PRS GROUP, INC.

EXHIBIT C
Groundwater Monitoring Plan

PRS Group, Inc.

5/20/2015

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GROUNDWATER MONITORING PLAN

PRS GROUP, INC.
TACOMA, WA 98421

1.0 INTRODUCTION

PRS Group, Inc. (PRS) manages wastes from off-site generators from their location at 3003 Taylor Way in Tacoma, Washington, as shown in Figure E-1 Facility Site Map. PRS operates under the requirements of WAC-173-303-515 (Standards for the management of used oil).

PRS stores and treats used oil for resale and treats wastewater suitable for discharge to the local sewer utility. Waste streams managed include used engine oil, non-PCB transformer oils, lubricating oils, oily wastewaters, bilge and ballast wastes, and drilling fluids. PRS also manages non-dangerous waste sludge for offsite disposal at a Subtitle D landfill.

This Groundwater Monitoring Plan (GWMP) was prepared in compliance with the requirements of the Dangerous Waste Regulations (WAC 173-303) and the Washington State Department of Ecology (Ecology).

1.1 BACKGROUND

The GWMP is designed to monitor the groundwater emanating from the facility. It utilizes nine existing groundwater monitoring wells installed at the facility. The monitoring wells, the analyses conducted, and the frequency of sampling are included in Table 1 **Groundwater Monitoring Schedule**. The monitoring wells are located to provide adequate information on (1) groundwater flowing onto the site from off-site, (2) groundwater underlying the site; and (3) groundwater leaving the site and flowing to off-site, downgradient locations. The monitoring wells were installed on site from 1991 through 2010. Groundwater samples will be analyzed for the chemicals of potential concern (COPCs) reviewed during past groundwater investigations on the site, including volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), and select heavy metals.

The site or sections of the site have historically been owned by the city of Tacoma, Ohio Ferro-Alloys, Pacific Northwest Processing (a rendering plant), Pierce County, Port of Tacoma, several private individuals, and a prior PRSI owner. The site was an electrical power substation beginning in 1942 until 1976; from 1976 to present the site has been used for waste oil and water recycling prior to use as a rendering plant known as Pacific Northwest Processing.

The groundwater monitoring program outlined in this GWMP is designed to address all of the regulated areas at the facility and areas with releases of dangerous wastes and dangerous constituents.

1.2 GROUNDWATER MONITORING OBJECTIVES

This GWMP addresses the following major elements:

- Description of the current GWMP monitoring network;

- Procedures for completing water-level surveys, groundwater sampling, well evacuation, field decontamination, sample storage and transportation, sample analysis, and quality assurance/quality control;
- Procedures and requirements for well construction, maintenance, and decommissioning;
- Requirements for annual reporting and notification;
- Personnel functions and responsibilities;
- Worker health and safety planning
- How the GWMP's objectives will be met; and
- Field and laboratory quality assurance.

2.0 SITE HYDROGEOLOGICAL CHARACTERISTICS

PRS has collected geological and hydrological data for the site in previous environmental investigations. A detailed description of the site geological and hydrogeological characteristics is presented in the Comprehensive Remedial Investigation (RI) Report, dated October 2, 1996 and Addendum, dated December 19, 1996. The information presented in this section is based on the findings of the RI. The boring logs for all monitoring wells included in the GWMP are provided in Appendix A. A summary of the geological and hydrogeological characteristics is provided below.

2.1 SITE SETTING

The facility lies in a relatively flat area surrounded by developed and undeveloped industrial properties. The elevation of the facility is approximately 10 feet above sea level. The site occupies approximately .66 acres.

2.2 SITE GEOLOGY

The local geological units underlying the facility include:

- Fill material, consisting of silt and sand, dredged from the Blair and Hylebos Waterways in the 1950s and 1960s as well as from gravel borrow sources. Wastes reportedly dumped in the area around the facility from the late 1960s include slag from Asarco. The fill material ranges in thickness from a few feet to approximately 25 feet.
- Deltaic-alluvial sediments deposited by the Puyallup River, which flowed out of the Cascade Mountain Range to discharge into Commencement Bay of Puget Sound. A delta formed at the mouth of the Puyallup River in the Commencement Bay area, depositing alternating layers of sands and silts which can be over 100 feet in thickness.

2.3 SITE HYDROGEOLOGY

The hydrogeological units underlying the facility include:

- Shallow Aquifer – The shallow aquifer, which is unconfined, is present throughout the property and has also been encountered at borings on neighboring properties. The shallow aquifer is underlain by the silt aquitard.

- Silt Aquitard – The silt aquitard is present beneath all of the property and has been encountered in borings on neighboring properties as well. The silt aquitard is bounded above by the shallow aquifer and below by the deep aquifer.

- Deep Aquifer – The deep aquifer appears to be present throughout the property. The unit is fully saturated and is hydraulically confined by the overlying silt aquitard.

Water level measurements collected from the on-site monitoring wells vary from 1 to 15 feet below ground surface, depending on the aquifer, its location, and seasonal variations. The direction of groundwater flow seems to be dependent on seasonal variations.

South of the site along Taylor Way is a 24” sewer utility line bedded in porous sands/gravel providing an easy path for groundwater to flow toward. This area acts as a sink for groundwater during drier months allowing groundwater to flow southerly into the bedded area. Conversely during the wet season the utility line bedded area is saturated with groundwater and seems to push groundwater away, reversing the flow of groundwater towards the north.

3.0 MONITORING NETWORK

The groundwater monitoring well network and maintenance program for the facility are described in this section.

3.1 MONITORING WELL LOCATIONS

The locations of the full groundwater monitoring network are shown on Figure 2 **Monitoring Well Locations**. Figure 2 also shows the monitoring wells that will be monitored for both water levels and chemical constituents during the sampling events.

3.2 MONITORING WELL NUMBERING SYSTEM

Each well designation consists of four alphabetic characters ending in “A” for shallow wells and “B” for the deep aquifer.

3.3 MONITORING WELL CONSTRUCTION

For all wells in the groundwater monitoring network, well construction details are summarized in Table 2 **Well Construction Information**, and well construction logs are provided in Appendix A. More detailed installation descriptions are provided in the RI (1996), 2004 Monitoring and Drilling Summary Report, 2010 Monitoring and Drilling Summary Report and subsequent quarterly progress reports. Monitoring well construction is discussed further in Section 3.5.4.

3.4 MONITORING WELL SURVEY

In the Public Land Survey System, the facility is located in the SW1/4 of Section 36, Township 21 North, Range 3E, Willamette Meridian. The latitude/longitude coordinates are approximately 47°15’N/122°22’W. All survey data are recorded relative to this section, township, and range. All vertical survey data was based on the national Geodetic Vertical Datum (NGVD) of 1929 and converted to the North American Vertical Datum (1988). All horizontal data are provided relative to the Washington State Plane Coordinate System, South Zone (North American Datum, 1983/91). Table 3 provides Well Survey Data.

3.5 MONITORING WELL NETWORK INSPECTION, MAINTENANCE, AND REPLACEMENT

This section describes a program to provide regular inspection, and if necessary, maintenance of the monitoring wells and associated equipment. In addition, well construction and decommissioning procedures are presented in this section.

3.5.1 WELL INSPECTION

The integrity of monitoring wells within the monitoring network is inspected quarterly. The inspection involves an all-inclusive visual inspection of each well to determine if it has been damaged or tampered with, and verifies the physical condition of the well at the ground surface as well as the internal well casing. The physical condition of each well and problems discovered during the inspection will be recorded in a field inspection logbook and a Monitoring Well Inspection Form according to PRS SOP 400 **Documentation Procedures**. Both logbook and forms will be provided to the Senior Project Manager.

Problems that require immediate attention will be reported to the Senior Project Manager so as to remedy the condition prior to the next sampling event. Section 6.1 summarizes the duties and responsibilities of the Senior Project Manager. If a significant problem, such as a broken well head, bent casing, or other damage that compromises well access is discovered, it may be necessary to remedy the problem before sampling. A problem with the well integrity may require a modification of the sampling schedule or some other change in the sampling program. All decisions regarding such modifications will be addressed by the Senior Project Manager, who will notify and request approval from Ecology regarding such modifications. PRS will notify Ecology by telephone or in writing within 15 days of any visible damage to or deterioration of wells. Table B-1 **Project Personnel and Responsibilities** in Appendix A **Quality Assurance Project Plan** (QAPP) provides contacts and describes responsibilities for personnel.

3.5.2 MAINTENANCE

Borehole integrity will be maintained at each well. One of the following three methods will be consistently used to maintain borehole integrity:

- Annual comparisons of specific capacity. With this method, any well is redeveloped to within 5 percent of the original specific capacity if that well's annual capacity measurement is less than 80 percent of the original measured capacity.

- Annual sounding. With this method, any well that has an annually measured buildup of at least one foot of sediment must be redeveloped.

- Biennial comparisons of hydraulic conductivity. With this method, PRS must redevelop any well to within 5 percent of the original hydraulic conductivity if that well's biennial conductivity measurement is less than 80 percent of the original measured conductivity. Hydraulic conductivity must be determined by means of consistently performed slug tests.

All pumps and other sampling equipment used for groundwater monitoring will be calibrated regularly according to standard operating procedures (SOPs) and maintained regularly by the sampling team member(s) according to the equipment manuals and manufacturers' recommendations.

3.5.3 MONITORING WELL REPLACEMENT

If any monitoring well in the network must be replaced, PRS will make every effort to replace the well prior to the next sampling event. PRS will submit to Ecology a written explanation of the rationale for the well's replacement and the time frame and location for the replacement, at least 15 days prior to decommissioning. Ecology will approve the location of replacement wells prior to installation. The replacement will be completed upon approval of the agency and preferably prior to the next scheduled groundwater sampling event.

If it is agreed that the well should be replaced, the replacement well will be installed as close as possible to the well being replaced. A monitoring well construction form will be completed for the new well and a copy will be submitted to the agency. When necessary, wells will be decommissioned following the procedures specified in Section 3.5.5.

3.5.4 MONITORING WELL CONSTRUCTION

A qualified geologist will inspect the drilling and construction of all new or replacement monitoring wells. A detailed log of each well will be prepared. The logs and descriptions will include the following information:

- Date and time of construction;
- Drilling method and any drilling fluid used;
- Well location (surveyed to within 0.5 foot);
- Borehole diameter and well casing diameter;
- Well depth (to within 0.1 foot);
- Drilling logs and lithologic logs from the field, including a description of soil or rock types, color, weathering, texture, structure, and fractures;
- Casing materials;
- Screen material and design, including screen length and slot size, and depth interval of the well screens;
- Casing and screen joint type;
- Filter pack material, including size, placement method, and approximate volume, and depth interval of the filter pack material;
- Composition and approximate volume of sealant material and method of placement;
- Surface seal design and construction;
- Well development procedures;
- Ground surface elevation (to within 0.01 foot);
- Top-of-casing elevation (to within 0.01 foot) and
- Detailed drawing of well, including dimensions.

The logs and descriptions, as-built drawings, and location of the new well will be submitted to Ecology within 30 calendar days of well completion or according to the schedule approved by Ecology in specific work plans. Appendix A provides the log for each existing monitoring well in the groundwater monitoring well network.

3.5.5 MONITORING WELL DECOMMISSIONING

Wells will be decommissioned in accordance with the WAC 173-160-460 (Abandonment of Resource Protection Wells) and applicable updates. PRS' drilling contractor will file the appropriate notification of well abandonment with Ecology. The PRS Senior Project Manager will provide written rationale for the decision to decommission the well to Ecology at least 30 days prior to conducting the decommissioning. If the well being decommissioned is being replaced, it should be decommissioned no later than 90 days after installation of the replacement well.

Minor deviations from the decommissioning procedures that are deemed necessary due to unforeseen events in the field at the time of well abandonment will be noted in the operating record, along with an explanation of the need for the deviation. The PRS Senior Project Manager will notify Ecology in writing of any deviations within 15 days of well decommissioning.

4.0 GROUNDWATER LEVEL MONITORING

Water level measurements are collected quarterly for a one-year period in March, June, September, and December. Water levels are collected from nine monitoring wells. The wells included in the water level monitoring events are presented in Table 1.

4.1.1 SCHEDULE

A water-level measurement event is conducted in accordance with the schedule presented in Table 1. Water level measurements are conducted prior to the corresponding groundwater sampling event, if applicable, and measurements are obtained within as short a time as possible prior to sampling, not to exceed one working day.

Figure E-2 shows the locations of the wells used for water level measurements.

4.1.2 PROCEDURES

The procedure for measuring water levels is described in PRS SOP-120 **Measuring Water Elevations and Total Depths**, presented in Appendix C **PRS Standard Operating Procedures**. Wells will be vented prior to measurement to allow water levels to stabilize before measurement. Water level measurements and well venting times are recorded in the field on a water level field form. An example of the water level field form is provided in Appendix D **Field Forms**.

4.1.3 EQUIPMENT

Equipment used for the water-level survey is listed in the PRS SOP-120, as provided in Appendix C. Depth-to-water measurements are made using an electronic water-level meter. The meter consists of a coaxial cable or plastic-coated flat wire permanently marked with increments of 0.01–foot, a detection probe, and electronic controls contained in a spool or reel used at a permanently marked reference point on the well casing. The water-level meter/sounder registers a response when the probe attached to the cable contacts an electrically conductive medium such as water, thereby completing the electrical circuit. The response is visible (e.g., red light), audible (e.g., alarm), or a combination of the two.

4.1.4 REPORTING

All water-level data are recorded in the field on water-level data forms. An example of the form format is provided in Appendix D. The water-level data forms facilitate transmission of data from the field to the office. The field form is provided to the PRS Senior Project Manager to file with the facility field forms. The water level data are used to create potentiometric contour maps and a summary table of the water-level measurements, which are included with the annual report.

4.2 WATER QUALITY MONITORING

PRS SOP-124 **Low-Flow Groundwater Sampling Procedure**, provided in Appendix C, describes the groundwater sampling methodology. This section of the GWMP describes the equipment used and the procedures for groundwater sampling, field decontamination, field records preparation, sample identification, and sample storage and transport for water quality testing.

4.2.1 SCHEDULE

Groundwater samples are collected in accordance with the schedule presented in Table 1 **Groundwater Monitoring Schedule**. After one year of quarterly sampling according to the requirements in this GWMP, sampling will happen once a year in June. Figure E-2 shows the locations of wells used for groundwater sampling.

4.2.2 GROUNDWATER SAMPLING PROCEDURE

Groundwater samples are collected following the procedures outlined in the PRS SOP-124, presented in Appendix C. This is a low-flow groundwater sampling methodology based on groundwater sampling guidance and comments from Ecology and the U.S. Environmental Protection Agency under RCRA. The groundwater sampling procedure involves purging groundwater from the monitoring well prior to sampling at a flow rate of 0.2 to 0.5 liter per minute slowly increasing the speed while maintaining a drawdown of less than 0.33 feet. During the purging, groundwater quality parameters, including temperature, pH, turbidity, dissolved oxygen, oxidation/reduction potential (ORP), and specific conductivity, are monitored approximately every three minutes, and purging is conducted until these parameters stabilize within criteria outlined in PRS SOP-124. Following the instructions in PRS SOP-124, if the dissolved oxygen measurement is less than 1 mg/L, a sample is collected and analyzed by the colorimetric procedures outlined in PRS SOP-300 **Dissolved Oxygen Measurement**. Once the water quality parameters have stabilized, groundwater samples are collected using a flow rate of less than 500 mL/min. Immediately following the collection of groundwater samples, a sample is collected and measured in the field for ferrous iron following the procedures outlined in PRS SOP-301 **Ferrous Iron Procedures**.

4.2.3 EQUIPMENT

The monitoring wells included in this GWMP are sampled with a nondedicated peristaltic pump using dedicated polyethylene tubing. The tubing intake is set at mid-screen for sampling or mid-water column if the top of the screen is above the water table. The depth to mid-screen is provided for all wells in Table 2 **Well Construction Information**. Other equipment to be used for well evacuation is listed in PRS SOP-124. This equipment includes a flow-through water quality meter, turbidity meter, water level meter, a digital titrator and colorimeter, and/or oil/water interface detector. A multiparameter, flow-through water quality meter that measures and records pH, temperature, dissolved oxygen, ORP, specific conductivity, turbidity, and time was selected for use in this monitoring program. All meters are calibrated according to instrument instructions. Calibration information and operating instructions can be found in PRS SOP 123 and PRS SOP 302 presented in Appendix C. The calibration results for each parameter are recorded in the field logbook. Refer to PRS SOP-400 **Documentation Procedures**.

4.2.4 FIELD DECONTAMINATION PROCEDURES

The decontamination procedures for all nondedicated field sampling equipment are outlined in PRS SOP 200 **Equipment Decontamination Procedure**. This equipment includes any instrument that is placed in a well or comes in contact with the groundwater sample, including the water-level indicator and any nondedicated pump. Refer to SOPs for field decontamination during sampling of monitoring equipment used for measuring water quality parameters.

The flow-through water quality meter requires decontamination with deionized water, but not with soaps or solvents, which may adversely affect the probes in the meter. The flow-through cell is disconnected prior to sample collection; therefore, groundwater collected for laboratory analysis at the laboratory does not contact the flow-through cell.

4.2.5 FIELD RECORDS

PRS SOP-400 describes field logbook documentation procedures required for field sampling events, as well as field forms required for specific tasks. Field observations for well evacuation and groundwater sampling are recorded in the field in the logbook and on monitoring well water sampling sheets similar to the one show in Appendix D. The monitoring well water sampling sheet is designed to help the sampling team determine when the water quality parameters are stable enough to collect a sample and also facilitates transmission of data from the field to the office. The following information is recorded on the sampling sheet during well evacuation; well identification, date, sampling personnel, beginning and ending water levels, sampling method, equipment used, and samples collected. Readings of water quality parameters (pH, specific conductivity, temperature, turbidity, dissolved oxygen, and ORP are recorded on the sheet approximately every 3 minutes, along with flow rate and pump speed. The ferrous iron measurements conducted in the field as well as any colorimetric dissolved oxygen measurements obtained in the field are also recorded on the field sheets.

4.2.6 SAMPLE LABEL AND IDENTIFICATION SYSTEM

A sample label is affixed to each sample bottle before sample collection. Each label includes the following information:

- Project Name
- Sample number (see below),
- Sampling event location,
- Date and time of sample collection (using 24-hour time clock),
- Preservatives added to the sample,
- Analytes for which the sample is to be analyzed.

Water samples are labeled with a unique sample number. The sample number consists of the appropriate monitoring well designation followed by, and separated by a hyphen from, a date identification code. The date identification code consists of a four-digit number that represents the month and year that the sample was collected. For instance, the sample number SO-2A-0614 denotes a sample collected in June 2014 from monitoring well S0-2A.

Quality control samples follow a similar nomenclature. Field duplicate samples are labeled the same as regular samples, except a '9' is added to the sample number preceding the well number and separated by hyphens on either side (e.gl, S0-2A-9-0614). Matrix spike and matrix spike duplicate (MS/MSD) samples are labeled the same as regular samples; but should be noted on the chain of custody form that extra volume was collected for MS/MSD. Field blank samples are labeled: Field Blank#1-0614" and trip blank samples are labeled "Trip Blank#1-0614". The location at which field blanks are collected should be noted in the field logbook and/or field form. Equipment blanks are not normally collected, but might be necessary if non-dedicated tubing or bailers are used during groundwater sampling. If they are collected, equipment blanks are labeled "Equipment blank#1-0614" and, if collected, the location should be noted in the field logbook and/or field form.

4.2.7 SAMPLE STORAGE AND TRANSPORTATION

Immediately after each sampling is obtained, samples are packed for shipping and placed in ice-cooled transport containers. The transport containers consist of sturdy, insulated, commercially produced coolers. All bottle caps are secured tightly, and all glass containers are secured into position within the shipping container to avoid breakage. Trip blanks are included in any transport container that carries water samples being analyzed for VOCs or TPH as gasoline. A custody seal is affixed to the container prior to laboratory pickup or delivery. The chain of custody form should be taped to the top of the cooler or shipping container in most circumstances.

An example chain of custody form is provided in Appendix D. During sample collection or at the end of the day and prior to shipping or storage, chain-of-custody forms will be completed for all samples by a designated field team member. The information on the sample labels will be rechecked and verified against field logbook entries and the chain of custody forms. The chain of custody form should include information such as sample name, sample time, sample date, type of medium, and analyses requested. Any necessary changes to chain of custody forms, sample container labels, or the field logbook will be made by striking out the error with one line and entering the correct information. The new entries will be initialed and dated. Samples with extra volume for laboratory quality control protocols (MS/MSD and laboratory duplicates) will be designated as such on the chain of custody form. The field team should ensure that analyte method numbers and analyte lists required for the project are either listed on the chain of custody form, attached to the chain of custody form, or referred to on the chain of custody form. Every person who takes possession of the samples while transporting the samples from the field to the laboratory must sign the chain of custody form.

