protection
X	Rubber boots (if wet conditions)
Gloves (specify)	
X	Nitrile
	Latex
	Liners
	Leather
	Other (specify) ____________________
Protective clothing	
	Tyvek (if dry conditions are encountered, Tyvek is sufficient)
	Saranex (personnel shall use Saranex if liquids are handled or splash may be an issue)
X	Cotton
X	Rain gear (as needed)
X	Layered warm clothing (as needed)
Inhalation hazard protection	
X	Level D
	Level C (respirators with organic vapor filters/ P100 filters)

Limitations of Protective Clothing

PPE clothing ensembles designated for use during site activities shall be selected to provide protection against known or anticipated hazards. However, no protective garment, glove, or boot is entirely chemical-resistant, nor does any PPE provide protection against all types of hazards. To obtain optimum performance from PPE, site personnel shall be trained in the proper use and inspection of PPE. This training shall include the following:

- Inspect PPE before and during use for imperfect seams, non-uniform coatings, tears, poorly functioning closures, or other defects. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Inspect PPE during use for visible signs of chemical permeation such as swelling, discoloration, stiffness, brittleness, cracks, tears, or other signs of punctures. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Disposable PPE should not be reused after breaks unless it has been properly decontaminated.

Respirator Selection, Use, and Maintenance

GeoEngineers has developed a written respiratory protection program in compliance with OSHA requirements contained in 29 code of federal regulations (CFR) 1910.134. Site personnel shall be trained on the proper use, maintenance, and limitations of respirators. Site personnel that are required to wear respiratory protection shall be medically qualified to wear respiratory protection in accordance with 29 CFR 1910.134. Site personnel that will use a tight-fitting respirator must have passed a qualitative or quantitative fit test conducted in accordance with an OSHA-accepted fit test protocol. Fit testing must be repeated annually or whenever a new type of respirator is used. Respirators will be stored in a protective container.

Respirator Cartridges

If site personnel are required to wear air-purifying respirators, the appropriate cartridges shall be selected to protect personnel from known or anticipated site contaminants. The respirator/cartridge combination shall be certified and approved by National Institute for Occupational Health and Safety (NIOSH). A cartridge change-out schedule shall be developed based on known site contaminants, anticipated contaminant concentrations, and data supplied by the cartridge manufacturer related to the absorption capacity of the cartridge for specific contaminants. Site personnel shall be made aware of the cartridge change-out schedule prior to the initiation of site activities. Site personnel shall also be instructed to change respirator cartridges if they detect increased resistance during inhalation or detect vapor breakthrough by smell, taste, or feel although breakthrough is not an acceptable method of determining the change-out schedule. At a minimum, cartridges should be changed a minimum of once daily.

Respirator Inspection and Cleaning

The Site Safety and Health Supervisor shall periodically (i.e., weekly) inspect respirators at the project site. Site personnel shall inspect respirators prior to each use in accordance with the manufacturer's instructions. In addition, site personnel wearing a tight-fitting respirator shall perform a positive and negative pressure user seal check each time the respirator is donned to ensure proper fit and function. User seal checks shall be performed in accordance with the GeoEngineers respiratory protection program or the respirator manufacturer's instructions.

Facial Hair and Corrective Lenses

Site personnel with facial hair that interferes with the sealing surface of a respirator shall not be permitted to wear respiratory protection or work in areas where respiratory protection is required. Normal eyeglasses cannot be worn under full-face respirators because the temple bars interfere with the sealing surface of the respirator. Site personnel requiring corrective lenses will be provided with spectacle inserts designed for use with full-face respirators. Contact lenses should not be worn with respiratory protection.

ADDITIONAL ELEMENTS

Heat Stress Prevention

Site specific procedures for preventing heat stress include: provide shade, water, and frequent breaks.

The State of Washington and the State of California have regulations that provide specific requirements for handling employee exposure to heat stress. GeoEngineers' program complies with both sets of requirements and will be implemented in all areas where heat stress is identified as a potential health issue.

The Washington State requirements for preventing heat stress apply to outdoor work environments from May 1 through September 30, only when employees are exposed to outdoor heat at or above an applicable temperature listed in Table 11. To determine which temperature applies to each worksite, select the temperature associated with the general type of clothing or PPE each employee is required to wear.

TABLE 11. OUTDOOR TEMPERATURE ACTION LEVELS

All other clothing	89°
Double-layer woven clothes including coveralls, jackets and sweatshirts	77°
Non-breathing clothes including vapor barrier clothing or PPE such as chemical resistant suits	52°

Keeping workers hydrated in a hot outdoor environment requires more water be provided than at other times of the year. GeoEngineers is prepared to supply at least one quart of drinking water per employee per hour. When employee exposure is at or above an applicable temperature listed in Table 11, Project Managers will ensure that:

- A sufficient quantity of drinking water is readily accessible to employees at all times; and
- All employees have the opportunity to drink at least one quart of drinking water per hour.

Emergency Response

Indicate what site specific procedures you will implement.

- Personnel on-site should use the "buddy system" (pairs),
- Visual contact should be maintained between "pairs" on-site, with the team remaining in proximity to assist each other in case of emergencies.
- If any member of the field crew experiences any adverse exposure symptoms while on-site, the entire field crew should immediately halt work and act according to the instructions provided by the SSO.
- Wind indicators visible to all on-site personnel should be provided by the SSO to indicate possible routes for upwind escape. Alternatively, the SSO may ask on-site personnel to observe the wind direction periodically during site activities.
- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated should result in the evacuation of the field team, contact of the project manager, and reevaluation of the hazard and the level of protection required.
- If an accident occurs, the SSO and the injured person are to complete, within 24 hours, an Accident Report for submittal to the project manager, the HSM and human resources. The project manager should ensure that follow-up action is taken to correct the situation that caused the accident or exposure.

A sampling and monitoring plan for Drums and Containers

N/A

Site control measures

Listed above in Site Control Plan.

Spill containment plans (Drum and container handling)

N/A

Standard operating procedures for sampling, managing, and handling drums and containers

Drums and containers used during the cleanup shall meet the appropriate DOT, OSHA and EPA regulations for the waste that they contain. Site operations shall be organized to minimize the amount of drum or container movement. When practicable, drums and containers shall be inspected and their integrity shall be ensured before they are moved. Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled. Before drums or containers are moved, all employees involved in the transfer operation shall be warned of the potential hazards associated with the contents.

Drums or containers and suitable quantities of proper absorbent shall be kept available and used where spills, leaks or rupture may occur. Where major spills may occur, a spill containment program shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred. Fire extinguishing equipment shall be on hand and ready for use to control incipient fires.

Entry Procedures for Tanks or Vaults (Confined Spaces)

N/A

Personnel Medical Surveillance

GeoEngineers' employees are not in a medical surveillance program as they do not fall into the category of "Employees Covered" in OSHA 1910.120(f)(2) which states a medical surveillance program is required for the following employees:

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

Sanitation

Field staff and subcontractors must go off site to access sanitation facilities.

Lighting

Fieldwork will be conducted during daylight hours.

Excavation, trenching and shoring

N/A

Other programs

None.

Documentation to Be Completed for HAZWOPER Projects

NOTE: The Field Log is to contain the following information:

- Updates on hazard assessments, field decisions, conversations with subs, client or other parties.
- Air monitoring/calibration results; personnel, locations monitored, activity at the time of monitoring (if performed).
- Actions taken.
- Action level for upgrading PPE and rationale.
- Meteorological conditions (temperature, wind direction, wind speed, humidity, rain, snow, etc.).

Required forms:

- Field Log.
- Health and Safety Plan acknowledgment by GEI employees (Form 2).
- Contractors Health and Safety Plan Disclaimer (Form 3).
- Conditional forms available at GeoEngineers office: Accident Report.

APPROVALS

1.		______________________	______________ Date
2.	Plan Approval	______________________ PM Signature	______________ Date
3.	Health & Safety Officer	Wayne Adams ______________________ Health & Safety Program Manager	______________ Date

FORM 1
HEALTH AND SAFETY PRE-ENTRY BRIEFING
MOXEE CITY SHOP AND STP

Inform employees, contractors, and subcontractors or their representatives about:

- The nature, level, and degree of exposure to hazardous substances they're likely to encounter, all site-related emergency response procedures, any identified potential fire, explosion, health, safety, or other hazards.
- Conduct briefings for employees, contractors, and subcontractors, or their representatives as follows:
- A pre-entry briefing before any site activity is started.
- Additional briefings, as needed, to make sure that the site-specific HASP is followed.
- Make sure all employees working on the site are: Informed of any risks identified and trained on how to protect themselves and other workers against the site hazards and risks
- Update all information to reflect current sight activities and hazards.
- All personnel participating in this project must receive initial health and safety orientation. Thereafter, daily brief tailgate safety meetings will be held or as deemed necessary by the Site Safety and Health Supervisor (such as a significant change in field conditions).
- The orientation and the tailgate safety meetings shall include a discussion of emergency response, site communications and site hazards.

Date	Topics	Attendee	Company Employee Name	Initials

FORM 2
SITE SAFETY PLAN – GEOENGINEERS' EMPLOYEE ACKNOWLEDGMENT
MOXEE CITY SHOP AND STP

(All GeoEngineers' site workers complete this form, which should remain attached to the safety plan and filed with other project documentation).

I, ____, do hereby verify that a copy of the current Safety Plan has been provided by GeoEngineers, Inc., for my review and personal use. I have read the document completely and acknowledge a full understanding of the safety procedures and protocol for my responsibilities on site. I agree to comply with all required, specified safety regulations and procedures. I understand that I will be informed immediately of any changes that would affect site personnel safety.

Signed ______________________ Date ________________

Range of Dates From: ______________________
To: ______________________

Signed ______________________ Date ________________

Range of Dates From: ______________________
To: ______________________

Signed ______________________ Date ________________

Range of Dates From: ______________________
To: ______________________

Signed ______________________ Date ________________

FORM 3
SUBCONTRACTOR AND SITE VISITOR SITE SAFETY FORM
MOXEE CITY SHOP AND STP

I, ____, verify that a copy of the current site Safety Plan has been provided by GeoEngineers, Inc. to inform me of the hazardous substances on site and to provide safety procedures and protocols that will be used by GeoEngineers' staff at the site. By signing below, I agree that the safety of my employees is the responsibility of the undersigned company.

Signed ______________________________ Date ______________________

Firm: ____

Signed ______________________________ Date ______________________

Firm: ____

Signed ______________________________ Date ______________________

Firm: ____

Signed ______________________________ Date ______________________

Firm: ____

Signed ______________________________ Date ______________________

Firm: ____

Signed ______________________________ Date ______________________

Firm: ____

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