For most samples, the field team either transports the samples to the laboratory or has a laboratory courier come to the site at the end of the sampling day to pick up samples for delivery to the laboratory. Upon receipt of the sample transport containers by the analytical laboratory, laboratory personnel open the containers and examine the contents for problems, such as damaged transport containers, broken custody seals, missing or broken sample bottles, chain of custody discrepancies, and documentation errors. Problems are reported to PRS. After the samples are analyzed by the analytical laboratory, laboratory personnel store the samples in a secure location at the laboratory for the remainder of their holding times. All notifications from the Laboratory will be provided to the Senior Project Manager or Sampling Team Leader.

4.2.8 ANALYTICAL PROCEDURES

The sampling and analysis schedule for this GWMP is included in Table 1. Typical detection limits and more detailed information about the analytical methods are provided in the QAPP (Appendix B). Groundwater monitoring analytical data will be analyzed and validated in accordance with the requirements in the QAPP.

The analytical laboratory purchase new and certified clean sample bottles for each sampling event. The recommended specifications for bottle types, volume of sample required for analysis, and types of sample preservative required for analyses are provided in Table1[1] and Table B-4 **Sample Containers, Preservation and Holding Times** in the QAPP. However, these recommendations may be modified by the laboratory as analytical methods are modified and improved.

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[1] Under some circumstances, it may not be possible to collect the sample volumes recommended by the laboratory, as shown in Table 1. In such a case, the field team will fill bottles per the laboratory project manager's instructions.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

All work associated with the GWMP will be conducted in accordance with the QAPP (Appendix B).

6.0 PERSONNEL FUNCTIONS AND RESPONSIBILITIES

All fieldwork will be completed in accordance with the project-specific Health and Safety Plan (HASP), included as Appendix E of this plan. The specific tasks of key personnel involved in the groundwater monitoring program are summarized below.

6.1 PRS SENIOR PROJECT MANAGER

The function of the Senior Project Manager is to:

- Maintain correspondence between regulatory agencies and PRS.
- Maintain the groundwater monitoring network in good working condition.
- Maintain Field Log Book inventory. (See PRS SOP-400 Documentation Procedures)
- Notify Ecology seven days prior to conducting sampling events.
- Train staff on procedures in the GWMP and document the training.
- Maintain standard operating procedures (SOPs).

6.2 SAMPLING TEAM LEADER

The functions of the Sampling Team Leader are to:

- Learn and follow all of the procedures in this GWMP.
- Notify the Senior Project Manager of any unresolved problems or deviations from approved procedures. Problems or deviations will be documented in a log book according to PRS SOP-400 **Documentation Procedures**. Oversee field sampling activities and equipment repair to prevent sample and/or well contamination.
- Work to prevent sample and/or well contamination by sampling from least to most contaminated. Examine sample bottles, preservatives, and sample transport containers. Maintain lines of communication between those personnel involved in the field sampling activities, the Senior Project Manager, and the analytical laboratory.
- Maintain or service all dedicated sampling equipment.
  Schedule sample analysis services with the analytical laboratory and the Field Team Leader.

6.3 FIELD TEAM LEADER

The functions of the Field Team Leader are to:

- Learn and follow all of the procedures in this GWMP.
- Take neat and complete field notes in field logbook and necessary forms.
- Provide field technical guidance for sampling and maintenance procedures.
- Obtain, maintain, and inspect all equipment used to fulfill their responsibilities.
- Verify or arrange for shipment of sample bottles and sample transport containers, both from the analytical laboratory to the field and from the field to the laboratory.
- Conduct health and safety meetings, and implement safety requirements.
- Calibrate equipment.

- Assume responsibility for storage and provide security of sample transport containers and sample equipment.
- Take all field measurements.
- Check that samples are correctly identified and packed securely with ice in the sample transport container(s).
- Perform or supervise the water-level survey and well inspection.
- Purge monitoring wells.
- Collect and preserve samples.

6.4 PRS DATABASE ADMINISTRATOR

The function of the PRS Database Administrator is to update the monitoring well information tables.

7.0 SCHEDULE

Quarterly monitoring events occur four times in the first one-year period in the first quarter (March), the second quarter (June), the third quarter (September), and the fourth quarter (December). Well inspections also occur every quarter. After one year of quarterly monitoring events according to this GWMP, PRS shall submit an annual groundwater data analysis report. After reviewing this report, Ecology will determined if the monitoring schedule shall be revised to annual monitoring events in the second quarter and a semiannual water level monitoring event in the fourth quarter.

8.0 REPORTING

PRS shall submit a groundwater data analysis report to Ecology annually on April 15. The report shall summarize the data collected and activities performed with respect to the groundwater monitoring program since the previous annual report. Each report shall include the following information:

- A description of groundwater monitoring activities completed during the year;
- A description of groundwater monitoring activities planned for the next year;
- A summary of any problems, how problems were resolved, deviations from the GWMP, and a justification for all deviations;
- All laboratory analyses (in a mutually agreed-upon electronic data format and as hard copies of the original laboratory data) in tabulated data format for which quality assurance procedures were completed during the current time period;
- A summary of constituent concentrations which exceed MTCA cleanup levels;
- All field measurements; and
- A table with measured groundwater elevations for each well as well as groundwater level contour maps.
- A summary of significant findings, changes in personnel, and significant contacts with Federal, state, and local governments, community and public interest goals.

9.0 REFERENCES

PRS, 1996, Remedial Investigation Report prepared by SECOR.
2004 Monitoring and Drilling Summary
2010 Monitoring and Drilling Summary

TABLES

TABLE 1

GROUNDWATER MONITORING SCHEDULE

PRS GROUP, INC.
TACOMA, WA

	Required Analyses							
Analytical Method	**VOC by 8260B**	**TPH-Diesel by NWTPH-Dx**	**TPH-GASOLINE BY NWTPH-Gx**	**Total Metals by 6020[1]**	**PCBs by 8082**	**Nitrate by EPA 353.3**	**Sulfate by EPA 375.4**	**Water Levels**
Container Requirements	**2 x 40 mL Vial**	**1 x 1 liter Amber Glass**	**2 x 40mL Vial**	**1 x 250 mL poly**	**1 x 1 liter amber**	**250 mL poly**	**250mL poly**	
Preservative	**HCL**	**HCL**	**HCL**	**HNO3**	**none**	**none**	**none**	
Monitoring Location								
MW-1A	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4
MW-1B	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4
MW-2A	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4
MW-3A	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4
CO-3A	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4
CO-3B	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4
SO-2A	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4
SO-4A	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4
SO-4B	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4
Field Blank	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4	1,2, 3, 4
Trip Blank	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4
Total Samples	**44**	**44**	**44**	**44**	**44**	**44**	**44**	

Notes:

1. Metals: Cr, As, Pb
2. Collection Schedule as follows:
    1 = Second Week in March
    2 = Second Week in June
    3 = Second Week in September
    4 = Second Week in December

After one year of quarterly events, groundwater monitoring is conducted annually in June

Abbreviations

As = Arsenic
Cr = Chromium
HCL = Hydrochloric Acid

HNO3 = Nitric Acid

mL = Milliliter

Pb = Lead

Poly = Polyethylene
TPH = Total Petroleum Hydrocarbons
VOC = Volatile Organic Compound

Table 2

Well Construction Information
PRS Group, Inc.
Tacoma, WA

Well ID	Installation Date	Contractor	Drilling Method	Total Borehole Depth	Initial Total Well Depth	Casing						Screen						Filter Pack			Seals				Information Source
						Depth Interval		Material	Nominal Diameter	Flush or Aboveground Monument	Type Of PVC joint	Depth Interval		Screened Hydro-geologic Unit	Material	Nominal Diameter	Slot Size	Depth Interval		Material	Depth Interval		Material	Surface Seal	
						Upper	Lower					Upper	Lower					Upper	Lower		Upper	Lower			
CO3A	8/23/91	Holt Drilling	Hollow Stem Auger	11.5’	11.5’	0.0	5.0’	PVC	2”	Flush	PVC	5’	10’	Shallow Aquifer	PVC	2”	0.02	4’	10’	sand	0.0 2’ 9.5’	2’ 4’ 10’	Concrete Bentonite	Concrete Flush Mount	Golder Associates
CO3B	8/26/91	Holt Drilling	Hollow Stem Auger	30’	29.5’	0.0	19.5’	PVC	2”	Flush	PVC	19.5’	29.5’	Deep Aquifer	PVC	2”	0.02	16.5’	29.5’	sand	0.0 2’ 29.5’	2’ 16.5’ 30’	Concrete Bentonite	Concrete Flush Mount	———
SO2A	8/23/91	Holt Drilling	Hollow Stem Auger	12.5’	12.5’	0.0	5’	PVC	2”	Flush	PVC	5’	12’	Shallow Aquifer	PVC	2”	0.02	4’	12’	sand	0.0 2’ 12’	2’ 4’ 12.5	Concrete Bentonite	Concrete Flush Mount	Golder Associates
SO4A	10/18/96	Cascade Drilling	Hollow Stem Auger	11.5’	10’	0.0	3’	PVC	2”	Flush	PVC	3.5’	11.5’	Shallow Aquifer	PVC	2”	.01	2.5’	12’	10/20 sand	0.0 1’ 2’	1’ 2’ 11.5’	Concrete Bentonite Sand	Concrete Flush Mount	Secor
SO4B	1/2010	Pacific NW Probe	Direct Push	30’	28.5’	0.0	18.5’	PVC	1”	Flush	PVC	18.5’	28.5’	Deep Aquifer	PVC	1”	.01	16’	18.5’	Fine sand	.5 3’ 16’	3’ 16’ 28.5”	Concrete Bentonite Grout	Concrete Flush Mount	RN
MW1A	3/22/08		Direct Push	12’	10’	0.0	5’			Flush	PVC			Shallow Aquifer										Concrete flush Mount	EMS
MW1B	1/2010	Pacific NW Probe	Direct Push	30’	29’	0.0	19’	PVC	1”	Flush	PVC	19’	29’	Deep Aquifer	PVC	1”	.01	19’	29	sand	0.5’ 3’ 16’	3’ 16’ 19’	Concrete Bentonite grout Bentonite	Concrete Flush Mount	RN
MW2A	3/22/08		Direct Push	12’	10’	0.0				Flush	PVC			Shallow Aquifer										Concrete Flush Mount	EMS
MW3A	3/22/08		Direct Push	12’	10’	0.0				Flush	PVC			Shallow Aquifer										Concrete flush Mount	EMS

Table 3

Well Survey Data

PRS Group, Inc.
Tacoma, WA

Well ID#	NORTHING	EASTING	ELEVATION (NAVD88)
MW-1A	709713.2652	1175727.8917	14.21’
MW-1B	709717.8682	1175726.3306	14.20’
MW-2A	709863.1699	1175714.5759	14.72’+/-
MW-3A	709868.2288	1175645.4877	13.91’
CO-3A	709849.1407	1175630.5507	13.10’
CO-3B	709843.1930	1175636.9974	12.92’
SO-4A	709800.9119	1175581.8993	14.61’
SO-4B	709817.2408	1175568.7243	14.10’
SO-2A	709868.5338	1175582.5228	14.21’

CONVERSION FORMULA USED TO CONVERT TO NAVD88 = NGVD29+3.501’

FIGURES

APPENDIX A

Groundwater Monitoring Well Logs

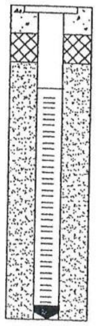
International Incorporated

PAGE 1 OF 1

FACILITY **PETROLEUM RECLAIMING SERVICE INCORPORATED** JOB # **00324-001-01** BORING/WELL **SO4A**
LOCATION **3003 TAYLOR WAY AVE., FIFE, WASHINGTON** SURFACE ELEVATION
START **10/18/96 1415** FINISH **10/18/96 1500** CASING TOP ELEVATION
LOGGED BY **P. JEWETT** MONITORING DEVICE **PID**
SUBCONTRACTOR AND EQUIPMENT **CASCADE DRILLING, INC.; LIMITED ACCESS HOLLOW STEM AUGER**
COMMENTS

PENETRATION RESULTS BLOWS 6"/6"/6"	Sample Depth Interval, feet	PID Reading	Sheen	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Depth Below Surface, feet
				5			5
				0	Silty Gravelly Sand (fill)		0
				▽			
8/9/9	▨	* 0	NS	5	Sand, black, medium dense, medium to coarse grained, saturated	SP	5
55 for 6"	☐	0			No recovery		
2/3/2	▨	* 0	NS	10	Silty Clay, brown to gray, intermixed with peat/organics, very soft, plastic, saturated	CL-ML	10
					Boring terminated at 11.5 feet. Groundwater encountered at approximately 3 feet during drilling. Boring converted to a groundwater monitoring well on 10/18/96.		
				15			15
				20			20
				25			25

Well Construction Schematic



▨ Field Screen/Lithologic Description Sample
☒ Preserved Sample
☐ No Recovery
* Sample Submitted for Laboratory Analysis

▽ Groundwater Level at Time of Drilling
▼ Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts

/ / Gradational Contact
/ Contact Located Approximately
— Contact

Concrete
Bentonite
10/20 Colorado Silica Sand
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

DWG: M324102L

PROJECT: PRSI/DRILLING/ TACOMA

RECORD OF BOREHOLE #C-03A

SHEET 1 **OF** 1

DATUM:

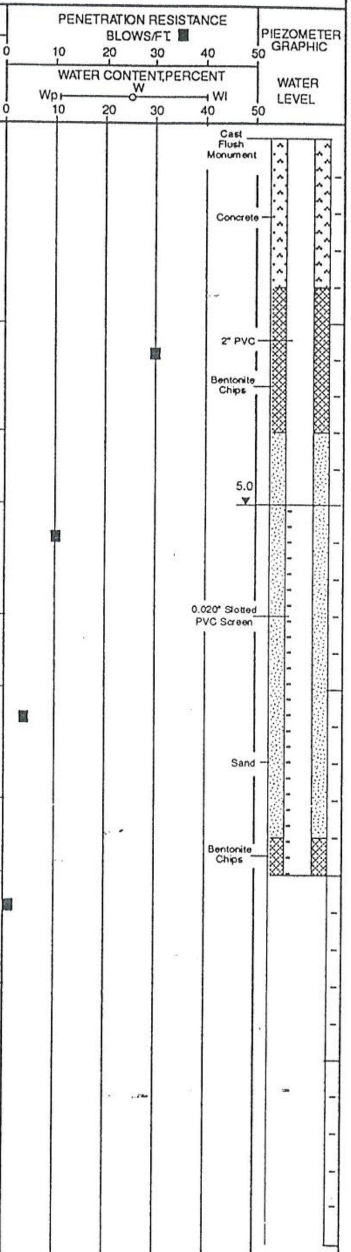
PROJECT NUMBER: 913-1215

BORING LOCATION:

BORING DATE: 8/23/91

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT
0	4 inch Hollow-stem Auger	0.0 Concrete							
		0.8 Loose, brownish-black (5YR2/1) silty, fine to medium sandy, fine to coarse GRAVEL and cobbles, dry	GP						
2.5		2.5 Compact, medium olive-brown (5Y4/4), fine to medium sandy, silty, fine to coarse GRAVEL and cobbles, dry			2.5	E	15-15-15	30	
		3.0 Loose, brownish-black (5YR2/1), fine to coarse SAND, trace silt, strong hydrocarbon odor, moist	SP						
5		5.0 Same material, hydrocarbon sheen visible on soil to 5.5'			5.0	E S	3-4-6	10	
7.5					7.5	E	4-3-1	4	
10					10.0	E	1-0-1	1	
		11.0 Very soft, olive-gray (5Y3/2), silty CLAY, some peat, moist	OL						
		End of hole							
12.5									
15									

E = Environmental Sample
S = Stratigraphic Sample



DRILL RIG: Mobile B-57

DRILLING CONTRACTOR: HOLT DRILLING

DRILLER: Bill

Golder Associates

LOGGED: D. Crawford

CHECKED: M. Lubrecht

DATE: 1/15/92

913-1215

PROJECT: PRSI/DRILLING/
TACOMA

RECORD OF BOREHOLE #C-03B

SHEET 1 **OF** 1

DATUM:

PROJECT NUMBER: 913-1215

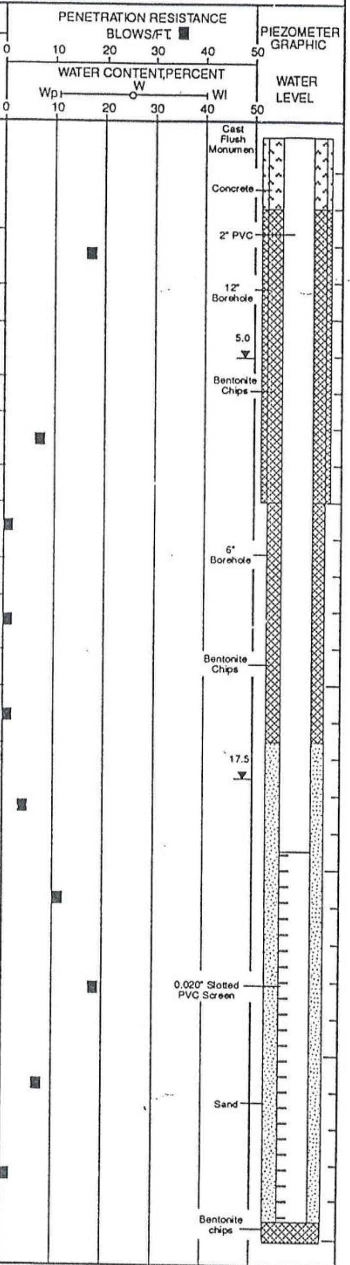
BORING LOCATION:

BORING DATE: 8/26/91

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. DEPTH
0	6 inch Hollow-stem Auger	0.0 Concrete		
		0.8 Loose, brownish-black (5YR2/1) silty, fine to medium sandy GRAVEL, dry	GP	
		2.5 Compact, brownish-black (5YR2/1) fine to coarse SAND, little fine to coarse gravel, moist	SP	
5				
		8.0 Soft, dusky yellowish-brown (10YR2/2) PEAT and clay, moist	PT	
		8.5 Firm, medium olive-brown (5Y4/4) silty CLAY to CLAY, little organic material, moist	ML-CL	
10				
15		15.0 Graded to trace organic material		
	4 inch Hollow-stem Auger	17.5 Loose, brownish-black (5YR2/1) fine to coarse SAND, trace fine to coarse gravel, wet	SP	
20		— Heaving Sand		
25		25.5 Soft, olive-gray (5Y3/2) silty CLAY, moist	CL	
		26.0 Loose, brownish-black (5YR2/1) fine to coarse SAND, wet		
		End of hole		
30				

E = Environmental Sample
S = Stratigraphic Sample

SAMPLES NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT
2.5	E	8-9-8	17	90
5.0	E			90
7.5	E S	2-4-3	7	90
10.0	E	1-0-1	1	100
12.5	E	1-0-1	1	90
15.0	E	1-0-1	1	90
17.5	E	1-1-3	4	75
20.0	E	4-4-7	11	90
22.5	E	11-10-8	18	90
25.0	E	6-3-4	7	
27.5	E	1-0-1		



DRILL RIG: Mobile B-57

DRILLING CONTRACTOR: HOLT DRILLING

DRILLER: Bill

Golder Associates

LOGGED: D. Crawford

CHECKED: M. Lubrecht

DATE: 1/15/92

PROJECT: PRSI/DRILLING/
TACOMA

PROJECT NUMBER: 913-1215

RECORD OF BOREHOLE #S-02A

BORING LOCATION:

SHEET 1 **OF** 1

DATUM:

BORING DATE: 8/23/91

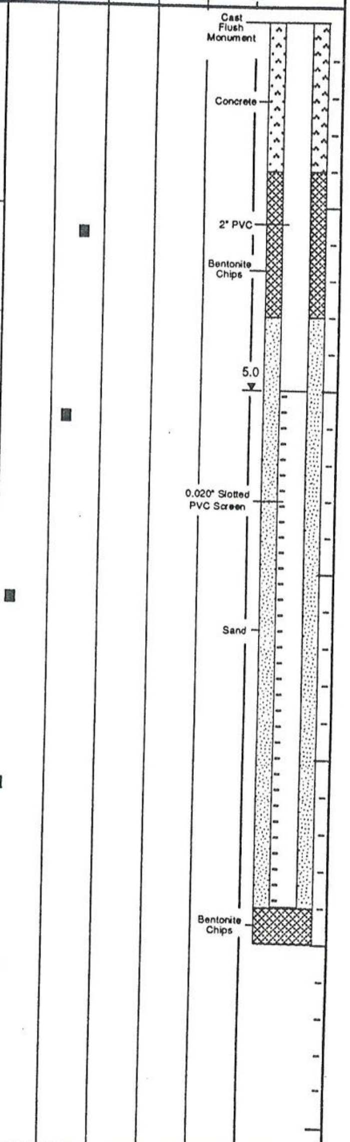
DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT
0	4 inch Hollow-stem Auger	0.0 Crushed rock, compacted sand and gravel	GP							
		0.3 Loose, medium olive-brown (5Y4/4) fine to coarse SAND, some fine to coarse gravel, little silt, dry (FILL)	SM							
2.5						2.5	E S	9-9-7	16	90
5		5.0 Loose, brownish-black (5YR2/1) fine to medium SAND, trace fine gravel, trace silt, wet	SP			5.0	E	3-5-8	13	90
7.5						7.5	E	1-2-1	3	25
		8.5 Loose, brownish-black (5YR2/1) fine to medium sandy SILT, wet	SM							
10						10.0	NO SAMPLE	1-0-1	1	0
12.5		12.5 Very soft, olive-gray (5Y3/2), silty CLAY, little organic material, wet	CL			12.5	E S	0-0-1	1	50
15										

PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50)

WATER CONTENT, PERCENT (Wp ⊢ W ○ ⊣ Wl; 0 10 20 30 40 50)

PIEZOMETER GRAPHIC

WATER LEVEL



E = Environmental Sample
S = Stratigraphic Sample

DRILL RIG: Mobile B-57

DRILLING CONTRACTOR: HOLT DRILLING

DRILLER: Bill

Golder Associates

LOGGED: D. Crawford

CHECKED: M. Lubrecht

DATE: 8/23/91

913-1215\44473

ems
Environmental Services
emsgroupllc.com

Boring Number: **MW03A**
Sheet Number: 3 of 3
Job Name: PRS Monitoring Well Installation
Date: 3/22/2008
Client: PRS Monitoring Well Installation
Location: 3003 Taylor Way Tacoma, WA center of north property line

Casing Depth: n/a
Casing Elevation: n/a
Well Screen Size: n/a
Water Level: 2.5 feet bgs
Surface Conditions: Asphalt

	Start	Finish
	Drilling	
Time:	9:55	10:05

Longitude:

Latitude:

Comments: Direct Push Probe used

Inches Driven	Inches Recovered	Sample Number	Sample Time & Interval	Depth to Water	Water Sampling Screen		Soil Description
						0 -	0-6" Asphalt
						-	6"-2'6": Gray medium to fine sand with silt and occasional gravel,
						1 -	
						-	
						2 -	2'6"-12': Wet brown medium to fine sand with silt and occasional gravel
				▽		-	
						3 -	
						-	
48	36					4 -	
						-	
						5 -	5-5'6": Gray and brown medium to fine well sorted sand with silt
						-	5'6"-6': Gray and white medium to fine well sorted sand with silt, moist

		SMW3A3.5	10:00			6	-	6-8': Gray well sorted silt with some fine sand, wet
		SMW3A3.5	10:20				-	
						7	-	
							-	
48	48					8	-	8-11'6": Gray poorly sorted silt with some clay, wet
							-	
						9	-	
							-	
						10	-	
							-	
						11	-	
							-	11'6"-16': Gray fine sorted sand with silt
48	48					12	-	
							-	
						13	-	
							-	
						14	-	
							-	
						15	-	
							-	
						16	-	
							-	
						17	-	
							-	Well Developed @1255
						18	-	

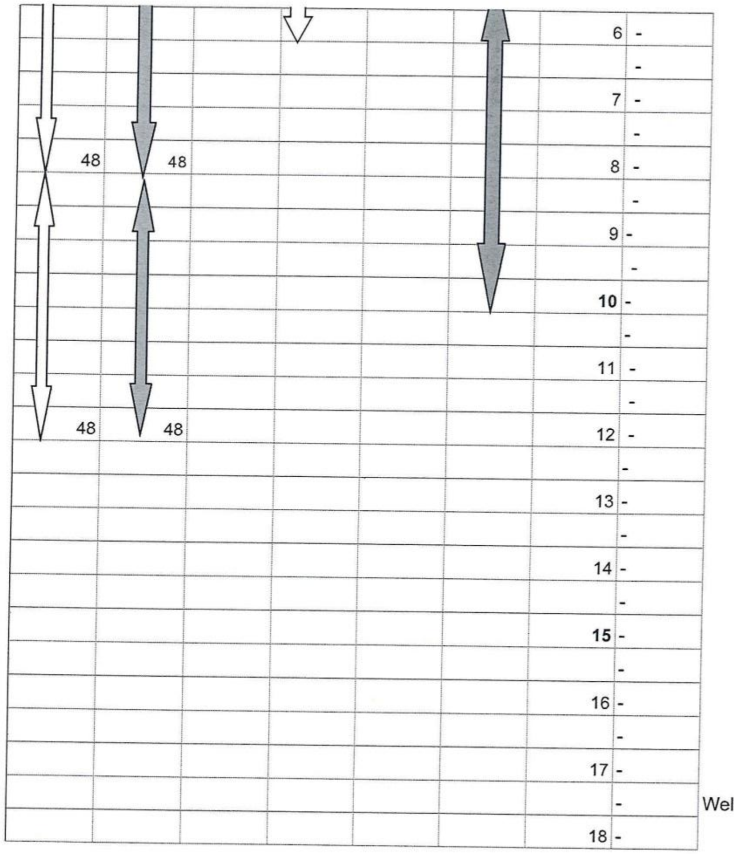
ems
Environmental Services
emsgroupllc.com

Boring Number: **MW02A**
Sheet Number: 2 of 3
Job Name: PRS Monitoring Well Installation
Date: 3/22/2008
Client: PRS
Location: 3003 Taylor Way Tacoma, WA northeast corner of property
Casing Depth: n/a
Casing Elevation: flush mount
Well Screen Size: n/a
Water Level: 3 feet bgs
Surface Conditions: Asphalt

	Drilling	
	Start	Finish
Time:	9:20	9:30

Longitude:
Latitude:
Comments: Direct Push Probe used

Inches Driven	Inches Recovered	Sample Number	Sample Time & Interval	Depth to Water	Water Sampling Screen		Soil Description
						0 -	0-6" Asphalt
						-	6"-3'6": Brown medium to fine sand with silt and occasional gravel
						1 -	
						-	
						2 -	
						-	
				▽		3 -	
						-	4-12': Wet gray medium to fine sorted sand with silt
48	36					4 -	
						-	
		SMW2A4'	9:35			**5** -	
						-	



Well Developed @ 1230

ems
Environmental Services
emsgroupllc.com

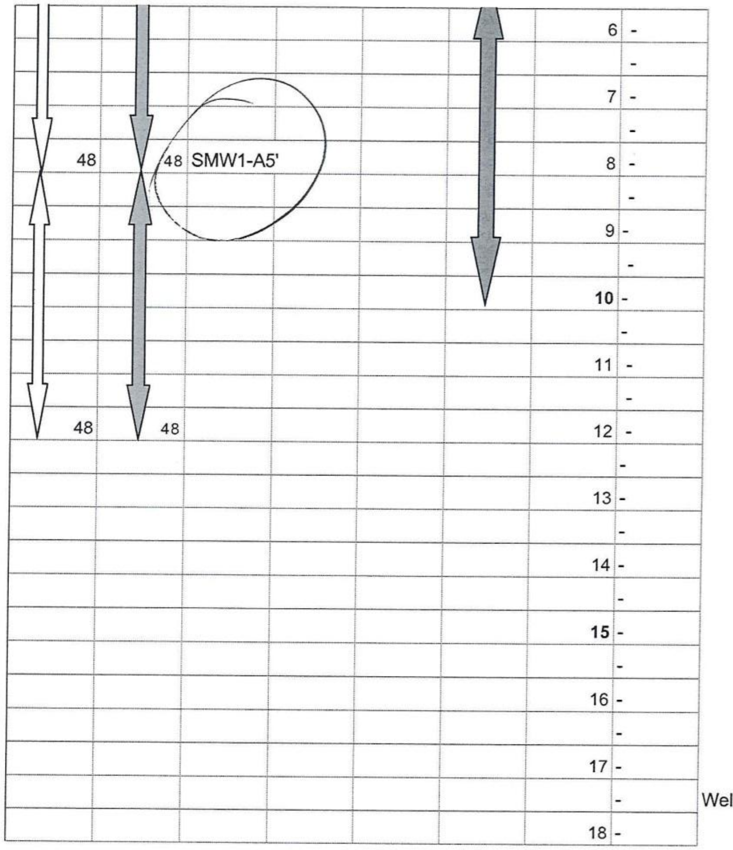
Boring Number: **MW-1A**
Sheet Number: 1 of 3
Job Name: PRS-Monitoring Well Installation
Date: 3/22/2008
Client: PRS
Location: 3003 Taylor Way Tacoma, WA Southeast corner of property

Casing Depth: n/a
Casing Elevation: flush mount
Well Screen Size: n/a
Water Level: 3 feet bgs
Surface Conditions: Asphalt

	Drilling	
	Start	Finish
Time:	8:27	8:55

Longitude:
Latitude:
Comments: Direct Push Probe used

Inches Driven	Inches Recovered	Sample Number	Sample Time & Interval	Depth to Water	Water Sampling Screen		Soil Description
						0 -	0-6" Asphalt
						-	6"-2'6": Brown medium to fine sand with silt and occasional gravel, resembling fill material
						1 -	
						-	
						2 -	2'6"-12': Wet brown medium to fine sand with silt and occasional gravel
						-	
				▽		3 -	
						-	
48	36					4 -	
						-	
						5 -	
			9:00		▲	-	



Well developed @ 1200

APPENDIX B

Quality Assurance Project Plan

QUALITY

ASSURANCE

PROJECT

PLAN

PRS Group, Inc.
Tacoma, WA

TABLE OF CONTENTS

TABLES

EXHIBITS

DISTRIBUTION LIST

This list identifies all individuals to receive a copy of the Approved Quality Assurance Project Plan, either in hard copy or electronic format, as well as any subsequent revisions.

Washington State Department of Ecology Project Manager:	Chuck Hoffman Washington State Department of Ecology Hazardous Waste and Toxics Reduction Southwest Regional Office PO Box 47775 Olympia, WA 98504-7775 360-407-6344 chof461@ecy.wa.gov
PRS Senior Project Manager	Tom Smith PRS Group, Inc. 3003 Taylor Way Tacoma, WA 98421 253-383-4175 tom@prsplant.net
PRS Sampling Team Leader:	Jay Johnson PRS Group, Inc. 3003 Taylor Way Tacoma, WA 98421 253-383-4175 jay@prsplant.net
PRS Database Administrator	Josh Simmons PRS Group, Inc. 3003 Taylor Way Tacoma, WA 98421 253-383-4175 josh@prsplant.net
Field Team Leader:	TBD Geo Engineers 1101 Fawcett Avenue; Suite 200 Tacoma, WA 98402 253-722-2415 @geoengineers.com
Spectra Laboratory Project Manager:	Steve Hibbs Spectra Laboratories 2221 Ross Way Tacoma, WA 98421

253-272-4850
steveH@spectra-lab.com

Spectra Laboratory QA Leader:

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253-272-4850
@spectra-lab.com

Data Validator

Geo Engineers
1101 Fawcett Avenue; Suite 200
Tacoma, WA 98402
253-722-2415
@geoengineers.com

QUALITY ASSURANCE PROJECT PLAN
PRS GROUP, INC.
TACOMA, WA 98421

1.0 BACKGROUND

PRS Group, Inc. (PRS) manages wastes from off-site generators from their location at 3003 Taylor Way in Tacoma, Washington, as shown in Figure E-1 Facility Site Map. PRS operates under the requirements of WAC-173-303-515 (Standards for the management of used oil).

The project description, regulatory background, site history, site characterization, and site conditions are described in the Comprehensive RI Report, addendums and quarterly reports.

This QAPP outlines quality assurance (QA) and quality control (QC) protocols to be followed in implementing the GWMP.

2.0 PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP) supports the groundwater monitoring and sampling activities at the facility. This QAPP addresses the type and quality of data needed to support environmental decisions and provides direction for collecting data during the groundwater monitoring and sampling activities and for assessing and reporting those data. This QAPP also outlines quality assurance (QA) and quality control (QC) protocols to be followed in implementing the GWMP.

3.0 ORGANIZATION

The individuals responsible for planning and implementing field and laboratory operations and QA/QC procedures for this project are identified in Table B-1 **Project Personnel and Responsibilities**, along with contact information and a summary of each individual’s responsibilities for project management and QA procedures.

3.1 Management Responsibilities

Project management responsibilities are shown in Table B-1. Detailed descriptions of the management and QA responsibilities of laboratory personnel are described in the Spectra Laboratories QA Manual (Exhibit B-1).

3.2 Quality Assurance Responsibilities

The personnel responsible for review and approval of the QAPP and for data verification, validation, and data quality assessment are described in Table B-1.

3.3 Field Responsibilities

Field responsibilities for collection of the samples are provided in the GWMP and in Section 6 through 8 of this QAPP.

3.4 Laboratory Responsibilities

Spectra will provide analytical services for the groundwater monitoring program. The Laboratory QA Leader, as described in Table B-1, will ensure that appropriate procedures are followed during sample analysis and preparation of the data packages and electronic deliverables.

Spectra has provided their QA Manual (Exhibit B-1) for review and approval by the PRS Senior Project Manager. The QA manual includes descriptions of the laboratory organization, personnel, and responsibilities; facilities and equipment, analytical methods and QA/QC protocols; and routine procedures for sample custody and data handling.

4.0 QUALITY OBJECTIVES

The sampling design, field procedures, laboratory procedures, and QC procedures are set up to provide high-quality data for use in the groundwater monitoring program. Specific data quality factors that may affect data usability include quantitative factors (representativeness and comparability). The measurement quality objectives (MQOs) associated with these data quality factors are summarized in Table B-2 **Measurement Quality Objectives** and discussed below.

4.1 Precision

Precision is the agreement among a set of replicate measurements without assuming knowledge of the true value. Precision is measured for this project by calculating the relative percentage difference (RPD) for analytical results from field duplicate and lab duplicate samples. Precision is optimized by collecting data at multiple locations and adhering to strict procedural guidelines that minimize possible sample contamination. RPD results that are outside the control limits listed in Table B-2 for laboratory split samples will be qualified appropriately during data validation.

Field precision will be assessed through the collection and analytical testing of field duplicates at a rate of one duplicate per 20 samples, or a minimum of one per sampling event. These analyses measure both field and laboratory precision. The results, therefore, may have more variability than laboratory-generated duplicates.

Laboratory precision is assessed through analysis of duplicate spiked and/or unspiked samples, as specified by the analytical method. Specific discussion of the different types of laboratory duplicate samples is found in Section 8.1. The RPD value will be calculated according to the following formula:

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

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 may also be expressed as the percent difference (%D) between replicate analyses. During data validation, the Data Validator will evaluate all RPD values and take action as described in U.S. Environmental Protection Agency (EPA) guidance (EPA, 2008, 2010).

4.2 Bias

Bias is systematic deviation of a measured value from the true value. Bias can be assessed by comparing a measured value to an accepted reference value in a sample of known concentration or by determining the recovery of a known amount of contaminated spiked into a sample. Bias is minimized for this project by standardizing field activity methodologies, including methods for equipment decontamination, sample collection, field observation and documentation, sample transport, and chain of custody control. Descriptions of these methodologies are included in the GWMP.

4.3 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy will depend on a combination of random error and of common systematic error (or bias). Accuracy will be evaluated for this project by evaluating laboratory spike sample recoveries that represent the difference between an observed value and an accepted reference value. Control limits for spike recoveries have been documented by the project laboratory and are found in Table B-2. Results showing noncompliant recoveries will be qualified appropriately during data validation. In general, if percent recoveries are consistently low, nondetect 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 consistently high. In such case, results for detected analytes may be higher than the true value. Accuracy will be optimized for this project by using procedures designed to reduce potential error that might impact the accuracy of results. The laboratory QC procedures, described in Section 8.1, also reduce error to improve accuracy.

Accuracy will be assessed by the percent recovery (%R) of a surrogate compound (also known as “system monitoring compound”), a matrix spike result, and/or results from a laboratory control sample (also known as standard reference material or blank spikes) where:

$$\text{Recovery (\%)} = \frac{\text{Sample Result}}{\text{Spike Amount}} \times 100$$

The Data Validator will evaluate all %R values and take action as described in EPA guidance (EPA, 2008, 2010).

4.4 Representativeness

Representativeness is the measure of how well data reflect the actual environment and the conditions under which the data are collected. Representativeness will be optimized for this project by using general historical and investigative information to determine proper locations of new sampling points that represent the areas of concern. The methodologies used to collect samples and measurements, as detailed in the GWMP, are also designed to collect representativeness of the data will be performed by:

- Comparing actual sampling procedures to those prescribed in the GWMP and this QAPP;
- Comparing analytical results from field duplicates to determine variation in the analytical results; and
- Flagging nonrepresentative data as invalid or identifying data that are noncompliant with project specifications.

Only representative data will be used in subsequent data reduction, validation, and reporting activities.

4.5 Comparability

Comparability is how well multiple data sets can be used for a common interpretation. Comparability will be optimized for this project by using the same standards for data collection at each location, and the same analytical procedures and QA procedures during each sampling event.

Comparability expresses the confidence with which one set of data can be compared to another. Since numeric goals do not exist for comparability, a statement of comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy. This statement will be included in the Data Review Reports (see Section 10.2.3).

4.6 Completeness

Completeness is a measure of the amount of data collected that are found to be valid in relation to the total amount of data intended to be collected according to the sampling design. Completeness will be optimized for this project by having all analytical results validated or reviewed by a data validator to assess the validity of the data.

The number of samples and results expected establishes the comparative basis for completeness and is defined as a ratio of acceptable measurements (including estimated data) obtained to the total number of planned measurements for an activity. Completeness (C) can be calculated as follows:

$$\%C = \frac{\text{(number of acceptable data points)}}{\text{(total number of data points)}} \text{ x } 100$$

The data quality objective (DQO) for completeness for this project is 100 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. Completeness below 100 percent will require review of the sampling objectives to determine whether further sampling and analyses may be required.

4.7 Reporting Limits

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Although results reported near the MDL provide insight to actual field conditions, quality assurance requires that analytical methods achieve a consistently reliable level of quantitation known as the practical quantitation limit (PQL). The laboratory will provide numerical results for all analytes and report them as detected above the PQL or undetected at the PQL.

Ideally, the laboratory's reporting limits (PQLs) should be low enough to compare to the applicable Model Toxics Control Act (MTCA) Method A or Method B screening levels. A reasonable level of effort will be exercised to achieve these goals. The current PQLs are shown in Table B-3 **Groundwater Practical Quantitation Limits**.

The PQLs listed in Table B-3 are considered "target" reporting limits, because several factors may influence laboratory practical quantitation limits and individual sample quantitation limits. Changes in laboratory protocols may change the applicable PQL that the laboratory can achieve. The most recent laboratory QA Manual will provide the current applicable PQL. Analytical procedures may also require dilution and/or cleanup of samples and subsequent reanalysis to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes may be reported as undetected at a PQL much higher than a specified screening level. Data users must be aware that nondetected analytes with a high stated reporting limit, although correctly reported, can bias statistical summaries, and careful interpretation is required to correctly characterize site conditions. During data validation, evaluation will be made and the most appropriate result for each analyte will be reported.

5.0 SAMPLING PROCESS DESIGN

The sampling design, including figures showing field work locations, tables of samples to be collected, and the sample collection schedule, are included in the GWMP.

6.0 SAMPLING PROCEDURES

Procedures for all field activities are described in the Section 4.1.2 and Section 4.2.2 of the GWMP. All field personnel will have completed 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Site Operations (HAZWOPER) training, as specified in the **Health and Safety Plan** (HASP) (Appendix E of the GWMP).

All instruments used in collection of samples will be properly calibrated according to the manufacturer's recommendations and decontaminated between samples if the instrument is reusable and comes in contact with samples. All samples will be placed in iced coolers immediately following sample collection, and strict chain of custody control will be maintained at all times. Samples will be delivered or shipped to Spectra Laboratories in Tacoma, Washington.

All instruments used in measuring water quality parameters will be calibrated according to PRS' SOPs.

6.1 Sample Identification

Each sample will be assigned a unique alphanumeric identification code (identifier) that contains sufficient information to identify the sample location and date. The sample labeling procedure is described in Section 4.2.6 of the GWMP.

6.2 Sample Labeling

A label will be securely attached to every sample container. Each label will include the following information:

- Sample number;
- Sampling event location;
- Project name;
- Preservatives added to the sample;
- Date and time of collection (using 24-hour time clock to minimize potential confusion about a.m. and p.m.; e.g., "1300" vs. "1:00 p.m."); and
- Analytes for which the sample is to be analyzed.

6.3 Field Log Maintenance

All sample locations descriptions, sample identifiers, and analyte lists will be recorded in the field log. The field log will include, but not be limited to, the following information:

- All incidents observed during each sampling event;
- The names of all personnel present involved in the sampling event;

- The major events that occurred during the day;
- Details about field procedures conducted; and
- Details about samples collected or problems that occurred.

Procedures for maintaining the field log are described in Section 4.2.5 of the GWMP and PRS-SOP-400 **Documentation Procedures**.

6.4 Sample Containers and Preservatives

Table 1 **Groundwater Monitoring Schedule** in the GWMP specifies the sample containers required for each analytical method. Table B-4 **Sample Containers, Preservation, and Holding Times** also specifies the required containers as well as the sample size, preservation protocol, and holding times for the list of analyses to be performed. All sample containers will be provided by the laboratory and will include the appropriate preservatives.

Sample containers will be placed in opaque, insulated coolers packed with ice to minimize their exposure to light and to cool them approximately to the recommended temperature. The coolers will be packed with sufficient packing material to prevent sample container breakage and/or leakage during transport.

The Senior Project Manager and Field Team Leader will plan sampling activities and coordinate sample delivery with laboratory personnel so that the sample holding time limits and temperatures specified in Table B-4 are not exceeded.

6.5 Sample Storage and Transportation

The exteriors of all sample containers will be wiped clean after they have been closed. Blank (QC) samples will be packaged with the primary samples that they control. Any vacant space in the cooler will be filled with ice or packaging material. If the cooler has a drain, it will be taped shut. Then each cooler will be secured using a chain of custody tape that will remain intact and verified by the testing laboratory.

6.6 Sample Chain of Custody

Chain of custody procedures will be followed by all project personnel to document sample transfer, sample possession, and sample integrity, from the time of sample collection through the completion of sample analysis. A chain of custody form will be initiated at the time of sampling, and will accompany the samples at all times including upon receipt at the project laboratory. The project laboratory maintains an internal custody protocol. The chain of custody form has blank fields for entering the sample identifier, the date and time of sample collection, the name of the person who collected the sample, and the requested laboratory analyses. Each chain of custody form will be signed by every person who handles the sample containers. Sample transfers will be noted on the chain of custody form for each sample.

The chain of custody form documents sample identifications, locations, sample times, and the analyses required for each sample. This is the principal document shared by the sample generator and the project laboratory. Therefore accuracy and completeness are extremely important. Personnel initiating the chain of custody form will refer to the field forms and the field log (described above in Section 6.3) to access the required information. This continuity will help make the various forms of documentation consistent and reduce the risk of error. The chain of custody form will accompany all samples during transport. The field sampler also will keep a copy of the chain of custody form for the project file.

All samples will be delivered directly to laboratory personnel authorized to receive samples (sample custodians). When the laboratory receives the samples, the sample custodian will inspect the exterior condition of the shipping container. Then the sample custodian will open and examine the interior of the shipping container. Next the sample custodian will examine the sample containers and check the contents of the shipping container against the chain of custody form. The sample custodian will record any inconsistencies or problems with the sample shipment (breakage or signs of leakage, and missing or extra samples) on the chain or custody record and notify the PRS Senior Project Manager or the Spectra Laboratories QA Leader for immediate resolution. Official acceptance of sample custody will be documented by the sample custodian's signature on the chain of custody form. The samples will then be tracked through the laboratory by the laboratory's internal custody procedures.

7.0 MEASUREMENT PROCEDURES

A list of analyses and target reporting limits for this project are provided in Table B-3. The analytical and QA/QC procedures used by the laboratory QA Manual and SOPs included as Exhibit B-1.

7.1 Laboratory Measurement Procedures

Groundwater samples will be analyzed for the list of analytes as identified in the GWMP. These analytes are listed in Table B-3. Chemical laboratory analyses will be performed using the following sets of standard laboratory methods:

- Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition (EPA, 2007);

- Ecology method NWTPH (for total petroleum hydrocarbons)

Specific analytes, reference methods, and target reporting limits (i.e., the applicable PQL), are presented in Table B-3.

7.2 Field Measurement Procedures

Field equipment will be used and calibrated in general accordance with the manufacturer’s recommendations. More details on field procedures are provided in the GWMP.

8.0 QUALITY CONTROL

This section outlines QC procedures to be followed by both field personnel and the analytical laboratory. Following these QC procedures will support the development of a complete and accurate data set following laboratory analysis and data validation. In this section, a sampling event is defined as consecutive days of sampling not separated by more than two days of inactivity.

8.1 Analytical Laboratory Quality Control

The project laboratories are required to adhere to specified criteria in the following areas to verify the validity of data being produced:

- Holding times;
- Instrument tuning;
- Initial calibrations and continuing calibration verification;
- Method blanks;
- Surrogate spike compounds;
- Matrix spike samples and matrix spike duplicates(MS/MSD)
- Laboratory control samples (LCS)
- Laboratory duplicates; and
- Internal standards.

8.1.1 Holding Times

Holding time constraints for each method will be met to ensure the validity of the results report. Holding times are outlined in Table B-4.

8.1.2 Instrument Tuning

Instrument tuning for analyses by gas chromatography/mass spectrometry (GC/MS) will be completed to ensure that mass resolution, identification, and, to some degree, sensitivity of the analyses are acceptable. Instrument tuning will be completed each 12-hour period during which samples or standards are analyzed. In the event that an instrument tuning does not meet control limits, analyses of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any project samples analyzed while the instrument is out of calibration will be reanalyzed.

8.1.3 Laboratory Instrument Calibration

Initial calibration of instruments, as applicable, will be performed at the start of the project and when any ongoing calibration does not meet control criteria. The number of points used in the initial calibration is defined in each analytical method. Continuing calibration verification will be performed as specified in the analytical methods to track instrument performance. In the event that continuing calibration verification does not meet control limits (as specified by the method requirements), analysis of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any project samples analyzed while the instrument was out of calibration will be reanalyzed. Calibration documentation will be retained at the laboratory and readily available for review.

8.1.4 Laboratory Method Blanks

According to the EPA (2008, 2010), "the purpose of laboratory (or field) blank analyses 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)."

Method blanks are laboratory QC samples that consist of either a contaminant-free, soil-like material or deionized water. Method blanks are created in the laboratory during sample preparation and follow samples throughout the analysis process. The frequency of method blanks will be at least one per analytical batch for each matrix. No more than 20 non-QC field samples can be contained in one batch.

If a substance is found in the method blank then one (or more) of the following events occurred.

- The 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 contaminated the samples during preparation or analysis.

Give method blank results, validation guidelines aid in determining which substances in samples are considered "real" and which ones are inadvertent contaminants of the analytical process.

During data validation, the Data Validator will evaluate all method and field blank sample results and take action as described in EPA reference documents (EPA, 2008, 2010); professional judgment will be applied as necessary.

8.1.5 Surrogate Spikes

Surrogate spike compounds are used during analysis for organic analytes to verify the accuracy of the instrument being used and assess extraction efficiency. Surrogates are substances similar to, but not one of, the target analytes. A known concentration of surrogate compound is added to the sample and passed through the instrument, and the surrogate compound recovery is recorded. Each surrogate compound used has an established range of acceptable percent recoveries, as summarized in Table B-2. 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 exists, although nondetected results are considered accurate.

8.1.6 Matrix Spike/Matrix Spike Duplicates

Laboratory precision will be determined by splitting spiked or unspiked samples. MS/MSD sample analyses are used to determine accuracy and precision and to assess interferences caused by the physical or chemical properties of the sample itself. The analyst uses this information to determine the precision of the preparation and analytical techniques used to analyze the duplicate sample.

MS samples are preselected by field personnel and labeled accordingly on the chain of custody (see Section 8.2.6). The laboratory divides the sample into equal aliquots, and then spikes each of the aliquots with a known concentration of target analytes. Matrix spike samples are prepared by spiking a known amount of one or more of the target analytes at a concentration of 5 to 10 times higher than the expected sample result. Matrix spikes will be prepared and analyzed at a minimum frequency of 5 percent or one for each batch of 20 or fewer samples for each matrix. Same analyses (such as total petroleum hydrocarbons) do not require MS/MSDs, as shown on Table B-5 **Quality Control Sample Types and Frequency**. In addition, some analyses only require an MS sample and not an MSD.

MS/MSD data are reviewed in combination with other data quality indicators (e.g., LCS/LCS duplicate [LCSD]) to determine matrix effects. In some cases, matrix effects cannot be determined due to dilution and/or high levels of related substances in the sample.

8.1.7 Laboratory Control Spikes/Laboratory Control Spike Duplicates

The purpose of the laboratory control spike samples (also known as blank spikes) is to aid in assessment of overall accuracy and precision of the entire analytical process (e.g., sample preparation, instrument performance, and analyst performance). An LCS will be prepared and analyzed at a minimum of one LCS with each batch of 20 samples or fewer for each matrix. LCS are similar to matrix spikes; however, the LCS spike medium is “clean” or contaminant free.

8.1.8 Laboratory Replicates/Duplicates

Precision for inorganic analytes is monitored by analysis of [nonspiked] sample replicates/duplicates. Laboratory duplicate sample analysis, for inorganic analytes, will be prepared and analyzed at a minimum frequency of 3 percent or one laboratory duplicate with each batch of 20 samples or fewer for each matrix.

8.1.9 Internal Standards

Internal standards are added to all field and QC samples immediately prior to analysis for analyses completed by GC/MS. The internal standards are used to quantify target compounds and to ensure that the instrument is stable and functioning as calibrated.

No special QC procedures will be required for this project. Ranges of laboratory-established control limits for surrogates, MS/MSD recoveries, LCS recoveries, and laboratory duplicate RFDs, as applicable, are provided in Table B-2. The most current laboratory control limits will be used to evaluate results during data review and may be obtained directly from the Laboratory Project Manager.

8.2 Field Quality Control

Field QC samples are collected and analyzed to assess sample collection techniques, possible sources of contamination, interferences that may be attributed to the sample matrix, and, to some degree, the bias and precision of the reported results. Field QC will be evaluated, along with laboratory QC, by the Data Validator during data review and validation. Affected data will be qualified in accordance with EPA (2008, 2010) guidelines. A description of each type of QC sample is described below. For the purpose of this discussion, the term “primary sample” is defined to be a field sample of environmental medium (e.g., soil) other than a field QC sample.

8.2.1 Field Equipment Calibration Procedures

Field equipment requiring calibration will be calibrated to known standards in accordance with manufacturer’s recommended schedules and procedures for each instrument. Calibration (or drift) checks of the vapor measurement equipment will be conducted daily, and the instruments will be recalibrated as required. Calibration measurements will be recorded in the daily field logs. If field equipment becomes inoperable, it will be replaced with a properly calibrated instrument.

8.2.2 Equipment (Rinsate) Blanks

Equipment Rinsate blanks will be collected whenever nondedicated or nondisposable sampling equipment will be used. Equipment Rinsate blanks will be used to identify possible contamination from the sampling environment or from sampling equipment. These blanks will be collected by pouring deionized and distilled water over (or through) the decontaminated sampling equipment and into a sample jar. One equipment Rinsate blank will be collected for each type of sampling equipment used during the sampling event and will be analyzed for all analytes except convention analytes. The frequency of collection will be 1 per 20 samples collected. These are typically not required during routine sampling since PRS uses dedicated or disposable equipment for sampling all wells, but would be required if that were ever not the case.

8.2.3 Field Blanks

Sampling personnel will collect field blanks and submit the blanks to the laboratory as natural samples. Field blanks will be used to identify possible contamination occurring from the sampling environment. These blanks will consist of deionized and distilled water from the analytical laboratory in clean and preserved sampling containers. In the field, this water will be transferred to an empty sampling container at a specified sampling location. The sample will be preserved for the applicable analysis to be completed. The frequency of collection will be 1 per 20 samples collected. Field blanks will be analyzed for all analytes.

8.2.4 Trip Blanks

Trip blank samples, consisting of organic-free water poured into 40-milliliter (ml) sample vials at the laboratory under contaminant-free conditions, will be provided by the laboratory for each sampling event that includes analysis of volatile organic compounds (VOCs). Trip blanks remain sealed during sampling and are kept in the sample transport container at all times. Trip blank samples are analyzed for VOCs and gasoline-range organics and will provide a measure of potential cross-contamination with VOCs during shipment and handling.

Trip blanks will be included at a rate of one per cooler for analyses of all volatile constituents (e.g., VOCs, and gasoline-range organics). Results of trip blank samples are used to assess potential contamination that may impact groundwater samples during transport.

8.2.5 Field Duplicates

Field duplicates are used to assess the homogeneity of samples collected in the field and the precision of sampling methods. Field duplicates are prepared by collecting two aliquots (i.e., splits) of sample from the same sampling location using the same sampling equipment and technique, then submitting them for analysis as separate samples. Results from the analysis of field duplicates are used to evaluate the precision and consistency of laboratory analytical procedures and methods, and the consistency of the sampling techniques used by field personnel. Groundwater field duplicates will be collected at a rate of 1 per 20 samples per sampling event. Field duplicates will be collected at locations with suspected contamination. Any well and COC detections the previous sampling round would be eligible to be a field duplicate location the following round and no location will be sampled as a field duplicate location two rounds in a row. The field duplicate RPD should be less than 30 percent for groundwater samples.

8.2.6 Matrix Spike/Matrix Spike Duplicate

Extra sample volume must be collected by field staff to enable the lab to run MS/MSD analyses for the designated analyses listed in Table B-5. MS/MSD sample volume should be submitted at a rate of 1 per 20 samples collected, or one per field mobilization (lab batch) at a minimum. All MS/MSD samples should be noted on the chain of custody form. MS samples should be collected at relatively “clean” locations and are analyzed to assess the effects of the sample matrix on the accuracy of analytical measurements. Any well without COC detections the previous sampling round would be eligible to be a field duplicate location the following round and no location will be sampled as an MS/MSD location two rounds in a row. MSD samples are used to assess both accuracy and precision.

8.3 Corrective Action

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or QC performance outside established criteria. Corrective action can occur during field activities, laboratory analyses, data validation, or data assessment.

Corrective actions should be designed to correct the problem and to minimize the possibility of recurrence. Examples of corrective actions include modifying nonconforming procedures, forms, or worksheets; instituting a quality check; and the like. Proposed corrective actions should be reviewed and approved by the QA Leader prior to implementation. Significant noncompliance and corrective actions will be discussed in QA reports to the Project Manager and Washington State Department of Ecology (Ecology), as appropriate.

8.3.1 Field Corrective Action

Project personnel will be responsible for reporting technical or QA nonconformances or deficiencies of any activity or issued document to the Field Team Leader. The Field Team Leader will consult with the QA Leader to determine whether the situation warrants a reportable nonconformance and subsequent corrective action. If so, a Corrective Action Report (CAR) will be initiated by the QA Leader.

Corrective actions will be implemented and documented in the field record log. No staff member will initiate corrective action without prior communication of findings using the process described above.

8.3.2 Laboratory Corrective Action

Corrective action by the laboratory may occur prior to or during initial analyses. Conditions such as broken sample containers, multiple phases, low/high pH readings, and potentially high-concentration samples may be identified during sample log-in or prior to analysis.

Laboratory corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, and who checks potential sources of error, such as instrument calibration, spike and calibration mixes, and instrument sensitivity. If the problem persists, or cannot be identified, the problem should be referred to the supervisor, manager, and/or Laboratory Project Manager for further investigation and possible formal corrective action.

The contracted laboratory’s QA manual (Exhibit B-1) includes specific procedures for identification and documentation of nonconformance and implementation and reporting of corrective action.

8.3.3 Corrective Actions Resulting From Data Validation

If necessary, the Data Validator will contact the laboratory for further information, clarification, or needed resubmissions and/or corrective actions. All communications will be documented and included with the data validation report as an appendix.

In cases where a deficiency or problem is recurring nonconformance requiring more extensive corrective action, it should be documented on a formal CAR. The CAR will be sent to the organization responsible for the corrective action, and a copy routed to the QA Leader. When the corrective action is complete, the Data Validator will complete the CAR.

9.0 DATA MANAGEMENT PROCEDURES

Computerized systems will be used to record, store, and sort the technical data that will support the site investigation. The data record will include a unique sample code, station ID, sample type (matrix), analyte, analyte concentration, and concentration units. Automated data handling increases the data integrity by reducing errors, omissions, and ambiguities that can be introduced by manual procedures. In addition, automated procedures will generally be used by the laboratories to capture and summarize analytical results. In this case, electronic data files can be imported directly from the laboratory to PRS's database, minimizing both data entry effort and opportunities for error. Sampling location coordinates will be entered into the database to enable the generation of maps and figures using GISKey© and AutoCad© software.

Field logbooks, station/sample forms, and chain of custody/sample analysis request forms are prepared by the field team while sample collection activities are in progress. Sample information from the field, such as water elevation data, is entered manually. Data from the laboratories are entered directly from the electronic data deliverables (EDDS). A small portion of the laboratory data may be entered manually if electronic data cannot be supplied. Data qualifiers are entered into the database when data validation is completed and verified, and the data set is approved as final. All manual and electronic entries are verified by the data manager or validation personnel.

Project tables and reports are prepared using customized retrievals that filter and sort the data according to criteria specified by the user. The data are automatically formatted for direct use with statistics software packages and various geographic information systems (GIS) software.

9.1 Laboratory Data Reports

The project laboratory will complete all analyses as described in the GWMP and present the following, at a minimum, in a report to the QA Leader within approximately 30 days of the receipt of samples, unless a shorter turnaround time is requested.

- Case narrative: the case narrative will describe the analytical methods used and discuss any irregularities encountered during sample analyses and any resulting data qualification.

- Analyte concentrations: A summary of analytical results will be presented for each sample.

- Method reporting limits: Method reporting limits achieved by the laboratory will be presented with analyte concentrations.

- Laboratory data qualifier codes and a summary of code definition: Data qualifiers will appear next to analyte concentrations, and associated definitions will be summarized in the report.

- Lab QC results: Results for method blanks, MS/MSD, LSC/LSCD, lab duplicates, and surrogate recoveries will be provided with final results.

- EDD version of results: A full set of results will be provided in database format.

9.2 Project Database

Data validation will be performed on specified analytical data for this project (see Sections 10 and 11), and the data validator will enter validation qualifiers and comments into the data set as necessary. The QA Leader will then transmit the validated EDD along with the validation report to the database uploader, who will upload it into the project database. Tables from the database will then be backchecked against hard copy results. Any corrections will be made to the database based on backcheck findings. The data will then be considered final, and EDDs or tables will be created from the database as necessary for use in data analysis and reporting.

9.3 Records Management

The QA Leader will inventory and store all analytical data, including all resubmissions collected during data validation efforts, worksheets, and original data validation reports.

10.0 AUDITS AND REPORTS

10.1 Technical Systems Audits

Technical systems audits will not be performed. Any deviations from the GWMP that occur during the reporting period will be included in the annual reports provided to Ecology.

10.2 Reports

Procedures, observations, and test results will be documented for all sample collection, laboratory analysis and reporting, and data validation activities. In addition to data reports provided by the laboratories, reports will be prepared that address data quality and usability and that provide tabulated laboratory and field data. Internal and external reporting procedures for this project are described in this section.

Upon receipt of the chemical data from the laboratories, the data will be subjected to a QA review (e.g., data validation). The QA reviews are anticipated to be completed within 30 days of receipt of the last data package from the laboratory. The results of the validated data will then be reported according to the schedule in the GWMP. Details regarding the validation of data are presented in Section 11.0 of this QAPP. In the event of unscheduled delays in the project schedule, the PRS Senior Project Manager will inform the Ecology Project Manager.

10.2.1 Field Records

Field records will be maintained during all stages of sample collection and preparation for shipment to the laboratories. Field records will include the following items:

- Field logbook to record daily sampling activities, conditions, and field measurements.
- Combined station/sample log to document station locations and date and time of collection;
- Sample labels and tags;
- Combined chain of custody/sample analysis request (COC/SAR) forms;
- Custody seals to monitor cooler security during shipment; and
- Photographic documentation (if taken).

Descriptions of the information that will be reported on each field record form are provided in SOP-400, contained in Appendix D of the GWMP. In addition to the routine field records, the following reports will be completed if a deviation from the GWMP or QAPP is encountered:

- Corrective action reports documenting any problems encountered during field activities and corrective actions taken,
- A summary of any changes made to documented procedures and the rational for the changes.

10.2.2 Laboratory Data Reports

The laboratories will perform data reduction as described in each test method for this project and submit complete data packages, as appropriate, with full documentation for all analyses or other determinations. The laboratory QA managers or their designees are responsible for reviewing their respective laboratory data packages, verifying all method-specific QA/QC protocols were completed and are acceptable, and checking data reduction so that a QA review has been completed and are acceptable, and checking data reduction so that a QA review has been completed for all data reported prior to submittal to PRS. Any transcription or computation errors identified during this review will be corrected by the laboratory.

The analytical laboratories will provide all information required to complete an abbreviated QA review (i.e., summary review) on 100 percent of the data.

To complete an abbreviated QA review, the information to be reported (as applicable to the analytical method) will include, at a minimum, the following:

- A cover letter discussing analytical procedures and any difficulties that were encountered;
- A summary of analyte concentrations and method reporting limits;
- Laboratory data qualifier codes appended to analyte concentrations, as appropriate, and a summary of code definitions;
- Results for method and calibration blanks;
- Results for all QA/QC checks, including SMCs, surrogate compounds, MS samples, LCSs, MSD samples, and laboratory duplicate or triplicate samples.

10.2.3 Data Review Report

A data review report will be prepared upon completion of the data review. The data review reports will summarize the results of the data validation and data quality review and will describe any significant QA problems that were encountered. The data review reports for the chemical analyses may include all or a portion (depending on the type of data validation that maybe completed) of the following items:

- Executive summary of overall data quality and recommendations for data use and limitations;
- Description of sample collection and shipping, including chain of custody and holding time documentation;
- Description of analytical methods and detection limits;
- Description of data reporting;
- Description of completeness relative to QAPP objectives;
- Description of instrument tuning and initial and continuing calibration results;
- Description of any contamination in field and laboratory blanks and implications for bias of the data;
- Description of accuracy relative to QAPP objectives, including results of SMC, surrogate, MS, and LCS recoveries;
- Description of precision relative to QAPP objectives, including results for field and laboratory replicate analyses;

- Identification of cases where control limits or measurement performance criteria were not met and summary of the significance of these deviations; and

- Description of analyte identification and quantification.

All data and any qualifiers applied to the data as a result of the QA review will be reported in the final data report.

10.2.4 Location of Records and Reports

The records generated during sample collection and analysis document the validity and authenticity of the project data. During the pendency of the agreed order for corrective action and for ten years from the date of completion of work, PRS will be required to preserve all records, reports, documents, and underlying data in its possession relevant to the implementation of the order. PRS will be required to insert a similar record retention requirement into all contracts with project contractors and subcontractors. Upon request of Ecology, PRS shall make all records available to Ecology and allow access for review within a reasonable time.

11.0 DATA REVIEW, VERIFICATION, AND VALIDATION

Data review, verification, and validation are conducted to establish the data quality and usability for the project. These procedures are described below.

Data verification is the process of determining whether data have been collected or generated according to the GWMP, QAPP, and the respective SOPs or method descriptions.

Data validation is the process of evaluating the technical usability of the verified data with respect to the planned objectives of the project.

11.1 Sample Design and Sample Collection Procedures

The conformance of the field activities to requirements in the GWMP will be evaluated by the Field Team Leader and/or QA Leader on an ongoing basis while field activities are in progress. The review process will include immediate evaluation of any change to the sampling plan so that an alternate field procedure may be established.

Additional verification procedures may be completed for information generated in the field. A final verification review of field activities will be made when the field effort is complete. The verification results will be included in the data quality and usability report. Specifically, field forms will be reviewed for:

- Correct documentation of sample location;
- Complete and accurate procedures for sample collection or measurement and proper documentation;
- Proper chain of custody methodology, including sample shipment and preservation during transport; and
- Evaluation of field QC results; field QC sample contamination could result in data qualification.

The analytical laboratories will complete a data review and verification prior to producing results. This verification will include checking that QC procedures were included at the required frequencies and that the QC results meet the control limits specified by the laboratory at the time of analysis. Any QA issues identified by the laboratory will be described in the case narrative and may result in qualification of some of the results by the laboratory.

11.2 Verification and Validation of Chemical Data

Verification of chemical data will be completed at the laboratories and by the QA Leader. The laboratory will be responsible for the review and verification of all bench sheets; manual entry or transcriptions of data; review of any professional judgments made by a chemist during sample preparation, analysis, and calculation; and reporting of the final concentrations. The laboratory will also be responsible for the review of QC results to determine whether data are of usable quality or reanalyses are required. Any nonconformance issues identified during the laboratory's QA checks will be corrected and noted by the laboratory. Any data quality deviations will be discussed in the laboratory case narrative, including the direction and magnitude of any bias to the data, if possible.

Data validation and verification will be completed by the QA Leader prior to finalizing the data and release of the data set for interpretation. All data will be verified and validated in accordance with U.S. EPA National Functional guidelines (EPA, 2008, 2010), method-specific QC requirements, and laboratory-established control limits. Data will be qualified when QC procedures are not completed as required, when measurement performance criteria established in the applicable method are not met, or when specific data quality objectives established for this project are not achieved.

External data verification and validation will include an abbreviated QA review (summary data review) on 100 percent of the data. The laboratory information that will be reviewed, as applicable to the analyses completed, for each of these validation efforts is described below.

11.2.1 Abbreviated QA Review

Completion of an abbreviated QA review (i.e., a summary review data validation effort) assumes that all field results reported by the laboratory are correct. For this level of effort, summaries of applicable calibration and QC measurements are reviewed. Calculations and transcriptions are not verified or confirmed, and original instrument printouts are not reviewed. The following laboratory information will be reviewed, as applicable to each analysis:

- Chain of custody documentation to verify completeness of the data set;
- Case narratives discussing analytical problems (if any) and procedures;
- Sample preparation logs or laboratory summary result forms to verify analytical holding time constraints were met
- Instrument tuning, initial calibration, and continuing calibration results to assess instrument performance;
- Method blank, trip blank, equipment rinsate blank, and other field blank results;
- Surrogate or system monitoring compound recoveries to assess preparation and analyses;
- MS and LCS recoveries; and
- Laboratory duplicate, field duplicate, and MSD results.

12.0 DATA ASSESSMENT

The goal of data verification and validation is to determine the quality of each data point and to identify data pints that do not meet measurement performance criteria and other project DQOs. Nonconforming data may be qualified as estimated (J) or rejected (R) as usable during data validation if criteria for data quality are not met. Rejected data ® will be flagged as unreportable in the project database and will be excluded from all data retrievals. These data will not be used for any purpose. An explanation of the rejected data will be included in a data validation report. If the rejected data are needed to make a decision, then it may be necessary to resample. Any decision to resample would be based on discussions among the project management team.

Data qualified as estimated (J) will be appropriately qualified in the final project database. Although estimated data are less precise or less accurate than unqualified data, estimated results may still be used to evaluate and interpret site conditions provided that consideration of these data does not compromise the project objectives. The data review report will include all available pertinent information regarding the direction or magnitude of bias or the degree of imprecision for qualified data to facilitate the assessment of data usability.

The effect of estimated sample results in interpretation of site conditions depends on several factors.

- The nature and magnitude of the data quality problem: for example, a small positive bias in sample(s) concentration near a screening level may result in a conservative conclusion but a large negative bias may render the screening-level comparison meaningless.

- The nature and location of the affected samples(s): for example, a data deficiency in a result for a reference area may have a much greater impact on data interpretation than a similar deficiency in one of many results for a study site.

- The context of the sample results within the data set: for example, a questionable result for an analyte that is detected at high concentrations and important for site interpretation is likely to have a much greater impact on data interpretation than a questionable result for an analyte that is present at only low concentrations.

- The assessment of any data deficiencies on interpretive activities will be completed on a case-by-case basis. The data users are responsible for assessing the effect of the inaccuracy or imprecision of the qualified data on comparisons to screening criteria, statistical procedures, risk assessments, and other data uses. The effect of any data deficiencies on risk assessment and other interpretive activities and conclusions will be described in the final report.

13.0 REFERENCES

EPA (U.S. Environmental Protection Agency), 2007, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition, February.

EPA, 2008, USEPA Contract Laboratory Program, National Functional Guidelines for Superfund Organic Methods Review, EPA-540-R-0801, June

EPA, 2010, USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Superfund Data Review, EPA-540-R-10-011, January

TABLES

TABLE B-1

PROJECT PERSONNEL AND RESPONSIBILITIES

PRS Facility
Tacoma, Washington

Personnel	Responsibilities	Contact Information
Chuck Hoffman Washington State Department of Ecology Project Manager	Oversee all program activities to ensure compliance; perform technical oversight and consultation on major quality assurance problems; provide final approval of all necessary actions and adjustments for activities to accomplish project objectives. Provide final approval of the GWMP and QAPP.	Washington State Department of Ecology SWRO PO Box 47775 Olympia, WA 98504-7775 (360) 407-6344
Tom Smith PRS Group, Inc. Senior Project Manager	Overall responsibility for PRS Activities. Oversee all program activities to ensure compliance' provide technical oversight and consultation on major quality assurance problems; implement final approval of all necessary actions and adjustments for activities to accomplish project objectives.	3003 Taylor Way Tacoma, WA 98421 (253) 383-4175
Jay Johnson PRS Group, Inc. Sampling Team Leader	Coordinate with PRS Project Manager, Field Team members, and project laboratories for bottle and equipment shipments to the site and sample shipments to the laboratories; track submittal and receipt of samples to the laboratory, and initiate COC/SAR forms. Ensure field procedures are completed in accordance with GWMP and QAPP; authorize and document minor adjustments to the sampling plan in response to field conditions, as necessary, notify Project Manager.	3003 Taylor Way Tacoma, WA 98421 (253) 383-4175
Josh Simmons PRS Group, Inc. Database Administrator	Organize and maintain project database. Ensure that the data are stored in accordance with the GWMP and QAPP; supervise data management personnel.	3003 Taylor Way Tacoma, WA 98421 (253) 383-4175
Steve Hibbs Spectra Laboratories Laboratory Project Manager	Ensure that sample receipt and custody records are properly handled and data are reported within specified turnaround times; calibrate and maintain instruments as specified, perform internal quality control measures and analytical methods as required; tank appropriate corrective action as necessary; notify the QA/QC Leader when problems occur; report data and supporting quality assurance information as specified in the QAPP.	Spectra Laboratories 2221 Ross Way Tacoma, WA 98421 (253) 272-4850
TBD Field Team Leader Geo Engineers	Coordinate with the Sampling Team Leader, review QAPP and learn GWMP, take field notes, obtain field measurements, provide technical guidance, maintain all field equipment, conduct Health and Safety meetings, supervise field activities, verify shipment of sample bottles to and from locations; provide sampling report to PRS.	Geo Engineers 1101 Fawcett Avenue; Suite 200 Tacoma, WA 98402 253-722-2415
Jessie Bynum QA Leader Spectra Laboratories	Provide technical quality assurance assistance; review QAPP; oversee quality assurance activities to ensure compliance with QAPP; coordinate and supervise data validation and data quality report preparation; review and submit quality assurance reports.	Spectra Laboratories 2221 Ross Way Tacoma, WA 98421 (253) 272-4850
TBD Data Validator GeoEngineers		Geo Engineers 1101 Fawcett Avenue; Suite 200 Tacoma, WA 98402 253-722-2415

Abbreviations

COC = Chain of Custody
PRS = PRS Group, Inc.
QA/QC = quality assurance and quality control
GWMP = groundwater monitoring plan
QAPP = quality assurance project plan
SAR = sampling analysis request

TABLE B-2

MEASUREMENT QUALITY OBJECTIVES

PRS Facility
Tacoma, Washington

Analyte	Analytical Method[1]	LCS %Recovery Limits[2]	MS %Recovery Limits[2]	Sample Surrogate %Recovery Limits[2,3]	MS/MSD, or Laboratory Duplicate RPD Limits[4] (%)	Field Duplicate RPD Limits[4]
Total Metals	EPA 6020	80-120	75-125	NA	≤20	≤30
TPH – Diesel	NWTPH-Dx	45-159	45-140	50-150	≤20	≤30
TPH – Gasoline	NWTPH-Gx	77-122	71-128	50-150	≤30	≤30
PCBs	EPA 8082	53-118	53-118	54-170	≤30	≤30
VOCs	EPA 8260B	61-183	50-165	45-163	≤25	≤30

Notes

1. Method numbers refer to EPA SW-846 Analytical Methods or Washington State Department of Ecology (Ecology) recommended analytical methods.
2. Recovery limits are lowest and highest acceptable values based on 2009 Spectra Laboratories. For actual compound-specific ranges refer to current laboratory control limits.
3. Individual surrogate recoveries are compound specific.
4. RPD control limits are applicable only if the concentration is 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 2 times the MRL for soil and 1 times the MRL for water.

Abbreviations

EPA = U.S. Environmental Protection Agency
LCS = laboratory control sample
LCSD = laboratory control sample duplicate
MS/MSD = matrix spike/matrix spike duplicate
NA = not applicable
RPD = relative percent difference
VOCs = volatile organic compounds

TABLE B-3
GROUNDWATER PRACTICAL QUANTITATION LIIMITS

PRS Group, Inc. Facility
Tacoma, Washington

Constituent	CAS #	Analytical Method[1]	Lab MDL[2] (ug/l)	Lab MRL (Reporting Limit)[3] (ug/l)
Arsenic	7440-38-2	6020	0.09	0.50
Chromium	7440-47-3	6020	0.04	0.50
Lead	7439-92-1	6020	0.09	0.50
Diesel Range Hydrocarbons	n/a	NWTPH-Dx	32	100
Gasoline Range Hydrocarbons	n/a	NWTHP-Gx	33	50
1,1,1,2-Tetrachloroethane	630-20-6	8260	0.12	1.0
1,1,1-Trichloroethane	71-55-6	8260	0.54	1.0
1,1,2-Trichloroethane	79-00-5	8260	0.48	1.0
1,1-Dichloro-ethane	75-34-3	8260	0.44	1.0
1,2,3-Trichloropropane	96-18-4	8260	0.49	1.0
1,2-Dichloropropane	78-87-5	8260	0.57	1.0
2-Butanone	78-93-3	8260	3.96	10
2-chloroethylvinylether	110-75-8	8260	1.19	10
2-Hexanone	591-78-6	8260	1.7	10
4-Methyl-2-pentanone	108-10-1	8260	1.9	10
Acetone	67-64-1	8260	2.24	10
Acetonitrile	75-05-8	8260	4.1	10
Acrolein	107-02-8	8260	7.7	10
Acrylonitrile	107-13-1	8260	2.2	10
Benzene	71-43-2	8260	0.40	1.0
Bromodichloromethane	75-27-4	8260	0.45	1.0
Bromoform	75-25-2	8260	0.46	1.0
Bromomethane	74-83-9	8260	0.89	1.0
Carbon disulfide	75-15-0	8260	3.2	10
Chlorobenzene	108-90-7	8260	0.26	1.0
Chloroethane	75-00-3	8260	1.17	2.0
Chloroform	67-66-3	8260	0.38	1.0
Chloromethane	74-87-3	8260	1.47	2.0
cis-1,2-Dichloroethylene	156-59-2	8260	0.57	1.0
cis-1,3-Dichloropropene	10061-01-5	8260	0.24	1.0
Dibromochloromethane	124-48-1	8260	0.56	1.0
Dichloro-difluoro-methane	75-71-8	8260	1.0	1.0
Ethylbenzene	100-41-4	8260	0.28	1.0
m,p-Xylenes	108-38-3; 106-42-3	8260	0.76	2.0
Methylene chloride	75-09-2	8260	2.4	5.0
o-Xylene	95-47-6	8260	1.1	2.0
Tetrachloro-ethene	127-18-4	8260	0.39	1.0
Toluene	108-88-3	8260	0.39	1.0
trans-1,2-Dichloroethene	156-60-5	8260	0.41	1.0
trans-1,3-Dichloropropene	10061-02-6	8260	0.18	1.0
Trichloro-ethene	n/a	8260	0.54	1.0
Trichlorofluoromethane	75-69-4	8260	0.53	1.0
Vinyl acetate	108-05-4	8260	1.44	10
Carbon tetrachloride	56-23-5	8260	0.41	1.0
Vinyl chloride	75-01-4	8260	1.12	0.2

Notes

1. Methods are U.S. Environmental Protection Agency (EPA, 2007a) methods unless indicated otherwise; SIM Methods are standard methods of American Public Health Association (EPA, 2007); NWTPH Methods are methods approved by the Washington State Department of Ecology.
2. MDL = Method detection limit in micrograms per liter (ug/L) as reported by Spectra Laboratories, Tacoma, Washington (Project Laboratory).
3. MRL = Method reporting limit in micrograms per liter (ug/L) as reported by Spectra Laboratories, Tacoma, Washington (Project Laboratory).

Abbreviations

ug/L = micrograms per liter
SIM = selective ion monitoring

Table B-4
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES
PRS Group, Inc. Facility
Tacoma, Washington

Analyte	Analytical Method[1]	Sample Container	Preservation / Temperature	Holding Time[2]
Total Metals	EPA 6020	500 mL HDPE	HNO3 to pH< 2	6 months
TPH-Diesel	Ecology NWTPH-Dx	2 x 500 mL Amber Glass	≤6°C	7 days
TPH – Gasoline	Ecology NWTPH-Gx	2 x 40mL VOA	HCL to pH<2, ≤6°C	14 days
VOCs	EPA 8260B	3 x 40 mL vial	HCL to pH<2, ≤6°C	14 days
PCBs	EPA 8082	1 liter Amber Glass	≤6°C	7 days

Notes

1. Method numbers refer to SW-846 EPA Analytical Methods (EPA, 1986), or Washington State Department of ecology analytical methods, or Standard Methods (SM) for the Examination of Water and Wastewater.
2. Holding times are based on the elapsed time from date and time of collection.

Abbreviations

°C = degree Celsius
EPA = U.S. Environmental Protection Agency
HCI = hydrochloric acid
HDPE = high density polypropylene
HNO_3 = nitric acid
L = liter
mL = milliliter
SIM = selective ion monitoring
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis
VOCs = volatile organic compounds

Table B-5

QUALITY CONTROL SAMPLE TYPES AND FREQUENCY

PRS Group, Inc. Facility
Tacoma, Washington

Parameter	Field QC[1]			Laboratory QC[2]			
	Field Duplicates	Field Blank	Trip Blanks	Method Blanks	LCS	MS/MSD	Lab Duplicates
Total Metals	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	1 set/batch	NR
TPH- Diesel	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	NR	1/batch
TPH- Gasoline	1/20 samples per sampling event	1/20 samples per sampling event	1/cooler	1/batch	1/batch	NR	1/batch
VOC's	1/20 samples per sampling event	1/20 samples per sampling event	1/cooler	1/batch	1/batch	1 set/batch	NR
PCBs	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	1 set/batch	NR

Notes

1. A sampling event is defined as consecutive days of sampling not separated by more than two days of inactivity.
2. A batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS.
3. Field duplicates will be collected only for events with more than five samples.

Abbreviations

LCS = laboratory control sample
MS = matrix spike sample
MSD = matrix spike duplicate sample
NR = not required
QC = quality control
VOCs = volatile organic compounds

EXHIBIT B-1

Spectra Laboratories Quality Assurance Manual

APPENDIX C

PRS Standard Operating Procedures

Measuring Water Elevations and Total Depths

PRS SOP – 120

1.0 Purpose

The purpose of this Standard Operating Procedure (SOP) is to provide personnel with an outline of the specific information needed to measure water elevations and total well depths. This SOP provides a step-by-step guideline to be followed by personnel to assure consistent and representative water elevation and well depth measurements.

2.0 Application

This SOP provides a step-by-step guideline to be followed by the field sampling crew for measuring water elevations and total well depths.

3.0 References

Not applicable.

4.0 Associated SOPs

SOP – 121 – Monitoring Well Development
SOP – 124 – Low-Flow Groundwater Sampling Procedure
SOP – 200 – Equipment Decontamination Procedure
SOP – 302 – Photoionization Detector Calibration & Operation Procedure
SOP – 400 – Documentation Procedures

5.0 Equipment

The following equipment is necessary to measure water elevations and total well depths:

- A well key, hand drill, socket set, Allen wrench, pad lock key, or other well access equipment specific to the well monument cover plate.
- An electric water level meter calibrated to 0.01 foot with sufficient tape length to reach the bottom of the well, and narrow enough to fit in the well.
- Plastic or aluminum foil if required for providing a protective barrier.
- Required documentation materials including field books and field forms.
- Personal protective equipment (PPE) as described in the Site Health and Safety Plan.
- Decontamination equipment as described in SOP – 200 – Equipment Decontamination Procedure.
- A photoionization detector (PID) or similar instrument to monitor well head space for volatile organic compounds.

6.0 Procedures

The following procedures shall be followed when measuring water elevations and total well depths:

- Complete the measurements for all wells within one work day.

- Don the appropriate PPE as described in the Site Health and Safety Plan.

- Remove any soil or vegetation from the well cap and monument.

- Open the wellhead enclosure and remove any standing water inside the well monument prior to opening the well cap.

- Open the well cap. Immediately after removing the well cap, monitor the head space in the well using the photoionization detector. Record readings in the field notebook.

- Remove any down-hole equipment and allow water level to equilibrate for approximately 10 minutes prior to measuring the water elevation in the well or total well depth. Slowly lower a pre-decontaminated water level meter probe into the well casing until it reaches the water table. When the probe reaches the water table, it will alarm. Record the depth to water. Lower the water level probe to the bottom of the well to measure the total depth of the well. Gently bounce the probe on the well bottom and pull the slack on the tape to record to total well depth.

- Duplicate each water level and total depth measurement in the field to ensure that the readings are accurate. Record all results.

- Close and secure the well.

7.0 Decontamination Procedures

The electronic water level indicator probe/steel tape will be washed with phosphate free detergent and a scrubber, then thoroughly rinsed with distilled water. Decontamination procedures will be performed prior to arrival on site, relocation on site, and site exit.

8.0 Documentation

Water level and well depth measurements shall be documented in a detailed field notebook as described in PRS SOP – 400. The following documentation shall be recorded at each well location, as appropriate:

- Well Identification.

- Depth to water.

- Depth to bottom of the well.

- Date the water elevation or total well depth was measured.

- Time the water elevation or total well depth was measured.

- Pressure or vacuum observed in the well casing.

- Comments regarding well integrity.

- Visual and olfactory observations of the water.

9.0 Measure of Proficiency

Field staff will demonstrate proficiency on this SOP by successfully competing Sections 6.0, 7.0, and 8.0 of this SOP a minimum of twice under the direct supervision of the Corrective Actions Manager or her/his designee.

Monitoring Well Development
PRS SOP – 121

1.0 PURPOSE

The purpose of this SOP is to provide field personnel with a set of guidelines to assure proper monitoring well development. According to EPA all monitoring wells should be developed to create and effective filter pack around the well screen, to rectify damage to the formation caused by drilling, to remove fine particulates from the formation near the borehole, and to assist in restoring the natural water quality of the aquifer in the vicinity of the well.

2.0 APPLICATION

This SOP provides a step-by-step guideline to be followed by the field sampling crew for performing or overseeing monitoring well development.

3.0 REFERENCES

RCRA Groundwater Monitoring Draft Technical Guidance (Nov. 1992) EPA/530-R-93-001

4.0 ASSOCIATED SOPS

SOP – 200 – Equipment Decontamination Procedure
SOP – 302 – Photoionization Detector Calibration & Operation Procedure
SOP – 400 – Documentation Procedures

5.0 EQUIPMENT

The following equipment is necessary to properly develop a groundwater monitoring well:

- A well key, hand drill, socket set, pad lock key, or other well access equipment.
- A calibrated photo-ionization detector (PID) to monitor and record the well headspace.
- An electric water meter and oil/water interface probe calibrated to a hundredth of a foot, and sufficiently long to reach the bottom of the well.
- Well purging equipment (e.g. bailer, silicone line, PVC pipe, plug, pump, tubing, power supply, and extension cord), as needed.
- A solid PVC surge block.
- A sufficient number of 55-gallon drums (including lids, gaskets, and fasteners) to contain all purge water, unless other water handling arrangements have been made.
- A calibrated water quality meter that measures temperature, pH, specific conductivity, dissolved oxygen, redox potential, and turbidity.
- All required documentation including sample labels, field books, sampling forms, and chains of custody.

- Personal protective equipment as described in the Site Health and Safety Plan.

- Decontamination equipment as specified in the Work Plan.

6.0 DECONTAMINATION

All equipment that will come in contact with the well water will be decontaminated prior to arrival on site, relocation on site, and site exit. PRS – SOP – 200 shall be followed.

7.0 WELL DEVELOPMENT PROCEDURES

Upon arrival at each well, the following procedures shall be followed:

- Suit up in appropriate personal protective equipment as described in the Site Health and Safety Plan.

- Pump any standing water away from the well opening.

- Remove any soil or vegetation from around the well opening.

- Lay plastic sheeting around well to place equipment on and keep cords, tubing and pumps from touching the ground.

- Open the well cap.

- Monitor the headspace within the well using the PID. This is done by placing the instrument probe at the opening of the well, and recording the reading in the field book and on the appropriate field forms.

- Measure and record the depth to water and total depth of the well using a decontaminated water level indicator.

- Compute the unit purge volume using the following formula and the input values on the attached Well Volumes Sheet.

  1 well volume (including annular space) = [x(total well depth – water level)] + [(y x 0.40)(total well depth – bottom of seal)] where "x" is the Casing/Riser Volume per Unit Length, Internal (gal/ft), "y" is the Annular Volume per Unit length (gal/ft), and 0.40 is a conservative estimate of the porosity of the sand pack.

7.1 New Well Development Procedure

- If a submersible pump is to be used for well development, gently lower the pump to the well bottom. If a non-submersible pump is used, lower the tubing to the bottom of the well.

- Begin to purge the well at a rate sufficient to remove fines, slowly run the pump up and down the well over the length of the screen, and initiate physical water quality testing at least every 20% water removed for temperature, pH, conductivity, dissolved oxygen, and turbidity.

- A minimum of three and maximum of five well volumes (including annular space) will be removed. If this is the first time the well has been developed and water was used in the drilling process, the volume of water introduced into the formation during well formation must also be removed during development. *Purging is completed once the following has occurred:*

  - the minimum purge volume has been removed and the water quality parameters have stabilized by the following screening requirements for three consecutive readings: turbidity <

    5 NTU, specific conductivity within 10% of each other, and pH within 0.5 units; OR
  - the well runs dry; OR
  - five purge volumes and drilling process water volumes have been removed.

- Measure total depth of well after development.

- Containerize all purge water in 55-gallon drums, unless other handling arrangements have been made.

- Record additional information such as unique odors or water color, and a description of the suspended particle content in the field notes and on appropriate field forms.

- Upon completion of development, both the well and the purge drums are to be properly sealed and secured.

- All drums are to be permanently labeled as follows:

  - Well ID
  - Facility Name
  - Drum Contents
  - Date
  - Drum Number

- Close the well appropriately and record any well integrity concerns in the field book and on the sampling form.

7.2 Existing Well Development Procedure

- Remove pump from well.

- Attach one length of twine to the surge block or use a drill rig or tripod and lower it to the bottom of the well.

- Vigorously begin moving the surge block up and down in the well creating a surging action across the screened interval. This action will bring the finer grained materials into suspension.

- Remove the surge block.

- Begin to purge the well at a sufficient rate to remove fines and initiate physical water quality testing at a minimum of every 20% water removed for turbidity.

- Repeat surging and purging to reduce silt presence in water and keep checking total depth measurements.

- A minimum of three and maximum of five well volumes (including annual space) will be removed.

Purging is completed once the following has occurred:

- the minimum purge volume has been removed and the water quality parameters have stabilized by the following screening requirements for three consecutive readings: turbidity < 5 NTU, specific conductivity within 10% of each other, and pH within 0.5 units; OR
- the well runs dry; OR
- five purge volumes and drilling process water volumes have been removed.

- Measure total depth of well after development.

- Containerize all purge water in 55-gallon drums, unless other handling arrangements have been made.

- Record additional information such as unique odors or water color, and a description of the suspended particle content in the field notes and on appropriate field forms.

- Upon completion of development, both the well and the purge drums are to be properly sealed and secured.

- All drums are to be permanently labeled as follows:
  - Well ID
  - Facility Name
  - Drum Contents
  - Date
  - Drum Number

- Close the well appropriately and record any well integrity concerns in the field book and on the sampling form.

8.0 DOCUMENTATION

Documentation of all decontamination procedures associated with monitoring well activities including all field forms and the maintenance of a detailed field notebook as described in PRS SOP – 400.

9.0 MEASURE OF PROFICIENCY

Field staff will demonstrate proficiency on this SOP by successfully competing sections 6.0, 7.0, and 8.0 a minimum of twice under the direct supervision of the Corrective Actions Manager or her/his designee.

Multi-Parameter Meter Calibration and Operation Procedure

PRS SOP – 123

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide field personnel with an outline of the procedure for operating a Multi-Parameter Meter (MPM) during groundwater sampling activities. The MPM is used for the measurement of a variety of water quality parameter combinations such as dissolved oxygen, conductivity, specific conductance, salinity, resistivity, total dissolved solids (TDS), pH, ORP, pH/ORP combination, ammonium (ammonia), nitrate, chloride and temperature. Typical uses include surface water monitoring and groundwater monitoring documentation.

2.0 APPLICATION

This SOP provides a step-by-step guideline to be followed by the field sampling crew for operating a Multi-Parameter Meter.

3.0 REFERENCES

YSI Incorporated. YSI Professional Plus User Manual. http://www.ysi.com/media/pdfs/605596-YSI-ProPlus-User-Manual-RevD.pdf

YSI Incorporated. YSI Professional Plus Calibration Tips. http://www.ysi.com/media/pdfs/YSI-Professional-Plus-Calibration-Tips.pdf

4.0 ASSOCIATED SOPS

SOP – 124 – Low-Flow Groundwater Sampling Procedure
SOP – 400 – Documentation Procedures

5.0 EQUIPMENT

The following equipment is necessary to use and operate a MPM:

- A MPM instrument, including the meter's handheld readout screen and cable, such as the YSI Professionla Plus or equivalent instrument.
- The calibration solution liquids recommended by the manufacturer.
- Batteries for the specific MPM.
- Appropriate tubing to connect the well pump to the MPM.
- Required documentation including sample labels, field books and sampling forms.
- Personal protective equipment as described in the Site Health and Safety Plan.

6.0 CALIBRATION PROCEDURES

The following procedures shall be followed when calibrating a MPM:

- Don the appropriate personal protective equipment (PPE) as described in the Site Health and Safety Plan.
- Turn on the MPM and allow it to warm up as recommended by the manufacturer.
- Calibrate the MPM according to the manufacturer's instructions.
- Record calibration information and procedures in accordance with SOP – 400 – Documentation Procedures.
- The MPM shall be calibrated daily or as recommended by the manufacturer.

7.0 OPERATION PROCEDURES

The following procedures shall be followed when operating a MPM:

- Complete calibration procedures identified in Section 6.
- Attach/install the sensor guard to protect the sensor and membrane following calibration procedures.
- Place the probe in the flow-through container to measure water quality paramters and give the probe a quick shake to release any air bubbles.
- Collect water quality parameters, complete required documentation and complete decontamination procedures as identified in SOP-124.

8.0 DOCUMENTATION

Documentation of all calibration, operation and maintenance procedures and field measurements associated with Multi-Parameter Meter operation shall be maintained in a detailed field notebook as described in PRS SOP – 400.

9.0 MEASURE OF PROFICIENCY

Field staff will demonstrate proficiency on this SOP by successfully competing Sections 6.0, 7.0, and 8.0 of this SOP a minimum of twice under the direct supervision of the Corrective Actions Manager or her/his designee.

Low-Flow Groundwater Sampling Procedure

PRS SOP – 124

INTRODUCTION

The collection of “representative” water samples from wells is neither straightforward nor easily accomplished. Ground-water sample collection can be a source of variability through differences in sample personnel and their individual sampling procedures, the equipment used, and ambient temporal variability in subsurface and environmental conditions. Many site inspections and remedial investigations require the sampling at ground-water monitoring wells within a defined criterion of data confidence or data quality, which necessitates that the personnel collecting the samples are trained and aware of proper sample collection procedures.

The purpose of this standard operating procedure (SOP) is to provide a method which minimizes the amount of impact the purging process has on the ground water chemistry during sample collection and to minimize the volume of water that is being purged and disposed. This will take place by placing the pump intake within the screen interval and by keeping the drawdown at a minimal level (0.33 feet) (Puls and Barcelona, 1996) until the water quality parameters have stabilized and sample collection is complete. The flow rate at which the pump will be operating will depend upon both hydraulic conductivity of the aquifer and the drawdown with the goal of minimizing the drawdown. The flow rate from the pump during purging and sampling will be at a rate that will not compromise the integrity of the analyte that is being sampled. This sampling procedure may or may not provide a discrete ground water sample at the location of the pump intake. The flow of ground-water to the pump intake will be dependent on the distribution of the hydraulic conductivity (K) of the aquifer within the screen interval. In order to minimize the drawdown in the monitoring well a low-flow rate must be utilized.

Low-flow refers to the velocity with which water enters the pump intake from the surrounding formation in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface, which can be affected by flow regulators or restrictions (Puls and Barcelona, 1996). This SOP was developed by the Superfund/RCRA Ground Water Forum and draws from an USEPA’s Ground Water Issue Paper, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedure, by Robert W. Puls and Michael J. Barcelona. Also, available USEPA Regional SOPs regarding Low-Stress (Low Flow) Purging and Sampling were used for this SOP.

SCOPE AND APPLICATION

This SOP should be used primarily at monitoring wells which have a screen or an open interval with a length of ten feet or less and can accept a sampling device which minimizes the disturbance to the aquifer or the water column in the well casing. The screen or open interval should have been optimally located to intercept an existing contaminant plume(s) or along flowpaths of potential contaminant releases. Knowledge of the contaminant distribution within the screen interval is highly recommended and is essential for the success of this sampling procedure. The ground-water samples which are collected using this procedure are acceptable for the analyses of ground-water contaminants which may be found at Superfund and RCRA contamination sites. The analytes may be volatile, semi-volatile organic compounds, pesticides, PCBs, metals and other inorganic compounds. The screened interval should be located within the contaminant plume(s) and the pump intake should be placed at or near the known source of the contamination within the screened interval. It is critical to place the pump intake in the exact location or depth for each sampling event. This argues for the use of dedicated, permanently installed sampling devices whenever possible. If this is not possible then the placement of the pump intake should be positioned with a calibrated sampling pump hose sounded with a weighted-tape or using a pre-measured hose. The pump intake should not be placed near the bottom of the screened interval to avoid disturbing any sediment that may have settled at the bottom of the well.

Water-quality indicator parameters and water levels must be measured during purging, prior to sample collection. Stabilization of the water quality parameters as well as monitoring water levels are a prerequisite to sample collection. The water-quality indicator parameters which are recommended include the following: specific electrical conductance, dissolved oxygen, turbidity, oxidation-reduction potential, pH, and temperature. The latter two parameters are useful data, but are generally insensitive as purging parameters. Oxidation-reduction potential may not always be appropriate stabilization parameter, and will depend on site-specific conditions. However, readings should be recorded because of its value as a double check for oxidation conditions, and for fate and transport issues. Also, when samples are collected for metals, semi-volatile organic compounds, and pesticides every effort must be made to reduce turbidity to 10 NTUs or less (not just the stabilization of turbidity) prior to the collection of the water sample. In addition to the measurement of the above parameters, depth to water must be measured during purging (U.S. Environmental Protection Agency, 1995).

Proper well construction, development and maintenance are essential for any ground-water sampling procedure. Prior to conducting the field work, information on the construction of the well and well development should be obtained and that information factored into the site specific sampling procedure. The attached Sampling Checklist is an example of the type of information that is useful.

Stabilization of the water-quality indicator parameters is the criterion for sample collection. But if stabilization is not occurring and the procedure has been strictly followed, then sample collection can take place once three (minimum) to six (maximum) casing volumes have been removed (Schuller et al., 1981 and U.S. Environmental Protection Agency., 1986; Wilde et al., 1998; Gibs and Imbrigiotta., 1990). The specific information on what took place during purging must be recorded in the field notebook or in the ground-water sampling log.

This SOP is not to be used where non-aqueous phase liquids (immiscible fluids) are present in the monitoring well.

EQUIPMENT

- Depth-to-water measuring device - An electronic water-level indicator or steel tape and chalk, with marked intervals of 0.01 foot. Interface probe for determination of liquid products (NAPL) presence, if needed.
- Steel tape and weight - Used for measuring total depth of well. Lead weight should not be used.
- Sampling pump - Submersible or bladder pumps with adjustable rate controls are preferred. Pumps are to be constructed of inert materials, such as stainless steel and Teflon®. Pump types that are acceptable include gear and helical driven, centrifugal (low-flow type) and air-activated piston. Adjustable rate, peristaltic pump can be used when the depth to water is 20 feet or less.
- Tubing - Teflon® or Teflon® lined polyethylene tubing is preferred when sampling for organic compounds. Polyethylene tubing can be used when sampling inorganics.
- Power Source - If a combustion type (gasoline or diesel-driven) generator is used, it must be placed downwind of the sampling area.
- Flow measurement supplies - flow meter, graduated cylinder and a stop watch.
- Multi-Parameter meter with flow-through-cell - This can be one instrument or more contained in a flow- through cell. The water-quality indicator parameters which must be monitored are pH, ORP/EH, dissolved oxygen (DO), turbidity, specific conductance, and temperature. Turbidity readings must be collected before the flow cell because of the potential for sediment buildup which can bias the turbidity measurements. Calibration fluids for all instruments should be NIST-traceable and there should be enough for daily calibration through-out the sampling event. The inlet of the flow cell must be located near the bottom of the flow cell and the outlet near the top. The size of the flow cell should be kept to a minimum and a closed cell is preferred. The flow cell must not contain any air or gas bubbles when monitoring for the water-quality indicator parameters.
- Decontamination Supplies - Including a reliable and documented source of distilled water and any solvents (if used). Pressure sprayers, buckets or decontamination tubes for pumps, brushes and non-

phosphate soap will also be needed.

- Sample bottles, sample preservation supplies, sample tags or labels and chain of custody forms.
- Approved Field Sampling and Quality Assurance Project Plan.
- Well construction data, field and water quality data from the previous sampling event.
- Well keys and map of well locations.
- Field notebook, ground-water sampling logs and calculator. A suggested field data sheet (ground-water sampling record or ground-water sampling log) are provided in the attachment.
- Filtration equipment, if needed. An in-line disposable filter is recommended.
- Polyethylene sheeting which will be placed on ground around the well head.
- Personal protective equipment specified in the site Health and Safety Plan.
- Air monitoring equipment as specified in the Site Health and Safety Plan.
- Tool box - All needed tools for all site equipment used.
- A 55-gallon drum or container to contain the purged water.

Materials of construction of the sampling equipment (bladders, pumps, tubing, and other equipment that comes in contact with the sample) should be limited to stainless steel, Teflon®, glass and other inert material. This will reduce the chance of the sampling materials to alter the ground-water where concentrations of the site contaminants are expected to be near the detection limits. The sample tubing diameter thickness should be maximized and the tubing length should be minimized so that the loss of contaminants into and through the tubing walls may be reduced and the rate of stabilization of ground-water parameters is maximized. The tendency of organics to sorb into and out of material makes the appropriate selection of sample tubing material critical for trace analyses (Pohlmann and Alduino, 1992; Parker and Ranney, 1998).

PURGING AND SAMPLING PROCEDURES

The following describes the purging and sampling procedures for the Low-Stress (Low Flow)/ Minimal Drawdown method for the collection of ground-water samples. These procedures also describe steps for dedicated and non-dedicated systems.

Pre-Sampling Activities (Non-dedicated and dedicated system)

1. Sampling locations must begin at the monitoring well with the least contamination, generally up-gradient or furthest from the site or suspected source. Then proceed systematically to the monitoring wells with the most contaminated ground water.
2. Check and record the condition of the monitoring well for damage or evidence of tampering. Lay out polyethylene sheeting around the well to minimize the likelihood of contamination of sampling/purging equipment from the soil. Place monitoring, purging and sampling equipment on the sheeting.
3. Unlock well head. Record location, time, date and appropriate information in a field logbook or on the ground-water sampling log (See attached ground-water sampling record and ground-water sampling log as examples).
4. Remove inner casing cap.
5. Monitor the headspace of the monitoring well at the rim of the casing for volatile organic compounds (VOC) with a Photo- ionization detector (PID) or Flame ionization detector (FID), and record in the logbook. If the existing monitoring well has a history of positive readings of the headspace, then the sampling must be conducted in accordance with the Health and Safety Plan.

6. Measure the depth to water (water level must be measured to nearest 0.01 feet) relative to a reference measuring point on the well casing with an electronic water level indicator or steel tape and record in logbook or ground-water sampling log. If no reference point is found, measure relative to the top of the inner casing, then mark that reference point and note that location in the field logbook. Record information on depth to ground water in the field logbook or ground water sampling log. Measure the depth to water a second time to confirm initial measurement; measurement should agree within 0.01 feet or re- measure.
7. Check the available well information or field information for the total depth of the monitoring well. Use the information from the depth of water in step six and the total depth of the monitoring well to calculate the volume of the water in the monitoring well or the volume of one casing. Record information in field logbook or ground-water sampling log.

Purging and Sampling Activities

1. Non-dedicated system - Place the pump and support equipment at the wellhead and slowly lower the pump and tubing down into the monitoring well until the location of the pump intake is set at a pre-determined location within the screen interval. The placement of the pump intake should be positioned with a calibrated sampling pump hose, sounded with a weighted-tape, or using a pre-measured hose. Refer to the available monitoring well information to determine the depth and length of the screen interval. Measure the depth of the pump intake while lowering the pump into location. Record pump location in field logbook or groundwater sampling log.
2. Dedicated system - Pump has already been installed, refer to the available monitoring well information and record the depth of the pump intake in the field logbook or ground-water sampling log.
3. Non-dedicated system and dedicated system - Measure the water level (water level must be measured to nearest 0.01 feet) and record information on the ground-water sampling log, leave water level indicator probe in the monitoring well.
4. Non-dedicated and dedicated system - Connect the discharge line from the pump to a flow-through cell. A "T" connection is needed prior to the flow cell to allow for the collection of water for the turbidity measurements. The discharge line from the flow-through cell must be directed to a container to contain the purge water during the purging and sampling of the monitoring well.
5. Non-dedicated and dedicated system - Start pumping the well at a low flow rate (0.2 to 0.5 liter per minute) and slowly increase the speed. Check water level. Maintain a steady flow rate while maintaining a drawdown of less than 0.33 feet (Puls and Barcelona, 1996). If drawdown is greater than 0.33 feet lower the flow rate. 0.33 feet is a goal to help guide with the flow rate adjustment. It should be noted that this goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience (Puls and Barcelona, 1996).
6. Non-dedicated and dedicated system - Measure the discharge rate of the pump with a graduated cylinder and a stop watch. Also, measure the water level and record both flow rate and water level on the groundwater sampling log. Continue purging, monitor and record water level and pump rate every three to five minutes during purging. Pumping rates should be kept at minimal flow to ensure minimal drawdown in the monitoring well.
7. Non-dedicated and dedicated system - During the purging, a minimum of one tubing volume (including the volume of water in the pump and flow cell) must be purged prior to recording the water-quality indicator parameters. Then monitor and record the water-quality indicator parameters every three to five minutes. The water-quality indicator field parameters are turbidity, dissolved oxygen, specific electrical conductance, pH, redox potential and temperature. Oxidation-reduction potential may not always be an appropriate stabilization parameter, and will depend on site-specific conditions. However, readings should be recorded because of its value as a double check for oxidizing conditions. Also, for the final

dissolved oxygen measurement, if the readings are less than 1 milligram per liter, it should be collected and analyze with the spectrophotometric method (Wilde et al., 1998 Wilkin et al., 2001), colorimetric or Winkler titration (Wilkin et al., 2001). The stabilization criterion is based on three successive readings of the water quality field parameters; the following are the criteria which must be used:

Parameter	Stabilization Criteria	Reference
pH	± 0.1 pH units	Puls and Barcelona, 1996; Wilde et al.,
Turbidity	± 10 % NTUs (when turbidity is greater than 10 NTUs)	Puls and Barcelona, 1996 Wilde et al., 1998
Dissolved oxygen	± 0.3 milligrams per liter	Wilde et al., 1998

Once the criteria have been successfully met indicating that the water quality indicator parameters have stabilized, then sample collection can take place.

8. If a stabilized drawdown in the well can't be maintained at 0.33 feet and the water level is approaching the top of the screened interval, reduce the flow rate or turn the pump off (for 15 minutes) and allow for recovery. It should be noted whether or not the pump has a check valve. A check valve is required if the pump is shut off. Under no circumstances should the well be pumped dry. Begin pumping at a lower flow rate, if the water draws-down to the top of the screened interval again turn pump off and allow for recovery. If two tubing volumes (including the volume of water in the pump and flow cell) have been removed during purging then sampling can proceed next time the pump is turned on. This information should be noted in the field notebook or ground-water sampling log with a recommendation for a different purging and sampling procedure.

9. Non-dedicated and dedicated system - Maintain the same pumping rate or reduce slightly for sampling (0.2 to 0.5 liter per minute) in order to minimize disturbance of the water column. Samples should be collected directly from the discharge port of the pump tubing prior to passing through the flow-through cell. Disconnect the pump's tubing from the flow-through-cell so that the samples are collected from the pump's discharge tubing. For samples collected for dissolved gases or Volatile Organic Compounds (VOCs) analyses, the pump's tubing needs to be completely full of ground water to prevent the ground water from being aerated as the ground water flows through the tubing. The sequence of the samples is immaterial unless filtered (dissolved) samples are collected and they must be collected last (Puls and Barcelona, 1996). All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container. When filling the VOC samples a meniscus must be formed over the mouth of the vial to eliminate the formation of air bubbles and head space prior to capping. In the event that the ground water is turbid, (greater than 10 NTUs), a filtered metal (dissolved) sample also should be collected.

   If filtered metal sample is to be collected, then an in-line filter is fitted at the end of the discharge tubing and the sample is collected after the filter. The in-line filter must be pre-rinsed following manufacturer's recommendations and if there are no recommendations for rinsing, a minimum of 0.5 to 1 liter of ground water from the monitoring well must pass through the filter prior to sampling.

10. Non-dedicated system - Remove the pump from the monitoring well. Decontaminate the pump and dispose of the tubing if it is non-dedicated.

11. Dedicated system - Disconnect the tubing that extends from the plate at the wellhead (or cap) and discard

after use.

12. Non-dedicated system - Before locking the monitoring well, measure and record the well depth (to 0.1 feet).

    Measure the total depth a second time to confirm initial measurement; measurement should agree within0.01 feet or re- measure.

13. Non-dedicated and dedicated system - Close and lock the well.

DECONTAMINATION PROCEDURES

Decontamination procedures for the water level meter and the water quality field parameter sensors.

The electronic water level indicator probe/steel tape and the water-quality field parameter sensors will be decontaminated by the following procedures:

1. The water level meter will be hand washed with phosphate free detergent and a scrubber, then thoroughly rinsed with distilled water.
2. Water quality field parameter sensors and flow-through cell will be rinsed with distilled water between sampling locations. No other decontamination procedures are necessary or recommended for these probes since they are sensitive. After the sampling event, the flow cell and sensors must be cleaned and maintained per the manufacturer's requirements.

Decontamination Procedure for the Sampling Pump

Upon completion of the ground water sample collection the sampling pump must be properly decontaminated between monitoring wells. The pump and discharge line including support cable and electrical wires which were in contact with the ground water in the well casing must be decontaminated by the following procedure:

1. The outside of the pump, tubing, support cable and electrical wires must be pressured sprayed with soapy water, tap water and distilled water. Spray outside of tubing and pump until water is flowing off of tubing after each rinse. Use bristle brush to help remove visible dirt and contaminants.
2. Place the sampling pump in a bucket or in a short PVC casing (4-in. diameter) with one end capped. The pump placed in this device must be completely submerged in the water. A small amount of phosphate-free detergent must be added to the potable water (tap water).
3. Remove the pump from the bucket or 4-in. casing and scrub the outside of the pump housing and cable.
4. Place pump and discharge line back in the 4-in. casing or bucket, start pump and re-circulate this soapy water for 2 minutes (wash).
5. Re-direct discharge line to a 55-gallon drum, continue to add 5 gallons of potable water (tap water) or until soapy water is no longer visible.
6. Turn pump off and place pump into a second bucket or 4-in. Casing which contains tap water, continue to add 5-gallons of tap water (rinse).
7. Turn pump off and place pump into a third bucket or 4-in. casing which contains distilled/deionized water, continue to add three to five gallons of distilled/deionized water (final rinse).
8. If a hydrophobic contaminant is present (such as separate phase, high levels of PCB's, etc.) An additional decontamination step, or steps, may be added. For example, an organic solvent, such as reagent-grade isopropyl alcohol may be added as a first spraying/bucket prior to the soapy water rinse/bucket.

FIELD QUALITY CONTROL

Quality control (QC) samples must be collected to verify that sample collection and handling procedures were performed adequately and that they have not compromised the quality of the ground water samples.
The appropriate EPA program guidance must be consulted in preparing the field QC sample requirements for the

site- specific Quality Assurance Project Plan (QAPP).

There are five primary areas of concern for quality assurance (QA) in the collection of representative ground-water samples:

1. Obtaining a ground-water sample that is representative of the aquifer or zone of interest in the aquifer. Verification is based on the field log documenting that the field water-quality parameters stabilized during the purging of the well, prior to sample collection.
2. Ensuring that the purging and sampling devices are made of materials, and utilized in a manner, which will not interact with or alter the analyses.
3. Ensuring that results generated by these procedures are reproducible; therefore, the sampling scheme should incorporate co-located samples (duplicates).
4. Preventing cross-contamination. Sampling should proceed from least to most contaminated wells, if known.
   Field equipment blanks should be incorporated for all sampling and purging equipment, and decontamination of the equipment is therefore required.
5. Properly preserving, packaging, and shipping samples.

All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. The chain of custody procedures for the QC samples will be identical to the field ground water samples. The following are quality control samples which must be collected during the sampling event:

HEALTH AND SAFETY CONSIDERATIONS

Depending on the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. The site Health and Safety Plan should be reviewed with specific emphasis placed on the protection program planned for the sampling tasks. Standard safe operating practices should be followed, such as minimizing contact with potential contaminants in both the liquid and vapor phase through the use of appropriate personal protective equipment.

Depending on the type of contaminants expected or determined in previous sampling efforts, the following safe work practices will be employed:

Particulate or metals contaminants

1. Avoid skin contact with, and incidental ingestion of, purge water.
2. Use protective gloves and splash protection.

Volatile organic contaminants

1. Avoid breathing constituents venting from well.
2. Pre-survey the well head space with an appropriate device as specified in the Site Health and Safety Plan.
3. If monitoring results indicate elevated organic constituents, sampling activities may be conducted in level C protection. At a minimum, skin protection will be afforded by disposable protective clothing, such as Tyvek®.

General, common practices should include avoiding skin contact with water from preserved sample bottles, as this water will have pH less than 2 or greater than 10. Also, when filling pre- acidified VOA bottles, hydrochloric acid fumes may be released and should not be inhaled.

POST-SAMPLING ACTIVITIES

Several activities need to be completed and documented once ground-water sampling has been completed. These activities include, but are not limited to:

1. Ensure that all field equipment has been decontaminated and returned to proper storage location. Once the individual field equipment has been decontaminated, tag it with date of cleaning, site name, and name of individual responsible.
2. All sample paperwork should be processed, including copies provided to the Regional Laboratory, Sample Management Office, or other appropriate sample handling and tracking facility.
3. All field data should be complied for site records.
4. All analytical data when processed by the analytical laboratory, should be verified against field sheets to ensure all data has been returned to sampler.

REFERENCES

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U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Handbooks for Water-Resources

Investigations, variously paginated.

Wilkin, R.T., M.S. McNeil, C.J. Adair and J.T. Wilson, 2001, Field Measurement of Dissolved Oxygen: A Comparison of Methods, Ground Water Monitoring and Remediation, Vol. 21, No. 4, pp. 124 132.

Equipment Decontamination Procedure
PRS SOP – 200

1.0 PURPOSE

The purpose of this SOP is to provide field personnel with an outline of the procedure and frequency of decontaminating equipment that has come into contact with monitoring well water.

2.0 APPLICATON

This SOP provides step-by-step guideline to be followed by the field sampling crew to prevent cross-contamination between monitoring wells and preserve well integrity.

3.0 REFERENCES

RCRA Groundwater Draft Technical Guidance (EPA, 1992)

4.0 ASSOCIATED SOPs

PRS – 120 – Measuring Water Elevations
PRS – 121 – Monitoring Well Development
PRS – 124 – Low Flow Groundwater Sampling Procedure
PRS – 400 – Documentation Procedures

5.0 EQUIPMENT

The following equipment is necessary to properly decontaminate equipment used with monitoring wells:

- De-ionized water and spray bottle.
- Alconox and spray bottle, hexane and spray bottle, and 10% nitric acid and spray bottle, paper towels/rags.
- PVC pipe capped on one end, 5 feet long, 3” diameter.
- A clean hose and tap water source.
- A labeled 55-gallon drum for wastewater and a bucket to use for smaller volume prior to containing in a drum.
- Personal protective equipment as described in the Site Health and Safety Plan.

6.0 GENERAL DECONTAMINATION PROCEDURES

All reusable equipment that will come in contact with the well and/or be used to acquire samples will be decontaminated prior to arrival on site, relocation on site, and site exit.

6.1 DECONTAMINATION WHEN ORGANIC CONSTITUENTS ARE OF INTEREST

- Wash the equipment with a solution of nonphosphate detergent (Alconox or equivalent) and

water.
- Rinse the equipment with tap water.
- Rinse the equipment with Hexane.
- Rinse the equipment with DI water.

6.2 DECONTAMINATION WHEN INORGANIC CONSTITUENTS ARE OF INTEREST

- Wash the equipment with a solution of nonphosphate detergent (Alconox or equivalent) and water.
- Rinse the equipment with tap water.
- Rinse the equipment with 10% Nitric Acid Solution.
- Rinse the equipment with DI water.

6.3 DECONTAMINATION WHEN INORGANIC AND ORGANIC CONSTITUENTS ARE OF INTEREST

- Wash the equipment with a solution of nonphosphate detergent (Alconox or equivalent) and water.
- Rinse the equipment with tap water.
- Rinse the equipment with Hexane.
- Rinse the equipment with DI water.
- Rinse the equipment with 10% Nitric Acid Solution.
- Rinse the equipment with DI water.

7.0 SPECIFIC DECONTAMINATION PROCEDURES

7.1 NON-DEDICATED SUBMERSIBLE PUMP DECONTAMINATION

After sampling or developing a well using a non-dedicated submersible pump, decontaminate the pump as follows:

- Use hose to spray off pump with tap water.
- Place pump into a capped approximately 5’ long, 3” diameter PVC pipe.
- Fill the PVC pipe with tap water and detergent.
- Run the pump until the pipe is empty, refilling it with tap water 3 times. The discharge decontamination water will be pumped into a 55-gallon drum.
- Remove the pump and wash out the pipe using tap water from the hose.
- Place the pump in the pipe again and fill with tap water.
- Repeat the process, running the pump until the pipe empties 3 times, when there is half a pipe of water left, add 2 liters of Hexane and continue pumping until the pipe is empty.
- Remove the pump and rinse out the pipe with tap water.
- Place the pump back in the pipe and fill with tap water.
- Repeat the process, running the pump until the pipe empties 3 times, when there is half a pipe of water left, add 2L of 10% Nitric Acid.
- Run the pump until it empties, then rinse it with water and refill the pipe with di-ionized water.
- Run the pump until the pipe empties three times with the deionized water.

8.0 DOCUMENTATION

Documentation of all decontamination procedures associated with monitoring well activities including all field forms and the maintenance of a detailed field notebook as described in PRS SOP – 400.

9.0 MEASURE OF PROFICIENCY

Field staff will demonstrate proficiency on this SOP by successfully competing sections 6.0, 7.0, and 8.0 a minimum of twice under the direct supervision of the Corrective Actions Manager or her/his designee.

Dissolved Oxygen Measurement
PRS-SOP – 300

1.0 Purpose

The purpose of this Standard Operating Procedure (SOP) is to provide field personnel with an outline of the procedure for performing a colorimetric field test for the analysis dissolved oxygen in groundwater. The concentration of dissolved oxygen in ground water strongly influences the fate and transport of organic and inorganic contaminants. Multi-parameter meters generally provide only a qualitative measurement of dissolved oxygen levels less than 1 milligram per liter (mg/L). If the final dissolved oxygen reading recorded with the multi-parameter meter prior to groundwater sample collection is less than 1 mg/L, a water sample shall be collected and analyzed for dissolved oxygen in the field using colorimetric methods.

Colorimetric reagents use oxidation-reduction indicators that transform from reduced, colorless forms to oxidized, colored forms upon reaction with dissolved oxygen in water; the extent of color formation is proportional to the concentration of dissolved oxygen and can be measured by visual comparison to sets of color standards.

2.0 Application

This SOP describes procedures for performing a colorimetric field test for the analysis dissolved oxygen using the Hach Dissolved Oxygen AccuVac® field kit. The Hach Dissolved Oxygen AccuVac® field kit is commonly used in the environmental industry and is appropriate for analyzing dissolved oxygen concentrations ranging between 0.2 and 15 mg/L, at 0.2 mg/L increments. Other colorimetric or Winkler titration test kits may be used in accordance with manufacturer instructions, provided they are appropriate for analyzing dissolved oxygen concentrations less than 1 mg/L.

3.0 References

Wilkin, R.T., M.S. McNeil, C.J. Adair and J.T. Wilson, 2001, Field Measurement of Dissolved Oxygen: A Comparison of Methods, Ground Water Monitoring and Remediation, Vol. 21, No. 4, pp. 124 132.

Hach Company, 1994, Dissolved Oxygen AccuVac® Manual, Color Disc Kit 25150-50, Edition 1.

4.0 Associated SOPs

SOP – 124 – Low-Flow Groundwater Sampling Procedure
SOP – 400 – Documentation Procedures

5.0 Equipment

The following equipment is necessary to perform the dissolved oxygen colorimetric test procedure:

- Hach Dissolved Oxygen AccuVac® field kit. The test kit includes a sample beaker, zeroing vial, reagent ampoule, ampoule breaker, and color comparator with color disc.
- Required documentation including field books and sampling forms.
- Personal protective equipment as described in the Site Health and Safety Plan.

6.0 Colorimetric Test Procedures

The following procedures shall be followed when performing the dissolved oxygen colorimetric test procedure:

- Don the appropriate personal protective equipment (PPE) as described in the Site Health and Safety Plan.
- Collect 40 milliliter (mL) of sample in a clean beaker.
- Pour 10 mL of sample in to the zeroing vial. Place the zeroing vial in the left top opening of the color comparator.
- Use the ampoule breaker to break and fill the ampoule with sample from the beaker, or fill the ampoule by breaking the tip against the side of the beaker. Break the ampoule below the sample surface to prevent air from entering the ampoule.
- Without inverting the ampoule, immediately place the ampoule cap that has been filled with sample securely over the tip of the ampoule. The cap prevents contamination of the sample with atmospheric oxygen. Shake the ampoule for approximately 30 seconds. Allow 2 minutes for color development.
- Shake the ampoule again and place the ampoule in the right top opening of the color comparator.
- Hold the comparator up to a light source. Look through the openings in the front.
- Rotate the color disc in the comparator until the color matches in the zeroing vial and ampoule openings.
- Read the dissolved oxygen concentration in mg/L through the comparator scale window.
- Record the dissolved oxygen colorimetric test results in accordance with SOP – 400 – Documentation Procedures.

7.0 Documentation

Documentation of dissolved oxygen colorimetric test results and procedures shall be maintained on field sheets and in a detailed field notebook as described in PRS SOP – 400.

8.0 Measure of Proficiency

Field staff will demonstrate proficiency on this SOP by successfully competing Sections 6.0 and 7.0 of this SOP a minimum of twice under the direct supervision of the Corrective Actions Manager or her/his designee.

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Ferrous Iron Procedures

PRS-SOP – 301

1.0 PURPOSE

The purpose of this SOP is to provide field personnel with an outline of the procedure for performing a colorimetric field test for the analysis ferrous iron in groundwater. The concentration of ferrous iron (Fe^{2+}) versus ferric iron (Fe^{3+}) in groundwater has important implications for electron donation/acceptance processes in oxidation-reduction reactions, and hence the natural attenuation (biodegradation) of contaminants. Exposure to oxygen can rapidly oxidize ferrous iron to ferric iron, making standard sample collection and laboratory analysis procedures impractical. Therefore, analysis of ferrous iron must be performed in the field immediately following collection of groundwater samples.

Ferrous iron shall be measured in the field using colorimetric methods. During the colorimetric test, a ferrous iron reagent reacts with ferrous iron in a groundwater sample to form an orange color in proportion to the ferrous iron concentration. The ferrous iron concentration can be measured by visual comparison to sets of color standards. Ferric iron does not react. If needed, the ferric iron concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

2.0 APPLICATION

This SOP describes procedures for performing a colorimetric field test for the analysis ferrous iron using the Hach Ferrous Iron Color Disc Test Kit (Model IR-18C). The Hach Ferrous Iron Color Disc Test Kit commonly used in the environmental industry and is appropriate for analyzing ferrous iron concentrations ranging between 0.2 and 7 mg/L, at 0.5 mg/L increments. Other colorimetric ferrous iron test kits may be used in accordance with manufacturer instructions.

3.0 REFERENCES

Hach Company, 1997, Iron (Ferrous) Test Kit Manual, Model IR-18C, Color Disc Kit 26672-00.

4.0 ASSOCIATED SOPS

SOP – 124 – Low-Flow Groundwater Sampling Procedure
SOP – 400 – Documentation Procedures

5.0 EQUIPMENT

The following equipment is necessary to perform the ferrous iron colorimetric test procedure:

- Hach Ferrous Iron Color Disc Test Kit. The test kit includes two plastic sample viewing tubes, ferrous iron reagent packets, a measuring vial, and color comparator with color disc.
- All required documentation including field books and sampling forms.
- Personal protective equipment as described in the Site Health and Safety Plan.

6.0 COLORIMETRIC TEST PROCEDURES

The following procedures shall be followed when performing the ferrous colorimetric test procedure:

- Don the appropriate PPE as described in the Site Health and Safety Plan.
- Fill a viewing tube with 5 mL of sample water. This is the blank.
- Place the blank tube in the top left opening of the color comparator.
- Fill a measuring vial with 25 mL of sample water.
- Add the contents of one ferrous iron reagent packet to the measuring vial.
- Swirl to mix the ferrous iron reagent and the water sample. An orange color will develop if ferrous iron is present. Allow three minutes for full color development.
- Fill a second viewing tube with 5 mL of the prepared sample from the measuring vial.
- Place the second tube in the top right opening of the color comparator.
- Hold the comparator up to a light source. Look through the openings in front of the blank and prepared sample tubes.
- Rotate the color disc until the color matches in the openings in front of the blank and prepared sample tubes.
- Read the ferrous iron concentration in mg/L through the scale window on the comparator.
- Record the ferrous iron colorimetric test results in accordance with SOP – 400 – Documentation Procedures.

7.0 DOCUMENTATION

Documentation of ferrous iron colorimetric test results and procedures shall be maintained on field sheets and in a detailed field notebook as described in PRS SOP – 400 – Documentation Procedures.

8.0 MEASURE OF PROFICIENCY

Field staff will demonstrate proficiency on this SOP by successfully competing sections 6.0 and 7.0 a minimum of twice under the direct supervision of the Corrective Actions Manager or her/his designee.

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Photoionization Detector Procedure

PRS SOP – 302

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide field personnel with an outline of the procedure for operating a Photoionization Detector (PID) during groundwater sampling activities. The PID is used as a field screening instrument for the measurement of select volatile organic compounds (VOCs). A PID measures the concentration of organic vapors ionizable by a 10.6 electron volt lamp (standard) in parts per million (ppm) and quantifies organic vapor concentrations in the range between 0.1 ppm and 15,000 ppm (isobutylene-equivalent) with an accuracy of 1 ppm between 0 ppm and 100 ppm. Typical uses include groundwater screening for VOCs and breathing zone monitoring for health and safety documentation.

2.0 APPLICATION

This SOP provides a step-by-step guideline to be followed by the field sampling crew for operating a PID.

3.0 REFERENCES

RAE Systems. MiniRAE 3000 User's guide.
http://www.raesystems.com/sites/default/files/content/resources/Manual_MiniRAE-3000_059-4020-000_RevD.pdf

4.0 ASSOCIATED SOPS

SO – 121 – Monitoring Well Development
SOP – 124 – Low-Flow Groundwater Sampling Procedure
SOP – 400 – Documentation Procedures

5.0 EQUIPMENT

The following equipment is necessary to use and operate a PID:

- A PID instrument such as the RAE Systems- MiniRAE 3000 Hand-held VOC Monitor or equivalent instrument.
- Calibration gas with the appropriate concentration of calibration chemical as recommended by the manufacturer.
- The calibration gas regulator recommended by the manufacturer.
- Battery charger and batteries for the specific PID.
- Appropriate tubing to connect the calibration gas regulator to the PID.
- Required documentation including sample labels, field books and sampling forms.
- Personal protective equipment as described in the Site Health and Safety Plan.

6.0 CALIBRATION PROCEDURES

The following procedures shall be followed when calibrating a PID:

- Don the appropriate personal protective equipment (PPE) as described in the Site Health and Safety

Plan.

- Turn on the PID and allow it to warm up as recommended by the manufacturer.
- Calibrate the PID according to the manufacturer's instructions. PID calibration generally includes a 'fresh' (ambient) air calibration and a standard reference gas calibration.
- Record calibration information and procedures in accordance with SOP – 400 – Documentation Procedures.
- The PID shall be calibrated daily or as recommended by the manufacturer.

7.0 OPERATION PROCEDURES

The following procedures shall be followed when operating a PID:

- Complete calibration procedures identified in Section 6.
- Attach/install moisture filters to the instrument if available following calibration procedures.
- During operation, make sure the probe inlet and the gas outlet are free of obstructions. Obstructions can cause premature wear on the pump, false readings, or pump stalling.
- When screening the breathing zone for health and safety documentation, monitor the air quality at the breathing zone (chest or face level) and record the detected concentrations. Reference the Site Health and Safety documentation for applicable action levels, as appropriate.
- When screening for the headspace of a well, monitor the headspace directly after opening the well cap. Place the probe inlet directly above the well casing. Record the detected concentrations.
- If an increasing meter reading is indicated, monitor until the maximum meter reading is obtained.
- Do not allow water or soil to be introduced into the instrument.
- Humidity or moisture from rain can cause large fluctuations in PID readings. The PID should remain dry at all times while in operation.
- If fluctuating, erratic readings are observed, then it is possible that there is either moisture or dirt in the probe, in the moisture filter or on the lamp. If this occurs, follow the manufacturer's procedures to clean and dry the PID.

8.0 DOCUMENTATION

Documentation of all calibration, operation and maintenance procedures and field measurements associated with PID operation shall be maintained in a detailed field notebook as described in PRS SOP – 400.

9.0 MEASURE OF PROFICIENCY

Field staff will demonstrate proficiency on this SOP by successfully competing Sections 6.0, 7.0, and 8.0 of this SOP a minimum of twice under the direct supervision of the Corrective Actions Manager or her/his designee.

Documentation Procedure

PRS SOP – 400

1.0 PURPOSE

The purpose of the SOP is to outline, in detail, the required documentation needed to maintain accurate logs and files of all field procedures.

2.0 APPLICATION

This SOP provides documentation guidelines, including examples, required for all geotechnical exploratory and sampling procedures conducted or overseen by PRS.

3.0 REFERENCES

None.

4.0 ASSOCIATED SOPS

SOP – 120 – Measuring Water Elevations
SOP – 121 – Monitoring Well Development
SOP – 123 – Multi-parameter Meter Calibration & Operation Procedure
SOP – 124 – Micropurge Groundwater Sampling Procedure
SOP – 200 – Equipment Decontamination Procedure
SOP – 300 – Dissolved Oxygen Measurement
SOP – 301 – Ferrous Iron Measurement
SOP – 302 – Photoionization Detector Calibration & Operation Procedure

5.1 FIELD BOOKS

All field books should be pocket size “Rite in the Rain” or equivalent and should have non-removable pages. These field books are to be dedicated to a project, and the project manager is responsible for maintaining a field book inventory. This inventory should include a numbering and tracking mechanism for each field book assigned to a particular case.

Each field book is to be maintained as follows:

- Level the outside front cover with the following information: PRS Group, Inc., Dates Included, and Book Number. The inside cover should include: PRS Group, Inc., Project Manager’s Name, 3003 Taylor Way, Tacoma, WA 98421. 253-383-4175, dates included, and Book Number.
- Inside the cover, list the full names and initials of each person working on the project that will be referred to in the field book.
- Maintain all field notes directly in the field books (i.e. notes are not to be taken then transferred to the field

book at a later time).

- Record all field notes in permanent ink (sharpie markers).
- Initial, date, and number each page upon completion.
- Correction of mistakes are made with a single line and initialing the correction.
- Avoid blank spaces within the notes. Unavoidable blank spaces are to be struck with a single line.

Examples of information required in the field book include:

- The date of entry.
- Time of entry for specific events (in military time).
- A meteorological description of daily changes.
- Personnel present including arrival and departure times and affiliations.
- Make, model and condition of equipment used.
- The time interval and reasons for delays including a detailed description of corrective actions taken by the field crew.
- A detailed description and rationale for any deviations from the Work Plan, Sampling Plan, or Health and Safety Plan.

6.0 FIELD FORMS

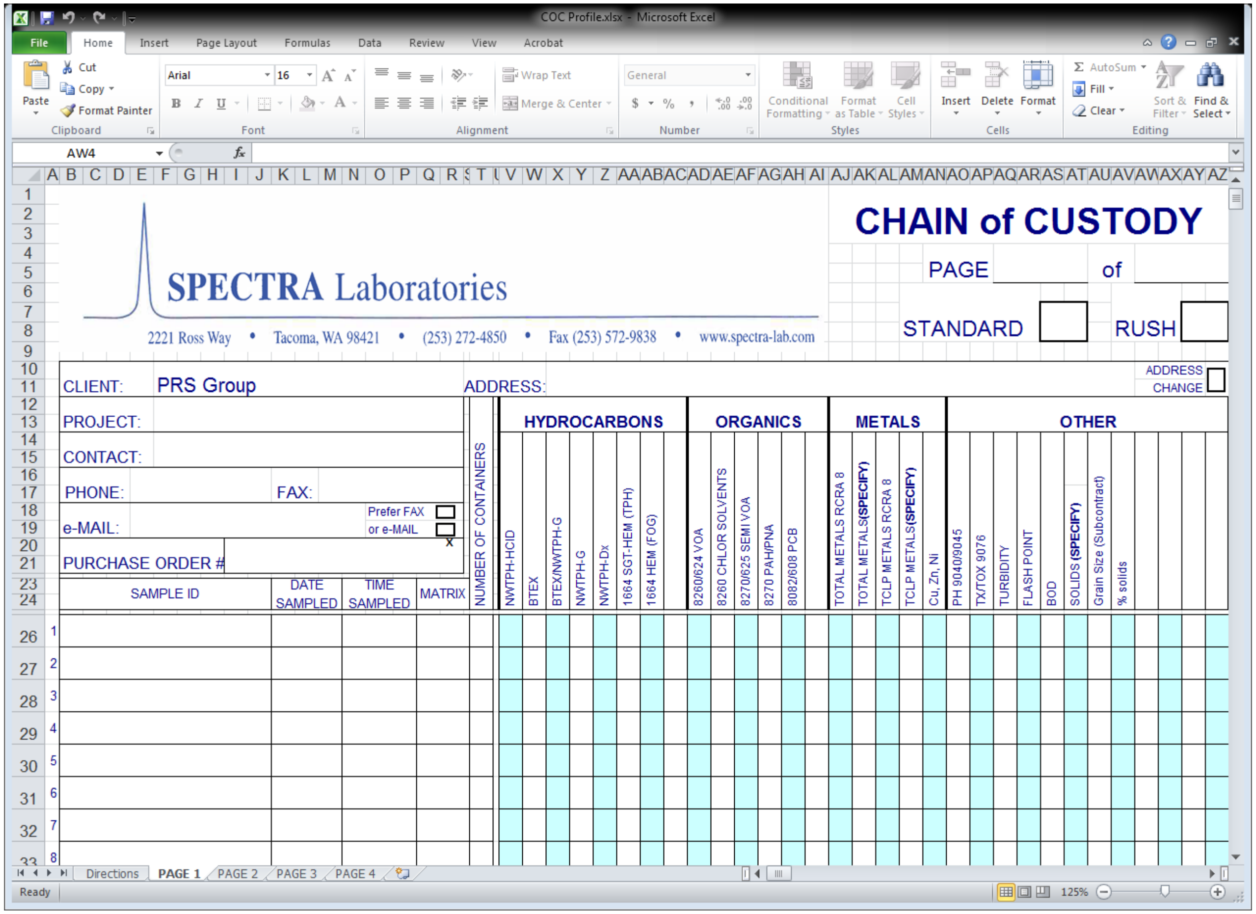
The field forms have been designed to detail all steps, actions, and readings associated with specific field procedures. These forms are to be completed in full. No sections are to be left blank, if a section is "not applicable", it is to be indicated as such. All forms, including locations diagrams, are to be completed in the field with permanent ink. Refer to Table 1 to see which forms are required for specific field procedures. Examples of each form are also attached.

7.0 MEASURE OF PROFICIENCY

Proficiency assessment for documentation is associated with specific procedural proficiency; therefore, no separate proficiency measures for documentation are needed.

APPENDIX D

Field Forms



SPECTRA Laboratories

2221 Ross Way • Tacoma, WA 98421 • (253) 272-4850 • Fax (253) 572-9838 • www.spectra-lab.com

CHAIN of CUSTODY

PAGE ____ of ____

STANDARD ☐ RUSH ☐

CLIENT: PRS Group

ADDRESS:

ADDRESS CHANGE ☐

PROJECT:

CONTACT:

PHONE: FAX:

e-MAIL:

Prefer FAX ☐ or e-MAIL ☒

PURCHASE ORDER #

						HYDROCARBONS								ORGANICS						METALS					OTHER											
	SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	NUMBER OF CONTAINERS	NWTPH-HCID	BTEX	BTEX/NWTPH-G	NWTPH-G	NWTPH-Dx	1664 SGT-HEM (TPH)	1664 HEM (FOG)		8260/624 VOA	8260 CHLOR SOLVENTS	8270/625 SEMI VOA	8270 PAH/PNA	8082/608 PCB		TOTAL METALS RCRA 8	TOTAL METALS**(SPECIFY)**	TCLP METALS RCRA 8	TCLP METALS**(SPECIFY)**	Cu, Zn, Ni	PH 9040/9045	TX/TOX 9076	TURBIDITY	FLASH POINT	BOD	SOLIDS **(SPECIFY)**	Grain Size (Subcontract)	% solids				
1																																				
2																																				
3																																				
4																																				
5																																				
6																																				
7																																				
8																																				

Monitoring Well Sampling Results

PRS Group Facility, Tacoma, WA	**Monitoring Well Sampling**	**Well #.**
Date:	**Sampling Personnel**	**Initial Well Headspace (ppm)**
Sampling Method		**Begin –Water Level (ft)**
Equipment Used-	**1 vol = [.17(Total well depth-water level)]**	**End – Water Level (ft)**
		Pump Intake Depth (ft)

Water Quality Measurements

Time	Volume Removed	pH (0.1)	Conductivity (3%)	Temperature (3%)	Turbidity (10%)	Dissolved Oxygen (10%)	Redox Potential (± 10mV)
Military	(ml)	(pH units)			(NTU)		

Signature ____________________________ Date: _______________ No. of bottles _______

Page _______ of ____

PRS Facility

Monitoring Well Inspection Form

PRS Inspector ____________________

Date:_______________

Well ID	Is well labeled?	Surrounding Impacts?	Well/pump condition	Internal condition (is cap secured)	Monument Condition	Well Accessible?	Recent construction in area that may have caused changes?	Other problems	Maintenance Performed

PRS Facility

Water Level Field Form

Field Event:__________________ Date (mm/dd/yyyy): ______________________

Field Geologist(s): ____________________________ ____________________________ Organization: ____________________________

Well ID	**Well Venting**		**Liquid- Level Measurement**		**Total Well Depth**	**Comments**
	Time	Headspace PID Reading	Time	Depth to Water		
	(24-h Clock)	(ppm)	(24-h clock)	(Feet)	(Feet)	

APPENDIX E

Health and Safety Plan

HEALTH AND SAFETY PLAN

PRS Group Facility

Tacoma, WA 98421

Depending on the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. The site Health and Safety Plan should be reviewed with specific emphasis placed on the protection program planned for the sampling tasks. Standard safe operating practices should be followed, such as minimizing contact with potential contaminants in both the liquid and vapor phase through the use of appropriate personal protective equipment.

1.0 Well Purging and Sampling

There are multiple well locations, generally around the perimeter and within the PRS facility Guidelines and expectations are as follows:

- Telephone communications will be available at the site at all times.
- All sampling equipment will be deployed and ready before opening the well.
- All well caps will remain closed until immediately before sampling. The time the wells will be open shall be minimized.
- All wellheads will be closed and secured immediately after sampling and investigation.
- Minimum level D Personal Protective Equipment within the restricted zone during sampling.
- All PPE, equipment or instruments will be decontaminated and calibrated prior to site arrival.
- Sampling will not be permitted during electrical storms, periods of high winds, or otherwise severely inclement weather.
- All removed or purged fluids will be immediately containerized. These containers shall be immediately sealed to prevent off gassing. Care shall be taken when opening these containers to prevent exposure from vapors, gases or dusts. If reopening of the containers becomes necessary, the worker shall open these while standing at a ninety-degree angle to the prevailing winds. All contaminated containers shall be placed sufficiently downwind of operations
- Drums/containers of purged fluids will be handled by PRS personnel according to Industry Standards.
- All equipment and tools will be decontaminated as described in PRS SOP – 400.
- Safety cones/barricades shall be placed near all sampling zones between traffic areas and workers and equipment.
- Facility managers shall be notified a minimum of seven days prior to sampling in order to properly notify facility workers of the sampling activities.

MONITORING

Personnel Monitoring: The need for personnel exposure monitoring will be determined by the Sampling Team Leader based upon site activities at the time.

Ambient Monitoring: Ambient monitoring will be conducted on a regular basis during operations may include direct reading instruments, specific compound indicators (as needed), or air sampling as determined by the Sampling Team Leader. A Photoionization Detector – PID will be used prior to beginning operations to determine background levels in the breathing space at the site. These readings will be entered on a Field Form.

During a sampling event any reading above initial recorded background levels is an action level where activities will cease until background levels in the breathing space are back to ambient levels.

CHEMICAL HAZARDS

Particulate or metals contaminants

1. Avoid skin contact with, and incidental ingestion of, purge water.
2. Use protective gloves and splash protection.

Volatile organic contaminants (VOCs)

VOCs may be present at the well openings especially immediately upon opening the well, within removed soils and liquids, inside containers of contaminated soils or liquids. Downwind of operations would present the highest likelihood of chemical contamination or exposures. Upwind should be relatively chemical hazard free depending on the wind velocity if not in the immediate vicinity of the contaminate source. Wellheads represent the most likely location for exposures. The well headspace can contain the highest concentration of VOCs available during these operations. These compounds have or may be volatilized from the groundwater into the headspace and are at equilibrium between the groundwater and the air. Disturbing this headspace can cause the VOCs to evacuate from the wells into the breathing zone of samplers.

1. Avoid breathing constituents venting from well.
2. Pre-survey the well head space with an appropriate device as specified in the Site Health and Safety Plan.

PPE Level D Required

Respirator: No respirator required. An air-purifying respirator may be worn for comfort based upon any existing odors. Dust masks may be worn while dusts are present.

Eye Protection: Safety glasses are worn at all times if not wearing a full-face respirator.

Hearing Protection: Earplugs or muffs are required during noisy facility operations.

Clothing: Full skin protection. Clothing must meet the needs for weather and climate conditions as well as protection from the chemical hazards present in the area. Safety vests are recommended while sampling.

Head Covering: A hardhat will be worn at all times.

Shoe Covers: Rubber disposable booties, deconnable rubber steel toed safety boots or chemical resistant safety boots.

Gloves: Cloth or leather work gloves while operating equipment. Latex or similar type while sampling or handling contaminated materials.

PHYSICAL HAZARDS

- Physical hazards exist near the off/loading pads. All efforts shall be made to only sample CO-3A and CO-3B when offloading or loading are not being conducted.
- PRS is a working facility with truck and forklift traffic.
- All wells are within high traffic areas including blind corners.
- Noise caused by heavy equipment on the site.
- Sparks from electrical connections or static discharge can ignite explosive atmospheres within the wellhead.
- Slippery areas may cause injurious falls.

EMERGENCY MEDICAL TREATMENT:

First aid, call 911, refer to Figure A for the emergency route to the hospital. For all emergencies, the following will be performed:

1. Survey scene, inform PRS Group.
2. Do primary survey of victim(s), check for unresponsiveness
3. Phone emergency medical services.
4. Secondary survey – interview, vital signs, head-to-to exam. Apply first aid as appropriate

EMERGENCY CONTACTS

Tom Smith	253-383-4175	206-255-7509
Jay Johnson	253-383-4175	253-405-7754

EMERGENCY 911 INFORMATION

Physical Address:

PRS Group, Inc.
3003 Taylor Way
Tacoma, WA 98421
253-383-4175

Hospital

St. Josephs Hospital

1717 South J Street
Tacoma, WA 98405
253-426-4101

APPENDIX F

Groundwater Monitoring Cost Estimate for Financial Assurance

Appendix F
Groundwater Monitoring Plan
Groundwater Monitoring Cost Estimate for Financial Assurance
PRS Group, Inc. Facility; Tacoma, Washington

The assumptions identified in the attached three tables, Tables F-1, F-1-1, F-2, F-2-1, and F-3 provide the basis for a 10 year Financial Assurance for the Facility's Groundwater Monitoring Plan (GWMP).

Table F-1 is the estimated cost of one year of groundwater monitoring based on the program outlined in this GWMP. It includes the costs for semi-annual sampling of nine existent groundwater monitoring wells every June and December.

Table F-1-1 is year three through ten; PRS will be conducting annual sampling of 9 existent groundwater monitoring wells every June, and another annual groundwater level measurement event that includes all the monitoring wells every December. The staff and level of effort identified are considered normal for the work defined in the GWMP. Additional other Direct Costs are also identified in Table F-1, including travel, laboratory costs, and equipment rental.

Table F-2 summarizes the analytical laboratory costs anticipated for the semi-annual sampling. The analytical costs are based on the current laboratory rates PRS has with Spectra Laboratories, per the analytical method required under the GWMP. A copy of PRS' contract with Spectra is attached. The costs identified in Table F-2 include field, duplicate, and trip blanks for quality assurance.

Table F-2-1 summarizes the analytical laboratory costs anticipated for the annual sampling. The analytical costs are based on the current laboratory rates PRS has with Spectra Laboratories, per the analytical method required under the GWMP. A copy of PRS' contract with Spectra is attached. The costs identified in Table F-2 include field, duplicate, and trip blanks for quality assurance.

Table F-3 presents the Financial Assurance Cost Estimate for 10 years of groundwater monitoring as defined in the GWMP.

As detailed in the attached four tables, the Financial Assurance Cost Estimate for 10 years of groundwater monitoring according to the GWMP is $.

Place holder for Groundwater Monitoring Costs for Financial Assurance to be submitted when available.

Table F-1. PRS Group, Inc. Facility; Groundwater Monitoring Plan – Estimated Annual Groundwater Monitoring Costs for Financial Assurance.

Task	Labor Category	Task	Rate	Units	Cost
Labor Costs			($/hour)		
Annual Groundwater Monitoring (June)					
	Field Technician	Mob/demob			
		Field Sampling			
		Field Form Completion			
Annual Groundwater Monitoring (December)					
	Field Technician	Mob/demob			
		Field Sampling			
		Field Form Completion			
Quarterly Monitoring Well Inspections	(2 events)				
	Field Technician	Mob/demob			
		Field Sampling			
		Field Form Completion			
Annual Reporting (April)					
	Field Technician	Report Preparation			
	Senior Tech Review	Report Preparation			
Project Management					
	Project Manager	Oversight			
				Subtotal	
Other Direct Costs		Task			
Laboratory Costs		June Sampling			
		December Sampling			
				Subtotal	

				Total Cost per Year	

Table F-1-1. PRS Group, Inc. Facility; Groundwater Monitoring Plan – Estimated Annual Groundwater Monitoring Costs for Financial Assurance years three through ten.

Task	Labor Category	Task	Rate	Units	Cost
Labor Costs			($/hour)		
Annual Groundwater Monitoring (June)					
	Field Technician	Mob/demob			
		Field Sampling			
		Field Form Completion			
Annual Groundwater Level Measurements (December)					
	Field Technician	Mob/demob			
		Field Sampling			
		Field Form Completion			
Quarterly Monitoring Well Inspections (4 events)					
	Field Technician	Mob/demob			
		Field Sampling			
		Field Form Completion			
Annual Reporting (April)					
	Field Technician	Report Preparation			
	Senior Tech Review	Report Preparation			
Project Management					
	Project Manager	Oversight			
				Subtotal	
Other Direct Costs		Task			
Laboratory Costs		June Sampling			
				Subtotal	
				Total Cost per Year	